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Dissecting the impact of innovation on exporting in Turkey

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Does innovating promote firms' export probability? By separately modelling – theoretically as well as empirically – the impact of process and product innovation, we show that the joint adoption of both innovation strategies fosters Turkish firms' first time export entry in rich destination markets. Nevertheless, innovation strengthens firms' export probability. As predicted by our theoretical sketch, product innovation matters in particular for exporting to developing economies, while process innovation reinforces the role of product innovation for exporting to richer markets.

Keywords: export; cost saving; quality upgrading; product innovation; process innovation; Turkey

JEL Classification: O31; D22; F10; F14

1. Introduction

The mechanisms behind firm competitiveness and international success have always drawn the attention of a large part of economics and business literature. In this respect, innovation can constitute one of the main channels fuelling a firm's entry in foreign markets. On the one hand, the development of new products, better tailored for customers' preferences in the destination market, can ease a firm's access to this market. On the other hand, the introduction of new production processes may importantly reduce operational costs and improve a firm's ability to face export sunk costs and cross the national borders.

Understanding returns to innovation in terms of a firm's activity in foreign markets becomes particularly relevant from an emerging economy perspective. Innovation, indeed, is particularly costly for developing countries, due to their limited human capital and technology endowment. However, for these economies the export market represents an unprecedented opportunity, as it favours the exploitation of scale economies, technology transfers and new learning possibilities. As a consequence, it is fundamental to ascertain whether the innovative effort undertaken by firms is fruitful in promoting their presence abroad. We contribute to this topic by dissecting the role of product and process innovation and of their joint effect on manufacturing firms' export probability in Turkey. Our work is, therefore, aimed at giving new insights for policy interventions to sustain economic growth, especially in developing countries.

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Previous evidence on the export–innovation nexus is mainly focused on developed economies and has in general shown a positive causal impact of innovation on exporting. Recently, widespread evidence on the existence of important productivity differences between exporters and non-exporters in the period preceding foreign market entry (Wagner 2007) has stimulated a growing stream of literature aimed at analysing the sources of such disparity. Some papers, therefore, have rethought the relationship between a firm's innovation efforts and its export performance and have tested the hypothesis that product innovation has both a direct and mediate – through productivity – effect on exporting (Cassiman, Golovko, and Martínez-Ros 2010; Cassiman and Golovko 2011). Caldera (2010) reverses this view and, building on Bustos (2011), models more productive firms as self-selecting into innovation and innovators as being more likely to become exporters, due to the marginal cost reduction effect of innovation. Her empirical findings confirm once again the important role of innovation for the Spanish firm export probability.

The literature so far has rather neglected the different impacts of product and process innovation strategies. The only noticeable exceptions are Van Beveren and Vandenbussche (2010) for Belgian economy and Becker and Egger (2009) for Germany. Whereas the former study finds no effect of either innovation strategy on firm export activity when instrumental variables are used, the latter finds that innovation has a causal impact on the firm export status and that the distinction between process and product innovation is rather important, as it shows the dominant role of product with respect to process innovation, which only matters when adopted in conjunction with product innovation.

