CENTRO STUDI LUCA D'AGLIANO

WWW.DAGLIANO.UNIMI.IT

CENTRO STUDI LUCA D'AGLIANO
DEVELOPMENT STUDIES WORKING PAPERS

N. 306

May 2011

Are Exporters More Likely to Introduce Product Innovations?

*Massimiliano Bratti**
*Giulia Felice***

* University of Milan and IZA
** University of Milan and Centro Studi Luca d'Agliano

Are exporters more likely to introduce product innovations?*

Massimiliano Bratti†

(University of Milan and IZA)

Giulia Felice‡

(University of Milan and Centro Studi Luca d'Agliano)

May 2011

*Both authors equally contributed to this paper. We wish to thank all people who gave comments on previous versions of this paper and participants to all seminars and conferences in which it was presented, among which the workshop on 'Innovation, Internationalization and Global Labor Markets' (Turin), ICEEE (Ancona), EARIE (Toulouse), ETSG (Warsaw), SIE (Perugia), ITSG (Lecce), the workshop on "Importers, Exporters, Productivity and Innovation" (Perugia). We also thank Silvia Cerisola for valuable research assistance. The authors gratefully acknowledge financial assistance from the FIRB project (N.RBNE03YT7Z) funded by the Italian Ministry of Education, University and Research and from the Efige project (N.225551) funded by the European Commission under the Seventh Framework Programme. The usual disclaimers apply.

†(corresponding author) DEAS, Università degli Studi di Milano, via Conservatorio 7, I-20122, Milan, Italy. Telephone: +39 02 503 21545, Fax: +39 02 503 21505. E-mail: massimiliano.bratti@unimi.it

‡Centro Studi Luca d'Agliano, Università degli Studi di Milano, via Conservatorio 7, I-20122, Milan, Italy. E-mail: giulia.felice@unimi.it

Abstract

A firm's export status may improve its capacity of introducing product innovations. We explore this idea using very rich firm-level data on Italian Manufacturing, and sector-province specific measures of firms' distance from export markets and of their export market potential as instruments for differences in export activities. We find that exporting significantly increases the likelihood of introducing product innovations and that this effect is not fully captured by the channels commonly stressed by the theoretical literature, such as larger market (and accordingly firm) size or higher investments in R&D. We argue that heterogeneity in foreign customers' tastes and needs may explain our findings.

Keywords. Exporters, Firms, Italy, Manufacturing, Product Innovation

JEL Codes. F1 L2 O3

1 Introduction and motivation

The higher product innovativeness of firms that export can be considered as a strong empirical regularity. In spite of this, the direction of the relationship between exporting and product innovativeness is far from being completely understood. Indeed, exporting might induce innovation (see Section 2), innovation might induce exporting (among the others, see Basile, 2001; Lachenmaier and Woessmann, 2006) or both activities may be determined by other firm characteristics as suggested by the recent contributions of the new international trade literature (Melitz, 2003). Moreover, these explanations are not mutually exclusive and all may be compresent.

Although we do not rule out the existence of the other explanations for the positive correlation between exporting and innovation, in this paper we mainly aim to shed light on the first channel by analyzing whether firm's engagement in foreign markets leads to higher product innovativeness.

A good starting point to understand the potential innovation-enhancing effects of export activities is the micro-industrial literature on innovation. This literature distinguishes between technology-push factors, highlighting how activities and resources devoted to research by the supply side of the market autonomously drive innovation, and demand/market pull factors, stressing how firm level innovative activity is stimulated by the demand side of the market either in terms of market size or in terms of flow of ideas generated by information on customers' needs.[1] These ultimate sources of innovation at the firm level also lie at the core of the main pathways through which export activities could promote the introduction of new or better products, as systematized – in a general equilibrium framework where trade liberalization affects innovation – in Grossman and Helpman (1991) and Aghion and Howitt (1998). Those pathways can be broadly grouped into: scale or competition effects inducing firms to engage in higher research effort;[2] access to foreign knowledge, firms benefiting from spillovers from the supply side

[1] For a systematic review related to innovation in manufacturing, see Becheikh et al. (2006); see also Section 6 below.

[2] According to the two basic Schumpeterian hypotheses, foreign market may represent: 1) an increase in the size of the

of the economy; cross-country income and state of technology differences that may generate the right incentive for the exporters to invest in innovative activities or, alternatively, which may convey crucial information.

Despite the fact that many of these channels operate at the firm level, most of the existing empirical research assesses the effect of trade on innovation at the industry or the country level.[3] Research on the effect of exporting on product innovation at the firm level is still relatively scant, the bulk of the contributions investigating whether innovation induces export or whether ex-ante more innovative firms self-select into international markets.

Using product innovation to assess learning by exporting is useful for several reasons. First, product innovation is relevant *per se* since it gives different information with respect to alternative indicators of firm efficiency such as process innovation or productivity.[4] Second, because unlike R&D investment it is a measure of the output rather than an input of innovation activities, and represents an indicator of successful innovation efforts, not necessarily entailing an increase in either marginal or fixed costs of production. This motivates also the specific interest in Italy: many surveys show that although few Italian firms do R&D investments, many of them introduce product innovations. Hence, using a subjective indicator of product innovation can be particularly important when studying innovation in countries that structurally underinvest in research, where small and medium sized firms are prevalent – such as in Italy – and where innovation is likely to mainly be incremental (Santarelli and Sterlacchini, 1990). Last but not least, product innovativeness is an informative indicator of a firm's economic performance, as recent empirical evidence has shown that product innovation produces benefits also at the firm level, on sales, employment (Hall et al., 2008) and – in some cases – on productivity (Crépon et al., 1998).

We study the effect of exporting on product innovation using a rich firm-level database on manufacturing, the Survey of Italian Manufacturing Firms (*Indagine sulle Imprese Manifatturiere*, SIMF hereafter), which provides a wealth of information both on the inputs and the outputs of innovation and internationalization activities.[5] We first check for the robustness of the positive relationship between exporting and product innovation by using ordinary least squares (OLS) on the (rich) data we have, which enables us to control for firm's self-selection into exporting and product innovation activities based on many observable characteristics – recently emphasized by the New-New Trade Theory literature – such as size or productivity. Secondly, we make an attempt to address the issue of the potential firm *self-selection*

market, and the associated increase in the monopolistic rent for successful innovators will provide incentives to raise the firm's R&D expenditure; 2) an increase in the product market competitive pressure, that might force firms to innovate in order to survive.

[3] Keller (2004), Breschi et al. (2005).

[4] Moreover, the use of innovation measures overcomes some of the problems related to the interpretation of productivity measures. For instance, estimates of productivity using sales, which are common in the economic literature, often cannot distinguish between price (market power) and quantity (productivity) effects, since price and quantity data are not separately available.

[5] For some related literature using the same dataset see, among others, Basile (2001), Parisi et al. (2006), Angelini and Generale (2008), and Benfratello et al. (2008). The SIMF questionnaire has been used as the basis for the new survey on firm level data that will be carried out on seven European countries within the framework of the EFIGE (European Firms in a Global Economy) project, a large scale project funded by the EU commission under the FP7 programme.

according to *unobservable characteristics* into foreign markets and the consequent endogeneity of firm export status with respect to product innovativeness using an instrumental variables (IVs) strategy. In particular, we use some presumably exogenous sources of variation in firms' export status determined by province-sector specific measures of their distance from potential export markets and of their export market potential, i.e. supply-push and demand-pull factors. Both variables are likely to be strong and significant predictors of a firm's decision to enter foreign markets, as exporting costs increase with geographic distance while export market potential is likely to raise the demand for a firm's products. As we use more than one instrument, i.e. an overidentified model, we are also able to test for the instruments' validity, i.e. that they are truly exogenous and do not have a direct effect on firm's product innovation. Last but not least, we discuss the possible sources and pathways of the positive effect of exporting on product innovation.

Our empirical analysis shows three interesting results. First, the positive association between export status and a firm's product innovativeness survives the inclusion of many observable characteristics that might produce a spurious correlation between the two. Second, when the issue of potential endogeneity of firm's export status is tackled using an IVs strategy, exporting is found to have a large positive effect on the probability of introducing product innovations. Third, as for the sources and pathways, we observe that the effect of exporting remains even after controlling for many covariates capturing a higher 'formal' R&D investment for innovation and the effect of scale, and for other variables capturing firm's absorptive capacity.

Although our data do not allow us to directly identify the sources of the estimated effect, our analysis leads us to exclude that it is explained by the main sources of innovation generally highlighted by most of the recent empirical and theoretical literature, such as the incentives to invest in formal innovation inputs (e.g., R&D) induced by a larger or a more competitive market, or the spillovers generated by the interaction with other researchers in a larger market. In the spirit of the 'demand/market as information' theories of the sources of innovation, we advance the hypothesis that one possible source of the 'learning by exporting' that we find may be the cross-country heterogeneity either in consumers' tastes or in firms' needs for specific inputs. As a matter of fact, what a firm produces in the domestic market may not necessarily meet the foreign buyers' needs and it may be forced to modify or improve the product in order to find a niche in the foreign market. We claim that the interaction with foreign buyers and possibly competitors may convey to the firm important information on their needs and on the characteristics of the foreign market, which are too expensive or difficult to collect otherwise.

The structure of the paper is as follows. Section 2 includes a brief survey of the literature on the links between exporting and product innovation. Section 3 describes the data used. Section 4 reports the core of our empirical analysis that aims at estimating the causal effect of firm's export status on product innovativeness, Section 5 includes some robustness checks using alternative proxies of product innovation, and Section 6 discusses the potential causal pathways of the effect we estimate. Section 7 summarizes the main findings and concludes.

2 Firm-level empirical evidence on exporting and innovation

In this paper we focus on the most common internationalization mode (exporting) and on a direct measure of product innovation, that is a firm's likelihood of *introducing a new or an improved product*. Our analysis should be seen as complementing other studies focusing on different measures of innovation such as R&D, process innovation or productivity.

The positive relationship between firms' innovation and export activities may be due to a potentially two-way causal link or to a *self-selection* mechanism. In short, exports may induce innovation, innovation may spur exports, or a third unobservable firm characteristic (e.g. firm productivity) may make some firms self-select into both activities.

Since the seminal contribution by Marc Melitz (Melitz, 2003), a wide consensus has been reached by the empirical research that more productive firms self-select into international markets, but many papers using rigorous empirical strategies have been able to also identify positive causal effects of export activity on firm's productivity (for a review see Wagner, 2007; Greenaway and Kneller, 2007). More recently, some contributions (Costantini and Melitz, 2008; Iacovone and Javorcik, 2010) have argued that both the innovation performance and the export activity may represent a consequence of previous firms' decisions on R&D investment (an hypothesis labeled as *anticipation effect*, *conscious self-selection* or *learning to export*).[6]

As for the literature related to the causal effect of exporting on product innovation, we are aware of only few studies. Salomon and Shaver (2005), using firm-level data, find evidence of learning by exporting considering product innovation for Spanish manufacturing firms from 1990 to 1997. Information on product innovation is drawn from a survey where firms self-report the number of new or better products and the number of patent applications. The authors find a positive causal effect of both export status and export volumes on innovation performance, conditional on the firm's size, R&D expenditure and advertising intensity. In particular, the increase in product innovation takes place soon after exporting. In contrast to the previously mentioned contribution, firm size is never significant, while R&D expenditure and previous innovation have a positive and a negative impact on innovation, respectively. Liu and Buck (2007) considers the effect of three main channels of international spillovers – R&D activities of

[6]The recent contributions belonging to the New-New Trade Theory literature stress the *self-selection* mechanism pointing out how firms that are ex-ante more efficient (or more innovative) enter foreign markets because they are productive (and perhaps innovative) enough to bear the sunk costs of entry (Kneller and Yu, 2008; Hallak and Sivadasan, 2009). Nevertheless, some contributions in this framework highlight that export activities may induce existing firms to invest in order to improve the quality of products to be sold in high-income countries (see, for instance Verhoogen, 2008; Crinò and Epifani, 2009). Some others look at multiproduct firms (see, for instance Bernard et al., 2010b,a). Here, self-selection is not only across firms but also within firms across product lines; trade liberalization increases productivity at the firm level by inducing firms' specialization in the product lines in which they are more efficient.

foreign MNEs, export sales and expenditure on imported technology – on product innovation. The analysis is carried out by using a panel of sub-sector level data for Chinese high-tech industries, and new products are defined as either novel or improved products (like in our paper). The authors show a positive and significant effect of all the interactions between a measure of absorptive capacity and the three internationalization modes on product innovation; only exporting remains positive and significant taken by itself. It is worth noting that while domestic R&D looses statistical significance when the other variables are included, firm size remains one of the most relevant determinants of innovation in all specifications. Fafchamps et al. (2008) uses a panel of Moroccan manufacturers and find that product innovativeness is positively related to the length of exporting experience, which they interpret as an instance of learning by exporting. The authors explain this effect as the need of Moroccan firms – which are mainly specialized in consumer items such as garment, textile, and leather – to design products that appeal to foreign consumers. More recently, Lileeva and Trefler (2010) use an instrumental variables approach with a plant-specific tariff-cut instrument and find that Canadian plants that were induced by the tariff cuts to start exporting or export more engaged in more product innovation.[7] Finally, Bustos (2011) does not focus on firm export status, but directly on the effect of a reduction of Brazilian import tariffs on Argentinian firms, showing a significant increase in technology spending, and in dichotomous indicators of process and product innovativeness.

Our work differs from Liu and Buck (2007) in several respects, since we focus on firm-level data and our analysis is not limited to high-tech industries only but extends to the whole Manufacturing. This is important as in high-tech sectors most innovation is likely to be generated by R&D, which has however a very limited role for innovation in other industries and for small firms, and therefore for Italy which is characterized by the prevalence of small businesses and a specialization in low skill productions (Faini et al., 1999). Unlike Salomon and Shaver (2005) and Fafchamps et al. (2008), we do not use panel data estimators, but we dispose of a richer set of controls in our data that enables us to shed light on the potential pathways which might explain the effect of exporting that we estimate, or at least to exclude some, and we use a different strategy to identify the effect of exporting which is based on IVs. Last but not least, we use an instrument — based on demand-pull and supply-push export factors — different from Lileeva and Trefler (2010). The latter use the responses of Canadian plants to the elimination of US tariffs. This large tariff-cut took place during the period covered by their data, and caused a huge increase in Canadian exports towards the US. However, the nature of their instrument makes it likely that their IVs estimates mainly identify the innovation effect only of exports to the US, which may not easily generalize also to exports to other countries. Canada and the US, for instance, are two

[7] Two other contributions provide evidence of the existence of a positive association between exporting and innovation without aiming at identifying causal effects: Castellani and Zanfei (2007) and Gorodnichenko et al. (2010), which also consider other channels of technological transfer. Damijan et al. (2010) find for Slovenia a positive effect of exporting only on process but not on product innovations.

neighboring countries,[8] and the US represent one of the richest and most sophisticated export markets. In this respect, the innovation effect of exporting may be particularly strong for this specific pair of countries. The instruments we propose, by contrast, are likely to affect the exporting behavior of Italian firms to a very wide range of foreign markets, not necessarily the closest or the richest ones.

3 Data

In the empirical analysis we use data from the 8th (1998-2000) and 9th (2001-2003) waves of SIMF currently managed by the UniCredit banking group (formerly by Mediocredito Centrale and later by Capitalia).

The survey is representative of the population of Italian Manufacturing firms with more than 10 employees, and collects information on a sample of manufacturing firms with 11-500 employees and on all firms with more than 500 employees.[9] The SIMF has been repeated over time at three-year intervals and in each wave a part of the sample is fixed while the other part is completely renewed every time (see Capitalia, 2002, p. 39). This helps analyze both variations over time for the firms observed in different waves (panel section) and the structural changes of the Italian economy, for the part of the sample varying in each wave.

The data set gathers a wealth of information on: balance sheet data integrated with information on the structure of the workforce and governance aspects; information on innovation, distinguishing whether product, process or organizational innovations were introduced; information on investments and R&D expenditures; information on the firms' international activities (exports, off-shoring and FDI flows by area); information on financial structure and strategies. In order to implement the empirical strategy outlined in Section 4 we need to select all firms appearing in both the 8th and 9th waves of the survey, which refer to 1998-2000 and 2001-2003, respectively. This can create sample selection issues as some firms in the panel section might drop out from the sample for various reasons, such as non-response, cessation of activity, drop of firm size under 11 employees or change of sector. Moreover, due to the rotating structure of the panel, using more than two consecutive waves greatly reduces the number of firms appearing in the sample, exacerbating potential sample selection problems (cf. Nese and O'Higgins, 2007). That is the main reason why we use only two consecutive waves (the 8th and the 9th).

Here, we limit ourselves to comparing the values of some key variables for our analysis in the 8th wave and the 8th-9th wave panel. Table 1 reports means and standard deviations for these variables. The 1998-2003 panel appears to be fairly representative of the 1998-2000 cross-section under several dimensions, although the firms in the panel are slightly larger and more R&D intensive, both factors

[8] The same is true with respect to Bustos (2011).

[9] Like most data used in the literature SIMF is not representative of micro-firms (see, among others, Bernard and Jensen, 2004; Crespi et al., 2008; Bustos, 2011).

which might positively affect product innovation.

The dependent variable in our empirical analysis is a dichotomous indicator (INN) representing the answer to the following question in the 9th wave of SIMF: "*Did you introduce product innovations in 2001-2003?*". A 'product innovation' is defined as the introduction of a completely new product or of an important improvement of an old product at the firm-level.[10] The dependent variable INN takes on value one in case of positive answer and zero otherwise.[11] INN clearly encompasses both radical and incremental innovation and both improvements of an existing product and the introduction of a new product. A product can be new to the market, but also only to the firm. What our innovation variable allows us to say is that we are considering only modifications generating a change in the product content and not only in the product 'image' (e.g., design or re-packaging). The question in the survey used in our analysis corresponds to the one in the Community Innovation Survey, a survey collecting data on different innovation dimensions in several European countries and widely used in innovation research; the survey question follows the methodological guidelines of the Oslo Manual (OECD, 1997). Similarly 'subjective' measures of product innovativeness are commonly used in the literature. For two very recent examples see Lileeva and Trefler (2010) and Bustos (2011). We will assess the robustness of our results to alternative measures of innovation in section 5.

Our main independent variable of interest is exporting in 2000 available in the 8th wave of SIMF's survey, given by the answer to the question "*Did you export in 2000?*", which is represented by the dummy variable EXP that takes on value one in case of positive answer and zero otherwise.

Lagging export status is useful to address potential problems of reverse causality, that is the fact that firms that are likely to export are those who innovate in the same period, and to take into account the potential lag with which a learning by exporting effect on innovation is likely to emerge.

Table 2 reports some panel descriptive statistics splitting the sample between exporters and non-exporters. In line with past findings, it is immediate to note from the raw data that exporters are much more likely to introduce product innovations and that on average they also differ with respect to non-exporters in a number of observable characteristics that could affect product innovation. Indeed, exporters are considerably larger (their average size being about three-times that of non-exporters) and strongly differ in terms of formal R&D activities.

[10] In the survey, firms were not asked if they discontinued the production of old products. For this reason, we are not able to explore the effect of exporting on the range of products produced by firms (cf. Bernard et al., 2010b).

[11] It would also be interesting to estimate the effect of export intensity (the ratio between exports and sales) on product innovation. Unfortunately, this piece of information was not collected in the 8th SIMF wave from which we take export status. A 10th wave of SIMF was released for the period 2004-2007 but because of changes in the questionnaire and severe non-response, the linkage between the 9th and the 10th waves is problematic, and we prefer to use the 8th-9th waves panel.

4 Econometric analysis

Figure 1 shows the potential sources of the positive association observed between a firm's export status and its performance, for instance in terms of productivity or innovativeness. The solid arrows on the right part of the the figure show the self-selection argument: some observable or unobservable characteristics of the firm may positively affect both its performance and its export status. One implication of this argument is that if we were able to observe and to control for all these potential firm's characteristics, the positive correlation between export status and product innovativeness should disappear. This is what we will assess in Section 4.1, by including several firm's characteristics that are likely to affect both export and innovation activities in a linear regression estimated using OLS, and observe whether a positive correlation still survives. If this happens, it may be due either to a genuine causal effect of export status on product innovation (or to a reverse causal relationship, shown in the figure with the dashed arrows) or to some unobserved firm's characteristics responsible for both outcomes. In this latter case, we have an endogeneity problem: firm's unobservables may affect both exporting and product innovation. A way to address this issue and to estimate the causal effect we are interested in, the one going from export status towards product innovation (shown in the figure with the bold line), is using an IVs strategy. This consists of finding an exogenous (to the individual firm) source of variation in firm's export status. In Section 4.2 we will mainly use as a source of identification a mix of (domestic) supply-push and (foreign) demand-pull factors, related to the *countrywide* pattern of Italian exports by industry and to features of the countries to which these exports are directed, respectively. This will also help solve the potential reverse causality problem shown with the dashed arrows in Figure 1: successful innovators are more likely to export.