Within this framework, our theoretical view of the nexus between innovation and exporting is similar to Caldera's (2010), as we model more productive firms self-selecting into innovation and, in turn, enhancing the export probability. Our empirical approach, instead, is similar to the one undertaken by Becker and Egger (2009): within a Multiple Propensity Score Matching (MPSM) framework, we treat process and product innovation as two different strategies that, when adopted alone or in conjunction, may have different effects on the firm's export probability. However, our analysis presents several original contributions. First, building on the evidence on heterogeneous determinants and impact of the two innovation strategies, differently from Caldera (2010), we model product and process innovation as affecting the firm's profitability through two different channels. Whereas product innovation positively affects the firm's product quality, process innovation negatively affects its marginal costs. Our modelling strategy permits to highlight the reason why the two innovation activities are often undertaken together and constitutes the theoretical motivation for our empirical approach. Second, our focus is on an emergent country. It is interesting to investigate whether the importance of a firm's innovative efforts for success in the export market is different in this context, compared to that of a developed country. Whereas the notion of process innovation is rather similar in the two settings, a large fraction of newly introduced products in a developing economy consists of already existing products in the market that are new only to the firm, and that, therefore, emerge from imitation. In this respect, it is fundamental to assess the relevance of this type of innovations in terms of returns from export activity and to compare the findings to the existing evidence on developed economies. Third, we analyse the role of innovation for first time entry and for survival in the foreign market. Fourth, differently from Becker and Egger (2009), we split the firm's export status, i.e. our outcome of interest, according to the income level of the destination market in order to test whether entry in markets with different preferences for quality (Hallak 2006, 2010) and different average production costs is related to the adoption of distinct innovation strategies. Fifth, from the bulk of firm exports we neglect the so-called Carry-Along Trade (CAT) activity and focus on the manufacturing firm's exports of its own products (Bernard et al. 2012). This choice follows the need to isolate the innovation effect on the firm's ability to sell its own products abroad, as innovation deeply affects the firm's production technology. Finally, to the best of our knowledge, it is the first time that Turkish data are used to test the causal impact of innovation on exporting. The Turkish case can be considered an interesting one, as in the last two decades, especially, the country's central government has activated support programmes to enhance international competitiveness of domestic industrial companies by means of higher R&D and innovation expenditures (Grabowski et al. 2013). While recent evidence shows that such actions were actually effective in stimulating firms' innovation activities (Grabowski et al. 2013), an analysis of the direct impact of the latter on firms' international competitiveness is still missing. We contribute to fill this gap by hinging on an original data-set never used before for the investigation of this topic.

The work is structured as follows: the next section introduces the relevant literature; Section 3 presents our theoretical framework; Section 4 introduces the data sources and some evidence on product and process innovation for Turkish manufacturing; Section 5 presents the empirical strategy; Section 6 shows the main results from our analysis and Section 7 concludes.

2. Review of the literature

Far from being an exhaustive survey of the literature on the linkages between innovation and trade, this section aims at reviewing extant empirical work, which is the closest possible to our specific research question and empirical exercise on the relationship between exporting and innovation at the firm level.

The theoretical linkage between innovation and exporting points to a two-way causality direction. Better firms – larger, more productive, more human capital endowed – are, indeed, likely to self-select into exporting and innovation.

In addition, firms' choices on engagement in export and innovation activities are rather interrelated and each of the two activities affects returns from the other (Aw, Roberts, and Xu 2008, 2011; Atkeson and Burstein 2010; Melitz and Burstein 2013). Therefore, the wide and burgeoning empirical literature on export and innovation has investigated both causality directions. As a matter of fact, several works have investigated the impact of export entry on innovation, and in particular product innovation. Salomon and Shaver (2005) for Spain, Bratti and Felice (2012) for Italy, Hahn and Park (2011) for Korea and Lo Turco and Maggioni (2014) for Turkey, all find evidence of a positive effect of exporting on new product introduction at the firm level. Lin and Lin (2010) for Taiwan enlarge the scope to the analysis of the impact of imports and inward and outward foreign direct investments (FDI) and find a positive effect of both trade and FDI on innovation. On the contrary, Damijan, Kostevc, and Polanec (2010) for the Slovenian case find no significant effect on product innovation from export entry, while it spurs medium and large firms to introduce process innovations. They also find no evidence on the opposite nexus, from innovation to exporting. The latter, indeed, is what we aim at exploring in this paper by answering the following questions: (a) Has a firm's innovation activity an impact on its export probability? (b) Does a firm's involvement in only process, only product, or both innovation activities contribute differently to determine a firm's export probability? and (c) Does the effectiveness of each innovation strategy differ according to the destination market income level?

Concerning these issues, literature has investigated the impact on exports of both input – R&D spending – and output – process and product innovation – measures and, recently, has been rather affected by Melitz's (2003) contribution on firm heterogeneity in trade models.

On the one hand, before Melitz's (2003) work, several empirical analyses showed a positive direct relationship between product innovation and exporting. This evidence is supported by Kumar and Siddharthan (1994) for Indian firms belonging to low and medium-technology sectors and by Basile (2001) for Italian manufacturing firms. Sterlacchini (1999), also on Italian data, shows that innovating helps the export performance of small firms in non-R&D intensive sectors only, after their entry. From a comparison of UK and German firms in the 1991–1994 period, Roper and Love (2002) find that product innovation is positively related both to export probability and intensity.[1] However, in the case of Germany, the scale of plants' innovation activities has a slight negative effect on export probability.

On the other hand, widespread evidence on the existence of important productivity differences between exporters and non-exporters in the period preceding foreign market entry (Wagner 2007) has stimulated a growing stream of literature aimed at analysing the sources of such disparity. Some papers, therefore, are rethinking the relationship between a firm's innovation efforts and its export performance. In this line, Cassiman and Golovko (2011) for Spain, tested and verified the hypothesis that product innovation has both a direct and mediate – through productivity – effect on exporting.[2] In addition, Halpern and Muraközy (2012), for Hungarian firms, show that innovators enjoy positive productivity returns from innovation, export a larger share of their output and serve a higher number of destination markets. These findings are in line with the evidence on French firms recently provided by Elliot, Jabbour, and Vanino (2014). For the period 1999–2007, they explore the impact of innovation on the extensive and intensive margins of trade and they find a positive effect of product innovation on export product quality and the number of destinations served by exporters, besides a positive causal effect of both R&D spending and product innovation on firms' export probability and export value.

Caldera (2010) reverses the view that innovation affects firms' export entry through productivity improvements and, building on Bustos (2011), models of more productive firms as self-selecting into innovation and innovators as being more likely to become exporters, due to the marginal cost reduction effect of innovation. Her empirical model tests both R&D activity dummy and expenses and product and process innovation dummies and confirms that product innovation has a positive role on the export performance of Spanish firms. However, she also finds a positive, though less important, role for process innovation even if the author never tests the two innovation measures in the same specification. The process of self-selection into innovation, in a way, is confirmed by Van Beveren and Vandenbussche (2010) even if they interpret this self-selection as aimed at successful export. The authors use Belgian data on the period 1998–2004, and after carefully accounting for simultaneity, reverse causality and anticipation effect (Constantini and Melitz 2008) find no role for innovation (both innovation input and output) on the first time entry in the export market. In the same line, Lachenmaier and Wössmann (2006) use the 2002 IFO innovation survey and instrument innovation by means of the obstacles and impulses reported by the firm to test the impact of innovation (either product or process) on the export share and they find that being innovative causes firms to have substantially larger export shares than non-innovative firms in the same sector.[3] On the matching of the IFO business and innovation surveys for the period 1994–2004, Becker and Egger (2009) test the impact of the adoption of product and process innovation in a multiple treatment approach; they highlight the dominant importance of the former compared to the latter, which only matters when adopted in conjunction with product innovation.

In conclusion, there is scant literature dissecting the differential and joint impact of product and process innovation strategies, though, Van Beveren and Vandenbussche (2010) and Becker and Egger (2009) are the only noticeable exceptions. In addition, most of the previously reviewed evidence concerns advanced economies and, to the best of our knowledge, the only recent empirical analysis that estimates the causal impact of innovation on firms' export probability in a developing country setting is the work by Nguyen et al. (2008) who find positive effects of product, process innovation and product improvements on the export probability of small and medium Vietnamese enterprises.