4.1 Ordinary least squares

We formulate the following linear probability model (LPM) to estimate the probability that a firm introduces product innovations:

$$\mathsf{INN_i} = a_0 + a_1\mathsf{EXP_i} + a_2\mathsf{X_i} + u_i \tag{1}$$

where i is the firm subscript, $\mathsf{X_i}$ is a vector of firm's characteristics that might affect both innovation and exporting and u_i is an error term.[12]

In this section, we neglect the potential endogeneity of export status (with respect to product innovation) and use OLS. Our purpose here is simply to investigate whether the positive correlation between

[12]As known, the LPM has both advantages and disadvantages with respect to binary response models, such as probit or logit. The main advantage is that the LPM does not require assuming a specific distributional form for the error term u_i (e.g., normality in case of the probit model), while the main disadvantage is that the predicted values are not constrained to be in the unit interval.

a firm's export status and its product innovativeness survives the inclusion of several observable characteristics that may be the source of this correlation.

The OLS results are shown in Table 3, which reports specifications progressively adding covariates. In Model (1), which only includes export status, the estimated coefficient of exporting on the likelihood of introducing product innovations is 0.27 and highly statistically significant.

Some characteristics that may be associated with both a firm's export status and product innovation are the industry (2-digit ATECO sector[13]) in which a firm operates and its geographical location – region, i.e. NUTS 2 – which are then included in the regression. Model (2) shows a reduction in the effect of export status, which falls to 0.21. Exclusion Wald tests show that industry is a much better predictor of firm's product innovativeness than its geographical location: the corresponding p-values for the F-tests turn out to be 0.55 for administrative regions fixed effects and 0.00 for industry fixed effects. Despite this evidence, we keep firm's geographical location in the specifications that follow, in order to avoid omitting potentially important local unobservable variables.

Model (3) controls for some observable dimensions of firm heterogeneity that are likely to be related to both innovation and export activities, such as firm age, a dummy for group membership, dummies for spin-offs and mergers or acquisitions, firm size (number of employees), capital intensity and unit labor costs. The dummy for group membership and the one for mergers and acquisitions are positively and significantly (at the 5% statistical level) associated with product innovation, while unit labor costs are strongly negatively associated with firm's innovativeness.[14] Physical capital intensity is negatively associated with product innovations, and the coefficient is statistically significant at the 10% level. The coefficient on export status falls to 0.18.

Model (4) introduces a set of technological inputs, which are likely to be strongly associated with firm's product innovativeness: R&D intensity on employment (number of R&D workers over firm total employment), the percentage of R&D spent on product innovations, a dummy for ICT investments, a dummy for participating to a R&D consortium, and real investment in fixed capital, which could embody new technologies. All these new controls, except the last two, turn out to be significantly and positively associated with product innovation. The coefficient on export status experiences a noticeable drop, falling to 0.15, suggesting that part of the correlation between export status and product innovation might be accounted for by technological variables, and that firms that export also invest more in new technologies (ICT) or exert a higher formal innovative effort through R&D. Models (3) and (4) show that controlling for observed firm heterogeneity, which is likely to affect both product innovation and exporting, reduces the innovation effect of exporting.

Model (5) includes controls for other forms of potential international spillovers, in addition to those

[13] ATECO stands for *Classificazione delle attività economiche*, that is an Italian classification of economic activities (i.e. industries) equivalent to NACE European classification.

[14] Firm size is not significant, but scale effects are likely to be captured by lower unit labour costs.

running through trade, such as acquisition of foreign patents, a dummy for foreign ownership, a dummy for being located in a province bordering a foreign country and flows of FDIs. The last covariate only turns out to be positively associated with product innovation, but the coefficient on export status is only slightly affected. This result is not unexpected as in our data very few firms perform FDI flows (less than 2% in our estimation sample) while many firms export (about 68%), and the correlation between the two activities is not large.[15]

Model (6) includes further controls for managerial quality or decentralization, proxied by the return on investment index (ROI) and by the ratio of entrepreneurs, managers and cadres over the total number of employees, respectively. Both variables are not significant and the coefficient on export status falls only slightly.

Model (7) introduces two proxies of firm's absorptive capacity: average labor costs and the percentage of graduates over total firm's labor force. The latter turns out to be significantly (at the 10% statistical level) and positively associated with firm's product innovativeness. The coefficient on export status is not affected.

Model (8) controls for some proxies of the presence of firm's financial constraints, proxied by the number of bank branches over the population as a proxy of *operational distance* and a proxy of *functional distance* at province level (i.e. the average distance between a bank's head quarter and local branches at the province level).[16] Both variables turn out to be statistically insignificant, and the coefficient on exporting does not change.[17]

Although model (8) represents our preferred specification, we also estimated a model including lagged product innovation status as an additional control variable, Model (9).[18] This might be important in order to capture the potential dynamic structure of the product innovation process. Indeed, it might be the case that firms which innovated in the past are both more likely to have exported in the past and to innovate in the future. For this reason, the coefficient on export status (in 2000) might be picking up the effect of *past innovation* (during 1998-2000). However, our results show that even after controlling for past product innovation the coefficient on export status is only marginally affected, falling by 0.009, and remains highly statistically significant. Lagged product innovation is positively and significantly correlated with current product innovation. These estimates suggest, overall, that past export status is

[15] We also tried to include a dummy variable for making some production abroad, which is only available in the 9th wave of SIMF, and did find very similar results. Given that we only have imperfect proxies of FDIs stocks, and especially of delocalization of production, for 1998-2000 we checked the robustness of our results by splitting the sample in two, between firms with no more than 25 employees, which are very unlikely to perform FDIs, and firms with more the 25 employees, and the effect of export status turned out to be very similar in the two subsamples.

[16] See Alessandrini et al. (2008) for the effect of both measures of distance on firms' financing constraints. We thank Pietro Alessandrini, Andrea Presbitero and Alberto Zazzaro who kindly provided data on banking.

[17] This finding is qualitatively consistent with Benfratello et al. (2008) that using the SIMF panel but controlling for a narrower set of covariates find a weak and not robust effect of the banking system's development on firm's product innovation, while finding a stronger effect on process innovation.

[18] This variable, like export status, may be endogenous, but here we neglect this potential problem by using OLS since we estimate this specification only as a robustness check.

at least as important as past product innovation for the probability of current product innovation.[19]

Hence, from this first section of the empirical analysis we can be quite confident that the positive association between a firm's export status and its product innovativeness is a robust one, and survives the inclusion of an extremely rich set of *observable* firm characteristics which might generate a spurious correlation. Firms that exported in 2000 are *ceteris paribus* about 14 percent points more likely to introduce product innovations in 2001-2003 than those that did not export, in our preferred specification (8).[20] However, nothing ensures that we might have omitted some *unobservable* variables that simultaneously affect both a firm's export and innovation activities, and that the coefficient on export status may be simply picking up their effect. For this reason, in the next section we make an attempt to address this problem of potential *endogeneity* of export status using an IVs strategy.

4.2 Endogeneity and instrumental variables estimates

The identification of the causal effect of exporting with IVs requires finding some excluded instruments, that is variables providing an exogenous source of variation in a firm's export status.

From gravity models we borrow the idea that a firm's export status should be strongly negatively correlated with the distance between its geographical location and potential destination countries for its products (as transportation costs generally increase with distance), which represents one of the most robust empirical findings in international economics (Leamer and Levinsohn, 1995; Disdier and Head, 2008). In particular, we have information on the province (NUTS 3) in which a firm is located.[21] We use as an instrument the average distance from *potential* — and not actual — destination countries for a firm's exports. The average distance is computed in the standard way in this literature, by aggregating values using for single countries using export weights. (see Bernard and Jensen, 2004; Lileeva and Trefler, 2010).[22] Potential destination countries for a firm's products were identified by considering for each 2-digit ATECO sector the first 25 countries in terms of export value to which Italy exported in 1997.[23]

[19]We also estimated a specification adding lagged process innovation as a covariate. One possible criticism to our results is, indeed, that past adoption of process innovations induced by firm's internationalization might affect future product innovations. In that specification the coefficient on export status is 0.141, significant at the 1% statistical level, while the coefficient on past process innovation is 0.058, significant at the 5% level. Hence, the effects of past export status and process innovations on current product innovations appear to be independent. Some recent literature is stressing the role of imports on process and product innovation (Liu and Buck, 2007; Gorodnichenko et al., 2010), but unfortunately we do not have data on it. Thus, we built a proxy for importing which is a dummy that takes on value one if a firm bought transport or insurance services from abroad in 2001-2003 and zero otherwise – the information is not available for 1998-2000 – and included it in Model (8) as an additional covariate. The coefficient on exporting is 0.137, statistically significant at the 1% level, while the coefficient on the proxy for import status is 0.102, significant at the 5% level.

[20]We also estimated model (8) using a probit specification. The marginal effect computed at the sample mean turns out to be 0.16, statistically significant at the 1% level. We prefer model (8) to model (9) since the latter includes the lagged depedent variable, which is very likely to be endogenous and for which we do not have good instruments.

[21]In Italy, in the period we study, there were 103 provinces.

[22]Bernard and Jensen (2004) use US export weights to compute an average real exchange rate for the US, while Lileeva and Trefler (2010) use US import weights from Canada to build an average tariff variable. Unlike the two papers above, however, we use a pre-sample year to compute weights so as they are not affected by export behavior during the estimation period. Bernard and Jensen use average export shares between 1983 and 1992, their study spanning the period 1984-1992, and Lileeva and Trefler use the last year spanned by their data (1996).

[23]We do not use a finer disaggregation of ATECO mainly for two reasons: 1) coding errors increase when considering finer disaggregations; 2) exports are generally not available for all sectors/countries pairs when considering finer disaggregations.