None of the previous studies, however, explores the differential effectiveness of product and process innovation in penetrating destinations with different levels of income and, as a consequence, with a different set of preferences. In this paper, we, therefore, contribute to the extant literature by dissecting the impact of product and process innovation on exporting in the rapidly emerging Turkish economy and by highlighting the differential impact of the two strategies on firm probability to export to high- and low-income economies.

3. Theoretical framework

To model the impact of innovation on the export probability of Turkish firms, we rely on a simple theoretical framework which adapts the one in Bustos (2011), also extended by Caldera (2010). However, we depart from them in a number of ways in modelling both the demand and supply. First, we separately model process and product innovation and their joint adoption. Second, while Bustos (2011) explores the endogenous firm choice of technology that follows trade liberalization, we aim at modelling the impact of adopting an innovation on the firm's export probability. In this respect, here we offer a partial equilibrium approach, so we will abstract from dealing with industry dynamics and will assume industry characteristics as fixed and unchanged with respect to the choice of the single firm.

As in Caldera (2010), we start by showing that more productive firms engage in innovation and, from this, we demonstrate that innovators are more likely to export.

However, our main contribution relies on the different channels we exploit for product and process innovation, which allow for a richer pattern of possibilities in the relationship between innovation and exporting. In a standard monopolistic competition framework (Dixit and Stiglitz 1977; Melitz 2003), our main novelty is to model product and process innovation as two separate strategies, which may also be adopted in conjunction. This, indeed, is also the starting point of our empirical strategy that motivates the adoption of an MPSM framework. In our view, both product and process innovation positively affect variable profits in the face of an additional fixed cost to sustain the adoption of the innovation strategy. However, whereas process innovation positively affects variable profits through the reduction in the marginal production cost, the introduction of a new product – especially for firms willing to enter high-income markets – may consist in a higher quality variety, thus bringing higher revenues.[4]

This framework shows, in line with Caldera (2010), that larger and more productive firms are more likely to innovate and that innovators are more likely to export. Also, by distinguishing between the two different channels through which innovation affects profits, we will prove that among innovators, those firms undertaking both product and process innovators are more likely to export, compared to *one-way* innovators.

3.1. Demand

To model the impact of innovation on the firm's export behaviour, we take as a hypothesis that consumer's preferences can be represented by a constant elasticity of substitution utility function over different varieties ω of good X which, as in the quality ladder model by Grossman and Helpman (1991, 1993) differ in their quality content q. The representative consumer has income M and, given prices maximizes utility:

$$U = \left[\int_{\omega \in \Omega} [q(\omega)x(\omega)]^{\rho} d\omega \right]^{1/\rho}. \tag{1}$$

From the equation, the elasticity of substitution among varieties is $\sigma = 1/(1-\rho)$ and the demand for the generic variety ω_j is

$$x(\omega_j) = \frac{P_{\omega_j}^{-\sigma}}{P^{1-\sigma}} M. \tag{2}$$

With $P_{\omega_j} = \widetilde{p_{\omega j}}/q_{\omega j}$ denoting the quality adjusted price of variety ω_j, $\tilde{p}$ denoting the unadjusted price and P denoting the aggregate price index.

3.2. Supply

Moving to the supply side of this simple theoretical sketch, we follow Bustos (2011) and the adaptation provided by Caldera (2010) in order to model the impact of innovation on the firm's export status. However, we depart from them in that we separately model process and product innovation and their joint adoption.

As in Melitz (2003), we assume that firms differ in their productivity level, ϕ_i, whereas they share the same unit variable cost labelled as c. The manufacturing industry operates in monopolistic competition so that for all varieties the pricing strategy can be resumed by means of a mark-up, $\sigma/(\sigma-1)$, over the marginal cost, which, then, is assumed to be c/ϕ_i.

To enter the manufacturing industry, a firm pays a fixed entry cost and draws its productivity from a cumulative distribution function. After observing its productivity, a firm decides whether to exit or to stay and produce. In the latter case, according to its productivity level the firm may:

- Produce by means of the standard technology, which requires a fixed production cost, f, and grants revenues

$$r_0(\phi) = \left[\frac{\sigma - 1}{\sigma} \frac{\phi q(\omega)}{c} P \right]^{\sigma - 1} M \tag{3}$$

  and profits:

$$\Pi_0(\phi) = \frac{r_0(\phi)}{\sigma} - f. \tag{4}$$

- Introduce a process innovation, which requires an additional fixed cost f_{Pc}, reduces the variable unit cost to $c_{Pc} < c$ and grants revenues

$$r_{Pc}(\phi) = \left[\frac{\sigma - 1}{\sigma} \frac{\phi q(\omega)}{c_{Pc}} P \right]^{\sigma - 1} M \tag{5}$$

  and profits:

$$\Pi_{Pc}(\phi) = \frac{r_{Pc}(\phi)}{\sigma} - f - f_{Pc}. \tag{6}$$

- Introduce a product innovation, thus switching to the production of a better quality variety, which requires an additional fixed cost f_{Pd} and grants revenues

$$r_{Pd}(\phi) = \left[\frac{\sigma - 1}{\sigma} \frac{(\phi q_{Pd}(\omega))}{c} P\right]^{\sigma-1} M \quad \text{with } q_{Pd}(\omega) > q(\omega) \tag{7}$$

and profits:

$$\Pi_{Pd}(\phi) = \frac{r_{Pd}(\phi)}{\sigma} - f - f_{Pd}. \tag{8}$$

- Introduce both a process and product innovation which, under the simplifying assumption that the new variable cost is the same as under process innovation only, grants revenues

$$r_{PdPc}(\phi) = \left[\frac{\sigma - 1}{\sigma} \frac{(\phi q_{Pd}(\omega))}{c_{Pc}} P\right]^{\sigma-1} M \quad \text{with } q_{Pd}(\omega) > q(\omega) \tag{9}$$

and profits

$$\Pi_{PdPc}(\phi) = \frac{r_{PdPc}(\phi)}{\sigma} - f - \lambda(f_{Pd} + f_{Pc}) \quad \text{with } 0 < \lambda \leq 1. \tag{10}$$

The assumption on λ derives from the possible existence of a strong complementarity between process and product innovation (Van Beveren and Vandenbussche 2010), and this is partially supported by our data which show that the majority of innovators (61%) are actually involved in both activities.[5]

The innovation decision – The firm, then, decides to introduce a process innovation if:

$$\left(\frac{1}{c_{Pc}^{\sigma-1}} - \frac{1}{c^{\sigma-1}}\right)\left[\frac{\sigma - 1}{\sigma}\phi q(\omega) P\right]^{\sigma-1} M > f_{Pc}. \tag{11}$$

A product innovation if:

$$[q_{Pd}(\omega)^{\sigma-1} - q(\omega)^{\sigma-1}]\left[\frac{\sigma - 1}{\sigma}\frac{\phi}{c} P\right]^{\sigma-1} M > f_{Pd}. \tag{12}$$

And both a product and a process innovation if:

$$\left(\frac{q_{Pd}(\omega)}{c_{Pc}}\right)^{\sigma-1} - \left(\frac{q(\omega)}{c}\right)^{\sigma-1}\left[\frac{\sigma - 1}{\sigma}\phi P\right]^{\sigma-1} M > \lambda(f_{Pd} + f_{Pc}). \tag{13}$$

The probability to engage in product innovation is, thus, driven by quality upgrading, whereas the probability to engage in process innovation is driven by cost saving. In any case, a higher productivity level delivers a higher probability to engage in innovation (Caldera 2010). Given all this framework, an interesting point, that follows from our assumption on the different operational channels of process and product innovation, is that, under the hypothesis of strong complementarity between the two types of innovation (λ sufficiently less than 1), it is in general more likely that firms undertake them both as the lower marginal cost and the higher quality deliver variable profits higher than in the single innovation strategy case, whereas the fixed cost of innovation is less than the summation of the two innovation fixed costs.[6]

The export decision – Now, after the description of the innovation choice, we may turn to the export decision. We make the usual assumption that entry in the export market is costly due to the presence of a fixed export entry cost, f_{exp},[7] and a variable iceberg transport cost $\tau > 1$. The decision to export or not will be made by comparing profits after the entry to profits in the domestic market and a firm will export if $\pi^* + \pi > \pi$ where superscript * indicates the variable corresponding to the foreign market.