Individual countries' weights were determined by dividing the export value to a specific country by the total value of exports to all top 25 countries by sector.[24] This implies that both destination countries and country weights are different across sectors. This procedure enables us to compute a *sector-province specific measure of a firm's average distance from its most likely export markets* determined on the basis of all Italian firms' — not those located in a specific province — predetermined export behavior, which is a measure of distance that varies across sectors and provinces and that we call 'export distance', $\mathsf{EXPDIST}$.[25] Formally, $\mathsf{EXPDIST}$ was computed as follows:

$$\mathsf{EXPDIST}_{pi} = \sum_{j=1}^{25} w_{ij} \cdot d_{pj} \tag{2}$$

where d_{pj} is the great circle distance between province p and country j and $w_{ij} = \frac{\mathsf{EXPORT}^{1997}{}_{ij}}{\sum_{j=1}^{25} \mathsf{EXPORT}^{1997}{}_{ij}}$ is the weight of country j on the total exports of sector i (on the first 25 destination countries for sector i).[26]

Two firms in the same province have different values of $\mathsf{EXPDIST}$ if they operate in different sectors while two firms in the same sector but in different provinces have different measures of 'export distance', due to their different geographical locations. In order for the instrument to be valid, it is necessary that $\mathsf{EXPDIST}$ is not capturing mainly sector or geographical unobservables that also directly affect product innovation. As for the second possibility, our previous OLS result of the insignificance of administrative regions (NUTS 2) fixed effects on product innovation makes us rather confident that it should not be the case. However, we control in both stages of IVs for both sector fixed effects and region fixed effects, and for the firm being located in a foreign-border province. The dummy for foreign-border province should capture the fact that firms located in these provinces might be more likely both to be influenced by knowledge spillovers from foreign firms and to export to neighboring countries. In any case, in the computation of 'export distance' are only considered the main *destination countries of Italian exports by sector*, which are weighed by the fraction of exports. In this sense, our variable is much more specific that a simple interaction between province and sector fixed effects, and should be highly correlated with export status, capturing the combined effect of transportation costs and Italian sectoral comparative advantages on firms' export status, while being loosely correlated or uncorrelated with foreign knowledge spillovers taking place *independently of exporting*. Indeed, although this is far from being a formal test, when included in the most complete LPM specification estimated with OLS of the product innovation

We consider the first top 25 export destinations in analogy to Bernard and Jensen (2004).

[24]Data on exports were taken from the OECD's STAN Bilateral Trade Database. Export weights refer to 1997 so as they are predetermined with respect to the period under study (1998-2003).

[25]As weights are computed on the basis of all Italian firms' export behavior, they are unlikely to be correlated with province-specific or firm-specific unobservables.

[26]Great circle distance, which is commonly used in trade gravity models, is a raw measure of travel costs. For this reason we also experimented in the first stage with a dummy for the presence in the province of airports, which unfortunately did not turn out to be statistically significant in the IVs first stage.

equation, EXPDIST is not statistically significant at the 10% level. This instrument is similar to the ones commonly employed in labor economics, for instance when college distance (or proximity) is used to estimate the effect of education on wages or other outcome variables (see, for instance, Card, 1993; Currie and Moretti, 2003). Like in those applications, a key assumption for our instrument to be valid is that geographic location - in our analysis firm location - is exogenous with respect to the outcome variable, product innovation activity in our case. A possible criticism is that firm's location could be endogenous, that is a firm might choose a specific location since it offers a better environment for both exporting and innovation. However, this criticism does not appear to be particularly relevant for the Italian case given the very low geographic mobility of entrepreneurs. Michelacci and Silva (2007), for instance, using the Bank of Italy's Survey of Household Income and Wealth (SHIW) data for 1991-1995 show that in Italy about 79% of enterpreneurs established firms in the same province where they were born ('local firms'). If individuals mainly create firms where they were born, there does not seem to be much space for strategic location behaviour, in terms of search of the best innovation or exporting environments. The authors also show that 'local firms' are generally larger, have a higher value and are more capital intensive, which suggests that firms established by non-local enterpreneurs (movers) are not necessarily better (e.g., more innovative). However, we will assess the sensitivity of the IVs estimates to some potential threats to identification coming from non-random geographic location of firms.

The second instrument that we propose is related to the idea of 'market potential'. We use a proxy of average export 'market potential' that is defined as:

$$\mathsf{MKTPOT}_{pi} = \sum_{j=1}^{25} (d_{pj})^{-1} Y_j \tag{3}$$

where d_{pj} is the distance between province p and country j and Y_j may be either Gross Domestic Product (GDP) in country j (Harris, 1954) or per capita GDP in country j (Friedman et al., 1992). Here, we use inverse distance weighed per capita GDP in 1997 evaluated at 2000 U.S. dollars that is summed across the first 25 destination countries for exports of sector i, obtained as described above for EXPDIST. However, market potential could also have direct effects on a firm's incentives to innovate. Here, we argue that these effects should be captured by research formal inputs, such as R&D intensity or the R&D devoted to the introduction of new products, which have been included among the covariates. Moreover, as for the previous instrument, we are considering only the top 25 destination countries to which Italy exports. The main idea is that the market potential of *national* exports by sector can affect a firm's likelihood to export, although a single firm has little control over it, i.e. it should be exogenous with respect to product innovation at the firm level. Also in this case, since GDPs are weighed by the inverse of geographical distances, a crucial identifying assumption is that firm's location is exogenous with respect to product innovation. In any case, as we use an overidentified model (see below), we will be able to test for the instruments' validity.

The third instrument that we use is lagged unit labor cost, in 1998. This instrument should be valid, since after controlling for unit labor cost in 2000 in the innovation equation, it should not have any additional effect on product innovations between 2001 and 2003. At the same time it should be relevant, since high unit labor costs in 1998 are likely to negatively affect a firm's export status in 2000.

We use all three instruments, i.e. an *over-identified model*, in order to test for their validity.

IVs was implemented through two-stage least squares (2SLS). The top part of the Table 4 reports the first stage of the instrumental variables - linear probability model (IVs-LPM), and the bottom part the second stage. Although in column (1) the Partial R-squared for the excluded instruments is quite satisfactory (1.3%), the joint F-test is quite low (6.54) suggesting a potential weak instrument problem.[27] Hence, our instruments may be weak and produce a biased and imprecise estimate of the effect of export status on product innovation. Indeed, the coefficient on export status remains statistically significant at the 5% but is much less precisely estimated than with OLS, the standard error rising from 0.027 in model (8) of Table 3 to 0.24 when IVs are used. The lack of precision does not prevent us to conclude that the sign of the effect of export status on product innovation is positive. The Hansen-J statistic shows that the joint null hypothesis that the instruments are valid – that is that they are uncorrelated with the error term and that the excluded instruments are correctly excluded from the estimated equation – cannot be rejected in our specification.[28]

In column (2) of Table 4, as a further check of the instruments' validity, we estimate with 2SLS a model only including region and sector fixed effects among the controls, but excluding all the other firm characteristics. Were the instruments endogenous, we would expect them to be highly correlated with firm characteristics, and 2SLS estimates in column (2) to change radically from those in column (1). However, this does not happen: our instruments do not appear to be correlated with observables firm characteristics which are likely to affect both product innovation and exporting decisions.

From a qualitative point of view IVs results are consistent with the OLS results. We tend to interpret the difference in magnitude between OLS and IVs estimates as the result of a likely weak instrument problem.[29] The endogeneity test suggests that the null hypothesis that export status can be treated as exogenous cannot be rejected at the 10% statistical level. We interpret this as evidence that after cotrolling for a wide range of observable characteristics, the problem of endogeneity of export status, if any, should not be severe, and that OLS estimates are unlikely to suffer from a large bias.

[27] Stock and Yogo's critical values for 5%, 10% and 20% maximal IV relative bias (with respect to OLS) are 13.91, 9.08 and 6.46, respectively (Stock and Yogo, 2005)

[28] We also estimated models using only one instrument at the time, since in the presence of weak instruments the size of the IVs bias is increasing in the number of instruments (Hahn and Hausman, 2002), but we obtained similar results without any gain in precision. Although in the table we only report results from two-stage least squares, all models were also estimated with limited information maximum likelihood – which is less biased in the presence of weak instruments – without any appreciable improvement in precision. The full set of IVs estimates is available from the authors upon request.

[29] An alternative (not mutually exclusive) interpretation is that firm export status being self-reported is affected by classical measurement error, and OLS estimates are downward biased.

In spite of this, we think that it is important to also assess the robustness of our IVs estimates. There are a number of reasons why our IVs strategy could fail. Both EXPDIST and MKTPOT use geographical information on firm's location and assume that it is exogenous. Although, we already said that firm's and entrepreneur's geographical mobility is in general rather limited in Italy, we cannot completely rule out the possibility that some firms might have chosen their locations according to the expected benefits for their innovation activity. We think that firms that are more likely to behave strategically are larger (non-family) firms that have less tight connections with a specific territory. For this reason, it could be important to see how our results change when the analysis is limited to relatively smaller firms, whose location is more likely to be exogenous.

A second potential issue that might affect the EXPDIST and MKTPOT instruments is that the presence of a specific country among the first 25 destinations by ATECO sector and its weight (only for EXPDIST) may be affected by the (past) export activity of firms in our sample, especially if they are large. In this regard, we stress that weights are computed using pre-determined (1997) data and also in the worst case scenario, in which both destinations and weights are affected by firms in our sample, using this instrument would be similar to using lagged firm's export status as an instrument.[30] Also in this case, a robustness check is to replicate the IVs estimation for relatively small firms. Indeed, the likelihood that export destination countries and/or their weights at the national level are importantly affected by single firms in our sample is lower for smaller firms.

Hence, column (3) of Table 4 reports the estimates for the sample of firms with less than 50 employees. The results are not qualitatively or quantitatively different from those in the first column, although the null of exogeneity of export status can now be rejected at the 10% level.

As a further robustness check for the IVs estimates, in column (4) we report the estimates in the sample of firms that were established before 1990. These firms chosen their location more than 10 and 6 years before the year which the innovation outcome and EXPDIST and MKTPOT, respectively, refer to and it could be argued that the assumption of *exogenous location* is very likely to hold in this subsample. The results do not change.