A non-innovator will export if:

$$\frac{\tau^{(1-\sigma^*)}}{\sigma^*} r_0^*(\phi) > f_{\text{exp}}. \tag{14}$$

Firms introducing process innovation will export if:

$$\frac{\tau^{(1-\sigma^*)}}{\sigma^*} r_{Pc}^*(\phi) > f_{\text{exp}}. \tag{15}$$

Firms introducing product innovation will export if:

$$\frac{\tau^{(1-\sigma^*)}}{\sigma^*} r_{Pd}^*(\phi) > f_{\text{exp}}. \tag{16}$$

Finally, firms introducing process and product innovation will export if:

$$\frac{\tau^{(1-\sigma^*)}}{\sigma^*} r_{PdPc}^*(\phi) > f_{\text{exp}}. \tag{17}$$

With r^* representing revenues in the foreign market which depend on foreign income, M^*, and on the foreign aggregate price index, P^*. $\sigma^* \geq \sigma$, instead, represents the demand elasticity in the foreign market, which is assumed to be higher than the domestic one under the hypothesis of tougher competition abroad than in the domestic market (Caldera 2010).

Comparing innovators and non-innovators, it is straightforward to see that innovators are more likely to export, and it is more so for two-way innovators. As a matter of fact, the differences between Equations (17) and (16) and between Equations (17) and (15) rest on the disparity of variable profits under alternative innovation strategies and they always end up being greater than zero. On the contrary, it is not easy to say whether only product or only process innovation prevail when they are adopted in isolation, even if they both enhance a firm's export probability.

From the model, the difference between Equations (16) and (15) is lower, equal or higher than zero when $q_{Pd}(\phi)/q(\phi)$ is lower, equal or higher than c/c_{Pc}. In other words, when the relative quality improvement is higher than the cost advantage from innovation, the firm's export probability will be enhanced more by product than by process innovation. Furthermore, if we assume proportionality between home and foreign markets in relative quality and marginal cost and define average foreign quality as $q^* = q(\phi)/\delta$ and foreign marginal cost as $c^* = \delta c$, with $\delta > 0$, product innovation is, then, superior to process innovation when

$$\frac{q_{Pd}(\phi)}{q^*} - \frac{c^*}{c_{Pc}} > 0 \tag{18}$$

and this difference increases as either q^* or c^* declines.

This means that product innovation is more profitable than process innovation when export destinations display lower average quality and lower marginal production cost.

On the contrary, it is relatively less rewarding when exporting to destinations which are characterized by higher marginal costs and product quality.

Differences across markets in technology and quality of produced and/or traded goods are typically captured by disparities in their income levels. Lower income levels are associated with lower preference for quality and a lower share of high-quality goods in consumption (Hallak 2006; Crinò and Epifani 2012). In addition, exporters vary the quality of their products across destinations[8] by using inputs of different quality levels (Manova and Zhang 2012). It follows that exporters in low-income markets all benefit from similar cost advantages compared to local producers. As a consequence, we interpret condition 18 as product innovation being more rewarding than process innovation when exporting to developing partners which are characterized by lower quality and lower production costs, while process innovation as being more relevant when entering developed markets.

Resting on this theoretical model, we aim at testing the following hypothesis:

Hypothesis 1: Innovation positively affects the firm's export probability.

Hypothesis 2: Returns from each innovation activity may be heterogeneous, with *two-way* innovation dominating the *single* innovation strategies.