Finally, we also make an attempt to address the potential weak instruments' problem. As outlined by Vella and Verbeek (1999) an alternative way of computing endogenous treatment effects is by using a control function (CF) approach. Vella and Verbeek stress the relation existing between the CF and the IVs approaches. In particular, due to the weak identification in IVs, we try to improve on identification by using the non-linearity implicit in the CF approach. We use a probit model to estimate the export equation

$$\mathsf{EXP_i} = b\mathsf{Z_i} + v_i \tag{4}$$

[30]Firm's lagged export status is not directly used as an instrument since it would require using another wave, the 7th, greatly reducing the sample size.

in the first stage, where Z_i is a vector of variables, including a constant and v_i a standard normally distributed error term. Then we use the probit model estimates to compute the generalized residual ($\lambda_i(.)$) and include it in equation 1. The generalized residual is clearly a non-linear function of all variables included in the first stage. The estimating equation becomes

$$\mathsf{INN_i} = a_0 + a_1\mathsf{EXP_i} + a_2\mathsf{X_i} + \sigma_{u,v}\lambda_i(b\mathsf{Z_i}) + \epsilon_i \tag{5}$$

where $\lambda_i(b\mathsf{Z_i}) = \frac{\phi(b\mathsf{Z_i})}{\Phi(b\mathsf{Z_i})}$, and $\phi(.)$ and $\Phi(.)$ are the standard normal density and probability functions, respectively.[31] This estimator is consistent under a joint normality assumption of the error terms in the export status and the innovation equations. The coefficient on the generalized residual ($\sigma_{u,v}$) gives the correlation between the error terms in the two equations and can be used to test for endogeneity. To avoid identification relying on functional form only, in the first stage we use the same set of exclusion restrictions used to implement IVs. The results are included in column (5) of table 4. The first stage now does not seem to be affected by weak identification, as the Wald test for the exclusion restriction of EXPDIST, MKTPOT and lagged unit labor cost is 21.36. The results from the CF approach do not show an endogeneity problem, the coefficient on the generalized residual being statistically insignificant, and the estimated effect of export status (0.141) is very close to the one obtained with OLS.

We made a number of other robustness checks that are not reported in the table.[32] First, we re-estimated the IVs-LPM model in column (1) using an IVs-probit specification, in which the dependent variable is treated as dichotomic and the export status variable as it were continuous. This model is more restrictive than the IVs-LPM as it imposes joint normality between the error terms in the export and the product innovation equation, and can be estimated with maximum likelihood. The estimated average marginal effect of export status on product innovation evaluated at the sample mean was 0.462, statistically significant at the 1%. The p-value for the Wald test of the null hypothesis of exogeneity of export status, that is that the correlation between the error terms in the product innovation and the export status equations is null, was 0.12. Finally, we re-estimated the model using a sequential probit specification in which both export status and product innovation are treated as dicothomic, which was estimated using maximum likelihood assuming joint normality.[33] In this case the coefficient on export status was not statistically significant, but the Wald test for null correlation between the two equations (product innovation and export status) could not be rejected (p-value=0.89). When switching to the simple probit, as we already said (see footnote 20), the effect of exporting turns out to be significant and similar in magnitude to the LPM's estimate. All these pieces of evidence taken together may be interpreted as pointing to the absence of a severe endogeneity problem − conditional on the observables

[31] Standard errors are bootstrapped since the generalized residual is a generated regressor.
[32] The complete set of results is available upon request from the authors.
[33] In this model an endogenous dummy enters a probit equation.

– as far as firm's export status is concerned. Moreover, the qualitative result of a positive effect of exporting on product innovativeness is very robust to changing the modelling strategy.

5 Robustness checks to alternative proxies of innovation

As we said, our measure of product innovativeness, and similar measures used in the literature, have two main weaknesses (i) they are subjective measures, and (ii) they do not allow to distinguish between the introduction of new products and the simple improvement of older products. For this reason, we use some other pieces of information collected in the 9th SIMF wave. Firms which did invest in 2001-2003 were also asked the following question

> What are the objectives of the investiments you made during 2001-2003? Please, specify the degree of importance (1 high, 2 medium, 3 high)
>
> C1.4.1 Quality improvement of existing products
>
> C1.4.2 Increase in the production of existing products
>
> C1.4.3 Production of new products
>
> C1.4.4 Lower enviromental impact
>
> ...

for each objective we build an indicator which equals one if the firm ranked it as 'high' and zero otherwise. These indicators were then used to estimate linear probability models with OLS. We used the same specification in column (8) of Table 3. Table 5 reports the resuls. Row (1) shows no association between firm export status and investments made to improve existing products. By contrast, row (2) shows that exporting firms in 2000 are about 7 percent points more likely to have invested for producing new products between 2001 and 2003. Column (3)-(4) report a kind of 'falsification' check, to see whether exporting firms are likely to answer positively to questions defining other 'virtuous' behaviors (such as increasing production or investing to reduce the environmental impact of production), which however does not seem to be the case.

The pattern of results in this section seems to show that (i) the answers to the exporting and the product innovation questions are characterized by a statistically significant, positive and large association which is not found between exporting and other kinds of firm's behavior, suggesting that the association is unlikely to be driven by the subjective nature of the innovation indicator used, (ii) exporting seems to lead to the introduction of new products, rather than to a simple improvement of existing products.

6 Discussion

We have shown that export status positively affects the likelihood that a firm introduces product innovations. After controlling for several indicators of firm efficiency and quality, from the analysis in the previous section, we can say that we are capturing an effect that is over and above the common incentive of 'better' firms both to enter foreign markets and to renew their products. Nevertheless, it is worth mentioning that our results show a negative association of export status and product innovativeness with the main firm's efficiency indicator (i.e. unit labor costs), in line with the self-selection mechanism emphasized by the recent empirical literature.[34]

At this point, we might wonder what is the source of the incentive for exporters to innovate and through which pathways this effect takes place.

The literature investigating the sources of innovation at the firm level distinguishes between *technology push* and *demand/market pull* factors. According to the first explanation are the activities and capabilities of the firm that drive innovation – mainly basic research and industrial R&D – while the second maintains that innovation is mainly spurred by the external requirements of the market. This second approach looks in turn at the market/demand side in two different ways: a) demand as size of the market or 'incentive effect' (Schmookler, 1966; Jovanovic and Rob, 1987; Sutton, 1998); b) demand as information or 'uncertainty effect' (Myers and Marquis, 1969). This last stream of literature stresses the interaction with buyers as a source of information which raises the innovative effort of the firm, and it underlines either the role of 'sophisticated' customers who can provide feedbacks to producers or the role of taste heterogeneity (Malerba et al., 2007; Adner and Levinthal, 2001).[35] Then, theoretically, both *technology push* and *demand pull* factors might explain the higher innovativeness of exporters.

In our empirical specifications we are controlling for many covariates that are likely to mediate the effect of exporting on innovation in terms of higher formal innovative efforts such as investments in R&D, acquisition of foreign patents and of new capital goods to produce different products. Moreover, we control for firm size and unit labor costs (which are likely to fall with firm's scale of production). Our results are in line with the past literature showing an important role for these factors. Their inclusion as control variables allows us nonetheless to exclude that in our analysis export status is capturing either a scale effect or the effect of stronger competition on firm's formal research engagement.

A possible interpretation of the effect of exporting, drawing from the literature on multiproduct firms (Bernard et al., 2010b,a), is that exporting could produce a within-firm reallocation of resources, and a change in the product mix. In particular, exporters could focus on their 'core competency'. As a consequence, firms that do export could specialize in few products, and, perhaps, have stronger incentives to keep them up-to-date ('scale per product' effect). Despite this being another potential channel for the effect of exporting on innovation and a possible reading of our results, which we cannot completely rule

[34] According to the *learning to export* hypothesis mentioned in the Section 2, firms which plan to export start to increase their innovative effort mainly measured with formal R&D – but this could also extend to other forms of non-R&D innovation effort – before entering the foreign market. For evidence consistent with this idea see, for instance, Van Beveren and Vandenbussche (2010). Since we are controlling for past R&D intensity, and the share of R&D oriented to the introduction of new products – in some specifications also for past innovation – we think that it is unlikely that we are capturing this channel.

[35] Several empirical studies support the role of demand/market pull factors, for instance those showing that market research aiming to gather customer feedback and to detect the evolution of customer needs, monitoring competitors and other marketing strategies are beneficial to innovation (Becheikh et al., 2006).

out, we tend to exclude that this is driving *all* the effect in our specific case, since we control not only for total R&D intensity but also for the share of R&D *devoted to introducing product innovations*. On the ground that exporters could be focusing their production on their 'core competency', R&D for product innovations should partly capture their higher incentives to renew these products. Moreover, due to the characteristics of Italian Manufacturing where small size businesses are prevalent and formal R&D very rare (Table 2), there are possibly only a few exceptions in which firms have enough human resources to carry out R&D by product line.

As we control for proxies of absorptive capacity (graduate ratio and average labor costs) and internationalization modes other than exporting (FDI flows), which could represent some preferential ways to exchange information with foreign researchers, we tend to exclude that our results are mainly driven by technology-push factors.[36]

Then, the coefficient on export status is likely to capture other effects, which may take the form of pure knowledge spillovers, informal higher innovative effort or lower costs to gather information on foreign markets, which originate from the interaction with foreign customers. Export activities imply 'proximity' to foreign markets. This may reduce the cost of searching for successful innovation and of gathering information on the needs of foreign buyers and on the market location of competitors. As emphasized by the seminal contribution of Vernon (1966), advanced economies have the same access to scientific knowledge, but commercial innovation responds to demand. Proximity, which guarantees the effective communication between the potential market and the potential supplier, is at the basis of new products' development, due to uncertainty and ignorance on the characteristics of the market. More recently, the search/network approach to international trade has highlighted the role of incomplete information, in particular when trade is in differentiated products. Buyers – both consumers of final goods and firms seeking inputs – may incur costs in discovering the characteristics of foreign varieties; buyers and sellers may not automatically match across countries and they may need to interact (see, for instance Rauch, 1996; Rauch and Trinidade, 2003; Rauch and Watson, 2003). On the other hand, the interaction with diverse foreign agents (both buyers and competitors) should facilitate processes such as the transfer of tacit knowledge or imitation.

We take this evidence as consistent with the hypothesis that our results could be driven by 'demand as information' factors, that is to say by the interaction with customers and/or competitors in the foreign market. Unfortunately, in the SIMF dataset we do not have enough information to clearly single out the specific mechanisms at work.

[36] The interaction with foreign researchers may be more important for process innovation. The same specification of the LPM in Model (8) (Table 3) using a dichotomic variable for having introduced process innovations in 2001-2003 as the dependent variable was estimated with OLS. The coefficient on export status turns out to be 0.064 (s.e.=0.028), significant at the 5% level, an effect much smaller than the one observed for product innovation. This coefficient is statistically different from the one in the product innovation equation of Model (8) at the 5% level. This should not be considered as a formal test, but were the effect of exporting on product innovativeness mainly originating from the supply-side of export markets (e.g., interactions with foreign researchers), we would expect an effect at least as large on process innovativeness.

Having pointed out that interaction with foreign buyers (both firms and consumers) and possibly competitors may be a possible channel explaining the effect we find, we may wonder now what does distinguish the foreign from the domestic market.

Several contributions in the literature underline the role of cross-country differences in income and state of technology in driving product innovation, both through knowledge transfers and by generating the right incentives to innovate.[37] Since the largest part of Italian exports take place with economies characterized by similar levels of income and development,[38] we doubt foreign taste for quality or superior technologies of foreign firms – probably more relevant for less developed countries – to be the driving forces of product innovativeness of Italian exporters.[39]

Even among similar countries, nevertheless, there are several, not mutually exclusive pathways through which foreign demand may stimulate exporters' innovative behavior. First of all, heterogeneity in consumer tastes across countries due to cultural, geographic, ethnic and historical differences may represent an important incentive for firms that do export to introduce product innovations, that is to modify or improve their products to meet foreign needs (Goldberg and Verboven, 2005; Friberg et al., 2010; Ferreira and Waldfogel, 2010) .[40] It is worth noting that an exporter entering a new foreign market has to search for a niche to sell his production, this possibly implying changes in the characteristics of his product, not necessarily to meet diverse foreign needs but possibly to differentiate himself from foreign competitors (Desmet and Parente, 2008). Heterogeneity in tastes may also generate heterogeneity in foreign firms' technological specificities, e.g. the need to adapt intermediate goods, even across countries with the same state of technology. As a consequence, exporters supplying inputs to foreign buyers may have to customize their products for the foreign market.[41]

These considerations apply in particular to the case of Italian manufacturing, where small firms often engage themselves in incremental innovations and product adaptation.

7 Concluding remarks

In this paper, we have used an extremely rich dataset on Italian manufacturing firms to investigate the effect of a firm's export status on its likelihood of introducing product innovations. We have shown that

[37] For a comprehensive view of recent contributions, in particular on product quality and cross-country income differences, see for instance Baldwin and Harrigan (2007).

[38] Firms in SIMF report in 2000 an average percentage of exports directed to EU-15 of 62.6%, and to the US and Canada of 9.3%.

[39] As we said, we find a much lower effect of exporting on process innovativeness, which should be instead greatly affected in case Italian firms suffer a substantial technological gap.

[40] The role of cross-country consumer tastes heterogeneity has been highlighted by Dinopoulos (1988) and, more recently, by Bernard et al. (2010a) and by Di Comite et al. (2011), in an heterogeneous firms framework where firms choose their product range.

[41] Some insights on the role of location in the product space with respect to innovation induced by buyer-supplier relationships across countries are given in Grossman and Helpman (2005), while Puga and Trefler (2010) highlight how buyer-supplier relationships may also result in different innovation strategies when developed across countries, due to incomplete information.

a statistically significant correlation between exporting and introducing product innovations – consistent with *learning by exporting* – remains even after controlling for many observable firm characteristics that may be responsible for it. This result is also robust to allowing firm export status to be endogenous using an instrumental variables strategy. Indeed, when we use supply-push and demand-pull instruments based on firm's distance from potential export markets and firm's export market potential, export status turns out to have a high, and significant, positive effect on firm's innovation activity.

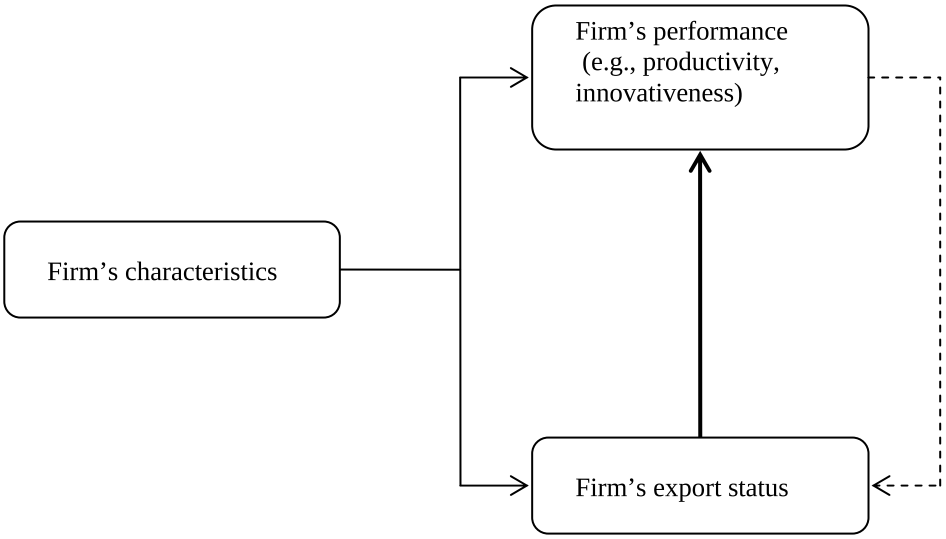
Although our data do not enable us to precisely determine the mechanisms through which exporting enhances product innovativeness, after controlling in our regressions for several mediating variables (e.g., firm size, R&D investment) our analysis suggests that a possible source for the 'residual' effect we are capturing may be the interaction between exporters and foreign customers (consumers or firms) and in particular the need of a domestic firm to modify its product when entering and staying in a foreign market.

Our results highlight that firms may differ not only in how they produce, but also in what they produce. Whether and how the characteristics of firms' products meet foreign needs, even between similar countries, may be crucial for enhancing innovation. From a policy perspective, this positive effect of exporting on firm level product innovation has both welfare implications, as a better match with customer needs should be reached through trade integration, and growth implications, since product innovation has positive effects on firms' sales and employment (Hall et al., 2008) and it is at the basis of firms' competitiveness and survival to worldwide competition.

Due to the nature of our data, which do not allow us to explore these hypotheses further, a deeper understanding of the role of 'demand as information' both at the theoretical and at the empirical level is left for future work.

Figures

Figure 1: Sources of association between exporting and firm's performance



Note. The solid arrows on the left side of the figure show a first source of (spurious) correlation between exporting and firm's performance, represented by the self-selection in both activities according to both observed and unobserved firm's characteristics. The bold arrow shows a genuine causal effect going from exporting towards product innovation. The dashed arrow shows a genuine causal effect going from firm's performance towards export status (reverse causality).

Tables

Table 1: Descriptive statistics for the SIMF's 1998-2000 cross-section and the 1998-2003 panel

Variable	1998-2000 wave			1998-2003 panel		
	N. obs.	mean	s.d.	N. obs.	mean	s.d.
% exporters in 2000	4,667	0.679	0.467	2,047	0.681	0.466
% group members 1998-2000	4,667	0.205	0.404	2,044	0.201	0.401
no. employees 2000	4,675	87.561	364.198	2,050	97.231	417.150
capital intensity 2000[(a)]	4,018	0.038	0.049	1,825	0.038	0.046
R&D intensity in 2000[(b)]	3,814	0.015	0.392	1,735	0.020	0.551
skill-ratio 2000[(c)]	4,675	0.347	0.184	2,050	0.336	0.173

Notes. [(a)] real capital stock per worker in thousands of Euros (at 2000 prices); [(b)] no. of R&D employees over total number of employees; [(c)] number of non-production (white collars) over production workers (blue collars).

Table 2: Descriptive statistics for non-exporters and exporters (1998-2003 SIMF's panel)

Variable	N. obs.	mean	s.d.
Non-exporters in 2000			
% made product innovations in 2001-2003	642	0.241	0.428
% group members 1998-2000	651	0.144	0.352
no. employees 2000	652	41.095	164.193
capital intensity 2000[(a)]	562	0.040	0.052
R&D intensity in 2000[(b)]	544	0.003	0.011
skill-ratio 2000[(c)]	652	0.319	0.178
Exporters in 2000			
% made product innovations in 2001-2003	1,371	0.508	0.500
% group members 1998-2000	1,390	0.227	0.419
no. employees 2000	1,395	123.636	490.921
capital intensity 2000[(a)]	1,262	0.036	0.044
R&D intensity in 2000[(b)]	1,190	0.028	0.666
skill-ratio 2000[(c)]	1,395	0.345	0.170

Notes. [(a)] real capital stock per worker in thousands of Euros (at 2000 prices); [(b)] no. of R&D employees over total number of employees; [(c)] number of non-production (white collars) over production workers (blue collars).

Table 3: Probability of introducing product innovations in 2001-2003 (linear probability models estimated with OLS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exporter (d)	0.265	0.206	0.183	0.147	0.145	0.143	0.143	0.144	0.135
	(0.024)	(0.026)	(0.027)	(0.026)	(0.026)	(0.026)	(0.027)	(0.027)	(0.027)
Firm age			0.001	0.001	0.001	0.001	0.001	0.001	0.001
			(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Group membership (d)			0.071	0.069	0.062	0.062	0.059	0.060	0.054
			(0.034)	(0.033)	(0.033)	(0.034)	(0.034)	(0.034)	(0.034)
Spin-offs (d)			-0.017	-0.026	-0.030	-0.029	-0.033	-0.031	-0.024
			(0.069)	(0.063)	(0.063)	(0.062)	(0.063)	(0.063)	(0.064)
Mergers or acquisitions (d)			0.097	0.060	0.060	0.061	0.062	0.065	0.055
			(0.046)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Size			0.013	0.008	0.007	0.007	0.007	0.007	0.005
			(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
Real capital intensity			-0.423	-0.452	-0.449	-0.423	-0.403	-0.400	-0.379
			(0.251)	(0.256)	(0.257)	(0.258)	(0.263)	(0.262)	(0.262)
Unit labour costs			-0.326	-0.258	-0.235	-0.225	-0.206	-0.212	-0.212
			(0.116)	(0.113)	(0.114)	(0.117)	(0.119)	(0.119)	(0.118)
% R&D to introduce new products				0.002	0.002	0.002	0.002	0.002	0.001
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R&D intensity on employment				1.275	1.288	1.286	1.225	1.226	1.176
				(0.206)	(0.207)	(0.207)	(0.213)	(0.213)	(0.215)
R&D consortium				-0.089	-0.104	-0.108	-0.112	-0.108	-0.089
				(0.169)	(0.166)	(0.167)	(0.163)	(0.164)	(0.159)
Invested in ICT (d)				0.107	0.105	0.104	0.103	0.103	0.090
				(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Variation in real capital stock				0.003	0.003	0.003	0.003	0.003	0.002
				(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
FDI flows (d)					0.186	0.184	0.182	0.180	0.169
					(0.068)	(0.068)	(0.068)	(0.068)	(0.068)
Bought patents abroad (d)					-0.094	-0.095	-0.115	-0.110	-0.115
					(0.092)	(0.091)	(0.093)	(0.093)	(0.095)
Foreign ownership (d)					0.008	0.006	0.006	0.006	-0.009
					(0.062)	(0.062)	(0.063)	(0.063)	(0.064)
Border province (d)					0.004	0.004	0.006	0.013	0.014
					(0.039)	(0.039)	(0.039)	(0.040)	(0.039)
Decentralized management						-0.037	-0.047	-0.047	-0.037
						(0.048)	(0.048)	(0.048)	(0.049)
Return on investment						0.001	0.001	0.001	0.001
						(0.001)	(0.001)	(0.001)	(0.001)
Graduate ratio							0.405	0.407	0.397
							(0.211)	(0.211)	(0.214)
Real cost per worker							-0.001	-0.001	-0.001
							(0.001)	(0.002)	(0.001)
Bank branches per 10,000 pop.								0.002	0.002
								(0.002)	(0.002)
Bank's functional distance								0.012	0.012
								(0.018)	(0.018)
Lagged product innovation (d)									0.127
									(0.032)
Region fixed effects	no	yes	yes	yes	yes	yes	yes	yes	yes
Industry fixed effects	no	yes	yes	yes	yes	yes	yes	yes	yes
R-squared	0.063	0.109	0.125	0.178	0.181	0.181	0.183	0.184	0.194
No. observations	1,635	1,635	1,635	1,635	1,635	1,635	1,635	1,635	1,635

Notes. Dummy variables are indicated with (d) after the variable. For the detailed description of the variables see the Appendix.

Table 4: Probability of introducing product innovations in 2001-2003 (instrumental variables and control function approach)

	(1) 2SLS[(a)]	(2) 2SLS[(a)]	(3) 2SLS[(b)]	(4) 2SLS[(c)]	(5) CFA[(a)]
1st stage: Export equation					
Instruments:					
Export distance (EXPDIST)	-0.014	-0.012	-0.013	-0.016	-0.045
	(0.005)	(0.005)	(0.006)	(0.005)	(0 .017)
Market potential (MKTPOT)	0.093	0.087	0.134	0.094	0.298
	(0.043)	(0.041)	(0.051)	(0.045)	(0.147)
Unit labour costs (1998)	-0.289	-0.591	-0.318	-0.321	-1.667
	(0.138)	(0.165)	(0.149)	(0.136)	(0.691)
All controls	yes	no	yes	yes	yes
Only region and sector fixed effects	no	yes	no	no	no
F-test instruments (p-value)	6.54 [0.00]	8.74 [0.00]	7.04 [0.00]	7.70 [0.00]	21.36 [0.00]
Partial R^2 instruments	0.013		0.017	0.016	
2nd stage: Product innovation equation					
Export (d)	0.498	0.428	0.450	0.428	0.142
	(0.237)	(0.154)	(0.189)	(0.216)	(0.029)
$\sigma_{u,v}$					-0.023
					(0.096)
All controls	yes	no	yes	yes	yes
Only region and sector fixed effects	no	yes	no	no	no
Hansen J-statistic (p-value)[(d)]	0.67 [0.71]	0.31 [0.85]	0.67 [0.72]	0.07 [0.97]	
Endogeneity test (p-value)[(e)]	2.07 [0.15]	2.61[0.11]	3.00 [0.08]	1.80 [0.18]	
No. observations	1,635	1,635	1,213	1,327	1,624

Notes. Standard errors clustered at the province × 2-digit industry level in parentheses, p-values in brackets and bootstrapped (1,000 replications) in the CF approach. Dummy variables are indicated with (d) after the variable. Only selected variables are reported in the table. The models also include all covariates of Model (8) in Table 3.

[(a)] Sample includes all firms. In the control function approach (CFA) eleven observations are dropped as participation to an R&D consortium perfectly predicts success, and the first stage was implemented as a probit model (the table reports the coefficients).

[(b)] Sample includes only firms with less than 50 employees.

[(c)] Sample includes only firms established before 1990.

[(d)] Overidentification test. The joint null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation.

[(e)] The endogeneity test is defined as the difference of two Sargan-Hansen statistics: one for the equation with the smaller set of instruments, where the suspect regressor is treated as endogenous, and one for the equation with the larger set of instruments, where the suspect regressor is treated as exogenous. The null hypothesis is exogeneity. This test, unlike the Durbin-Wu-Hausman test, is robust to various violations of conditional homoskedasticity and is suitable for our clustered data.

Table 5: Robustness checks

Dependent variables	mean	coeff.	s.e.	No. obs.	R^2
1. Invested for improving old products in 2001-2003	0.608	0.041	(0.032)	1,343	0.056
2. Invested for new products in 2001-2003	0.256	0.079	(0.026)	1,302	0.103
'Falsification' checks					
3. Invested for increasing production of old products in 2001-2003	0.438	0.012	(0.032)	1,337	0.060
4. Invested for reducing environmental impact in 2001-2003	0.209	0.012	(0.027)	1,289	0.062

Notes. The dependent variables are dichotomic indicators that equal one in case a specific investment objective was ranked of high (rather than of medium or low) importance. The columns 'mean' show the mean of the dependent variable in the estimation sample, and 'Coeff.' and 's.e.' the coefficient on firm export status (in 2000) and its standard error, respectively. Standard errors clustered at the province × 2-digit industry level in parentheses. All regressions also include the covariates of Model (8) in Table 3 and are estimated on firms which made investments in 2001-2003 and for which the dependent variable is non-missing.

Appendix: Variables Description

Product innovation. It is the dependent variable, which takes value one if a firm improved substantially its products or introduced new products during 2001-2003, and zero otherwise. Source: SIMF, 9th wave.

Export status. It is a dummy variable which takes on value one if a firm exported in 2000 and zero otherwise. Source: SIMF, 8th wave.

Export distance. It is a sector specific measure of distance of a firm from its most likely potential export markets. See section 4.2 for more details. Source: export data from OECD's STAN Bilateral Trade Database, coordinates data from
http://www.cepii.fr/anglaisgraph/bdd/distances.htm.
Unit of measurement: 100 Km.

Market potential. It is an inverse-distance weighed measure of gross GDP per capita in 1997 evaluated at 2000 U.S. dollars. The measure considers the top 25 export market destinations by industry (2-digit ATECO). Source for gross GDP per capita is the World Bank Development Indicators.

Size. Number of employees (divided by 100)), 2000. Source: SIMF, 8th wave.

Graduate ratio. Fraction of employees with a university degree, 2000. Source: SIMF, 8th wave.

Real capital intensity. It is the ratio between the real capital stock and the number of employees in 2000. The nominal capital stock is derived from balance sheet data and is evaluated at the net 'historical cost' that is cost originally borne by a firm to buy the good reduced by the depreciation measured according to the fiscal law (*Fondo di ammortamento*), which accounts for obsolescence and use of the good. The real capital stock is obtained using capital stock deflators provided by the Italian National Statistical Institute (cf. Moretti, 2004). All variables are deflated with the appropriate 3-digit production price index (ISTAT). Source: SIMF, 8th wave. Unit of measurement: thousands of 2000's euros.

Unit labor costs. Unit labor costs in 2000 (and 1998) are computed as the ratio between total real labor costs and real production. Real production is computed following Parisi et al. (2006) as the sum of sales, capitalized costs and the change in work-in-progress and in finished goods inventories deflated with the appropriate 3-digit production price index provided by ISTAT. Unit labor costs in 1998 are used as an instrument for export status in 2000. Source: SIMF, 8th wave; 3-digit industry specific deflators from ISTAT. Unit of measurement: thousands of 2000's euros.

% R&D to introduce new products. It is the % of R&D borne by a firm in 1998-2000 to introduce new products. Source: SIMF, 8th wave.

R&D intensity on employment. It is the number of R&D employees over total firm employment in 2000. Source: SIMF, 8th wave.

Invested in ICT. It is a dummy variable that takes on value one if a firm invested in ICT during 1998-2000 and zero otherwise. Source: SIMF, 8th wave.

Variation in real capital stock. It is the amount of real firm's investments during 1998-2000. Nominal investments are deflated with the appropriate 3-digit production price index provided by ISTAT. Source: SIMF, 8th wave. Unit of measurement: hundred thousands of 2000's euros.

FDI flows. It is a dummy variable that takes on value one if a firm performed FDI investments during 1998-2000 and zero otherwise. Source: SIMF, 8th wave.

Bought patents abroad. It is a dummy variable that takes on value one if a firm bought patents abroad during 1998-2000 and zero otherwise. Source: SIMF, 8th wave.

Foreign ownership. It is a dummy variable that takes on value one if a firm is foreign owned in 1998-2000 and zero otherwise. Source: SIMF, 8th wave.

Border province. It is a dummy variable that takes on value one if a firm is located in a province bordering a foreign country and zero otherwise. Source: SIMF, 8th wave.

Decentralized management. It is the ratio between entrepreneurs, managers and cadres over total number of employees in 2000. Source: SIMF, 8th wave.

Return on investment. ROI index in 2000. Source: SIMF, 8th wave.

Real cost per worker. It is total labor cost divided by the number of employees (real average wages) in 2000. Nominal labor costs are deflated with the appropriate 3-digit production price index provided by ISTAT. Source: our computation on SIMF, 8th wave. Unit of measurement: thousands of 2000's euros.

Bank branches per 10,000 population. Bank branches per 10,000 population in 1997. Source: kindly provided by Alessandrini, Presbitero and Zazzaro (Alessandrini et al., 2008).

Banks' functional distance. It is the average distance between a bank's head quarter and local branches at province level in 1997. Source: kindly provided by Alessandrini, Presbitero and Zazzaro (Alessandrini et al., 2008). Unit of measurement: 100 Km.

R&D consortium. It is a dummy that takes on value one if a firm participated to an R&D consortium in 1998-2000 and zero otherwise. Source: SIMF, 8th wave.

Lagged product (process) innovation. It is a dummy variable that takes on value one if a firm introduced product (process) innovations during 1998-2000 and zero otherwise. Source: SIMF, 8th wave.

Process innovation. It is a dummy variable which takes on value one if a firm introduced process innovations during 2001-2003 and zero otherwise. Source: SIMF, 9th wave.

References

Adner, R., Levinthal, D., 2001. Demand heterogeneity and technology evolution: Implications for product and process innovation. Management Science 47 (5), 611–628.

Aghion, P., Howitt, P., 1998. Endogenous Growth Theory. MIT Press.

Alessandrini, P., Presbitero, A., Zazzaro, A., 2008. Banks, distances and firms' financing constraints. Review of Finance 13 (2), 261–307.

Angelini, P., Generale, A., 2008. On the evolution of firm size distribution. American Economic Review 98(1), 426–438.

Baldwin, R., Harrigan, J., 2007. Zeros, quality and space: Trade theory and trade evidence. NBER Working Paper No. 13214.

Basile, R., 2001. Export behaviour of Italian manufacturing firms over the nineties: The role of innovation. Research Policy 30 (8), 1185–1201.

Becheikh, N., Landry, R., Amara, N., 2006. Lessons from innovation empirical studies in the manufacturing sector: a systematic review of the literature from 1993-2003. Technovation 26 (5-6), 644–664.

Benfratello, L., Schiantarelli, F., Sembenelli, A., 2008. Banks and innovation: Microeconometric evidence on Italian firms. Journal of Financial Economics 90 (2), 197–217.

Bernard, A., Redding, S., Schott, P., 2010a. Multi-product firms and trade liberalization. Quartely Journal of Economics. Forthcoming.

Bernard, A., Redding, S., Schott, P., 2010b. Multiple-product firms and product switching. American Economic Review, 100(1), 70–97.

Bernard, A. B., Jensen, J. B., 2004. Why some firms export. Review of Economics and Statistics 86 (2), 561–569.

Breschi, S., Lissoni, F., Montobbio, F., 2005. The geography of knowledge spillovers:. In: Clusters, Networks and Innovation. Oxford University Press.

Bustos, P., 2011. Trade liberalization, exports and technology upgrading: Evidence on the impact of MERCOSUR on Argentinean Firms. American Economic Review, forthcoming.

Capitalia, December 2002. Ottavo rapporto sull'industria italiana e sulla politica industriale. Tech. rep., Capitalia, Rome.

Card, D., 1993. Using geographic variation in college proximity to estimate the return to schooling. NBER Working Papers n. 4483.

Castellani, D., Zanfei, A., 2007. Internationalisation, innovation and productivity: how do firms differ in Italy? The World Economy 30 (1), 156–176.

Costantini, J., Melitz, M., 2008. The dynamics of firm-level adjustment to trade liberalization. In: Helpman, E., Marin, D., Verdier, T. (Eds.), The Organization of Firms in a Global Economy. Harvard University Press, forthcoming.

Crespi, G., Criscuolo, C., Haskel, J., 2008. Productivity, exporting, and the learning-by-exporting hypothesis: direct evidence from UK firms. Canadian Journal of Economics 41 (2), 619–638.

Crinò, R., Epifani, P., 2009. Export intensity and productivity. Development Working Papers 271, Centro Studi Luca d'Agliano, University of Milano.

Crépon, B., Duguet, E., Mairesse, J., 1998. Research, innovation, and productivity: An econometric analysis at the firm level. National Bureau of Economic Research Working Paper 6696.

Currie, J., Moretti, E., 2003. Mother's education and the intergenerational transmission of human capital: Evidence from college openings. Quarterly Journal of Economics 118 (4), 1495–1532.

Damijan, J. P., Kostevc, C., Polanec, S., 2010. From innovation to exporting or vice versa? The World Economy 33 (3), 374–398.

Desmet, K., Parente, S., 2008. Bigger is better: Market size, demand elasticity and innovation. IMDEA, Working Paper No. 10. International Economic Review, forthcoming.

Di Comite, F., Thisse, J., Vandenbussche, H., 2011. Verti-zontal differentiation in monopolistic competition. unpublished.

Dinopoulos, E., 1988. A formalization of the 'biological' model of trade in similar products. Journal of International Economics 25, 95–110.

Disdier, A.-C., Head, K., 2008. The puzzling persistence of the distance effect on bilateral trade. Review of Economics and Statistics 90 (1), 37–41.

Fafchamps, M., El Hamineb, S., Zeufackc, A., 2008. Learning to export: Evidence from Moroccan manufacturing. Journal of African Economies 17 (2), 305–355.

Faini, R., Falzoni, A. M., Galeotti, M., Helg, R., Turrini, A., 1999. Importing jobs and exporting firms? On the wage and employment implications of Italian trade and foreign direct investment flows. Giornale degli Economisti 58 (1), 95–135.

Ferreira, F., Waldfogel, J., 2010. Pop internationalism: Has a half century of world music trade displaced local culture? NBER Working Paper No. 15964.

Friberg, R., Paterson, R. W., Richardson, A. D., 2010. Why is there an home bias? a case study of wine. CEPR Discussion Papers 7885.

Friedman, J., Gerlowski, D., Silberman, J., 1992. What attracts foreign multinational corporations. Journal of Regional Science 32 (4), 403–418.

Goldberg, P. K., Verboven, F., 2005. Market integration and convergence to the law of one price: Evidence from the european car market. Journal of International Economics 65, 49–73.

Gorodnichenko, Y., Svejnar, J., Terrell, K., ., 2010. Globalization and innovation in emerging markets. American Economic Journal: Macroeconomics 2 (2), 194–226.

Greenaway, D., Kneller, R., 2007. Industry differences in the effect of export market entry: Learning by exporting? Review of World Economics 143 (3), 416–432.

Grossman, G., Helpman, E., 2005. Outsourcing in a global economy. The Review of Economic Studies 72(1), 135–159.

Grossman, G. M., Helpman, E., 1991. Innovation and Growth in the Global Economy. MIT Press.

Hahn, J., Hausman, J., 2002. Notes on bias in estimators for simultaneous equation models. Economics Letters 75 (2), 238–241.

Hall, B., Lotti, F., Mairesse, J., 2008. Employment, innovation, and productivity: evidence from Italian microdata. Industrial and Corporate Change 17 (4), 813–839.

Hallak, J., Sivadasan, J., 2009. Firms' exporting behavior under quality constraints. NBER Working Papers 14928.

Harris, C., 1954. The market as a factor in the localization of industry in the United States. Annals of the Association of American Geographers 44 (4), 315–348.

Iacovone, L., Javorcik, B., 2010. Shipping the good tequila out. investment, domestic unit values and entry of multi-product plants into export markets. Unpublished.

Jovanovic, B., Rob, R., 1987. Demand-driven innovation and spatial competition over time. Review of Economic Studies 54 (1), 63–72.

Keller, W., 2004. International technology diffusion. Journal of Economic Literature 42 (3), 752–782.

Kneller, R., Yu, Z., 2008. Quality selection, chinese exports and theories of heterogeneous firms trade. Discussion Papers, University of Nottingham, GEP 08/44.

Lachenmaier, S., Woessmann, L., April 2006. Does innovation cause exports? Evidence from exogenous innovation impulses and obstacles using German micro data. Oxford Economic Papers 58 (2), 317–350.

Leamer, E. E., Levinsohn, J., 1995. International trade theory: The evidence. In: Grossman, G. M., Rogo, K. (Eds.), The Handbook of International Economics. Vol. III. Elsevier, pp. 1339–1394.

Lileeva, A., Trefler, D., 2010. Improved access to foreign markets raises plant-level productivity... for some plants. The Quarterly Journal of Economics 125 (3), 1051–1099.

Liu, X., Buck, T., 2007. Innovation performance and channels for international technology spillovers: Evidence from Chinese high-tech industries. Research Policy 36 (3), 355–366.

Malerba, F., Nelson, R., Orsenigo, L., Winter, S., 2007. Demand, innovation and the dynamics of market structure: The role of experimental users and diverse preferences. Journal of Evolutionary Economics 17 (4), 371–399.

Melitz, M., 2003. The impact of trade in intra-industry reallocations and aggregate industry productivity. Econometrica 71 (6), 1695–1725.

Michelacci, C., Silva, O., 2007. Why so many local entrepreneurs? Review of Economics and Statistics 89 (4), 615–633.

Moretti, E., 2004. Workers' education, spillovers, and productivity: Evidence from plant-level production functions. American Economic Review 94 (3), 656–690.

Myers, S., Marquis, D. G., 1969. Successful Industrial Innovations. National Science Foundation 69-17., U.S. Government Printing Office, Washington D.C.

Nese, A., O'Higgins, N., 2007. Attrition bias in the Capitalia panel. International Review of Economics 54 (3), 383–403.

OECD, 1997. Proposed guidelines for collecting and interpreting technological innovation data: Oslo manual. OECD.

Parisi, M. L., Schiantarelli, F., Sembenelli, A., 2006. Productivity, innovation and R&D: Micro evidence from Italy. European Economic Review 50 (8), 2037–2061.

Puga, D., Trefler, D., 2010. Wake up and smell the ginseng: International trade and the rise of incremental innovation in low-wage countries. Journal of development economics 91(1), 64–76.

Rauch, J., 1996. Trade and search: Social capital, sogo shosha, and spillovers. NBER Working Paper No. 5618.

Rauch, J., Trinidade, V., 2003. Information, international substitutability and globalization. American Economic Review 93(3), 775–791.

Rauch, J., Watson, J., 2003. Starting small in an unfamiliar environment. International Journal of Industrial Organization 21 (7), 1021–1042.

Salomon, R. M., Shaver, J. M., 2005. Learning by exporting: new insights from examining firm innovation. Journal of Economics & Management Strategy 14 (2), 431–460.

Santarelli, E., Sterlacchini, A., 1990. Innovation, formal vs. informal R&D, and firm size: Some evidence from Italian manufacturing firms. Small Business Economics 2 (3), 223–228.

Schmookler, J., 1966. Invention and economic growth. Harvard University Press, Cambridge, M. A.

Stock, J. H., Yogo, M., 2005. Testing for weak instruments in linear IV regression. In: Andrews, D., Stock, J. H. (Eds.), Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg. Cambridge University Press, pp. 80–108.

Sutton, J., 1998. Technology and market structure: Theory and history. MIT Press, Cambridge M.A.

Van Beveren, I., Vandenbussche, H., 2010. Product and process innovation and firms decision to export. Journal of Economic Policy Reform 13 (1), 3–24.

Vella, F., Verbeek, M., 1999. Estimating and interpreting models with endogenous treatment effects. Journal of Business & Economic Statistics 17 (4), 473–478.

Verhoogen, E., 2008. Trade, quality upgrading and wage inequality in the mexican manufacturing sector. Quarterly Journal of Economics 123(2), 489–530.

Vernon, R., 1966. International investment and international trade in product cycle. Quarterly Journal of Economics 80 (2), 190–207.

Wagner, J., 2007. Exports and productivity: A survey of the evidence from firm-level data. The World Economy 30(1), 60–82.