Hypothesis 3: Returns from each innovation activity may be different according to the destination market income level: by comparing innovation strategies, we expect the contribution of product innovation to be more relevant for exporting to low-income destinations and the contribution of process innovation to be greater for exporting to high-income countries.

4. The data

4.1. The data sources

In order to test the hypothesis highlighted in the theoretical sketch, we exploit different data sources provided by TurkStat, which are listed and described as follows.

The Community Innovation Survey (CIS) 2008 – We use the 2008 wave[9] of the CIS which gives information on firms' innovation activity and allows for the distinction between process and product innovation. These variables, that will represent the treatments in our empirical framework, refer to a three-year period: the survey asks firms about the introduction of new processes and new products during the period 2006–2008. Consequently, when a firm declares to have innovated in that period we cannot determine whether the firm was engaged in a persistent activity or whether the firm only innovated in one year and, if this is the case, we are unable to identify it.[10] Due to this data structure, we are forced to consider the innovation action occurring in the 2006–2008 time span as occurring in a unique period. Thus, in the rest of the paper we label t^o the treatment period which corresponds to the time frame starting in 2006 and ending in 2008 and the reference year for this period is the last year in the span, i.e. $t = 2008$. Figure 1 shows our sample time line. The data include all firms with more than 250 employees and a sample of firms with between 10 and 250 employees and cover both service and manufacturing firms. Our focus is on manufacturing firms only.

The Structural Business Statistics (*SBS*) – The Annual Industry and Service Statistics collect information on firms' revenues, input costs, employment, investment activity and the primary four-digit NACE (rev 1.1) sector of activity over the period 2003–2008. These data cover the whole population of firms with more than 20 employees and a representative sample of firms with less than 20 employees. Economic activities that are included in the survey are the ones in the NACE sections from C to K and from M to O.

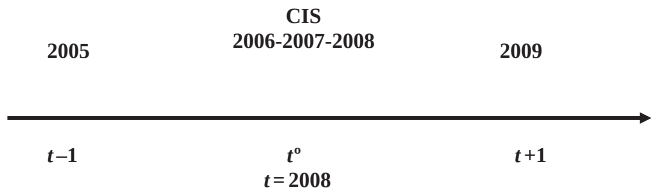

Figure 1. Time line.

The Annual Industrial Product Statistics (AIPS) – The TurkStat AIPS contain information on the type and number of produced goods, their volume and value of production together with the total quantity and value of total sales from goods produced within the reference year or preceding years. Product data are available for the years 2005–2009 and are collected at 10-digit PRODTR level,[11] a national product classification with the first eight digits corresponding to PRODCOM classification. The production data are available for firms employing more than 20 persons and whose primary or secondary activity is in either C (Mining & Quarrying) or D section (Manufacturing) of NACE Rev 1.1.

The Foreign Trade Statistics (FTS) – Foreign trade flows at the firm level are sourced from customs declarations and are available for the 2002–2009 time span. The import and export flows are collected for the universe of importers and exporters of goods at 12-digit Gümrük Tarife Istatistik Pozisyonu (GTIP) classification: the first eight digits correspond to Combined Nomenclature classification, and the last four digits are national. Furthermore, information on the origin/destination countries of trade flows is available. It is worth noticing that the recorded flows concern all trading and produced goods a manufacturing firm sells abroad. For this reason, we exploited firm-level production data, described just below, in order to discern produced exports from the bulk of firms' exports, thus discarding those flows of goods the firms just trade without any involvement in the production process. We made use of a correspondence between the codes of produced goods and those of trade flows at a high level of disaggregation, thus connecting 10-digit PRODTR production codes with 12-digit GTIP trade ones.[12] Since the matching between production and trade data may be problematic due to some potential mistakes in the attribution of good codes to each trade and production flow, we also adopted a more aggregated correspondence table.[13] Some recent firm-level evidence for other countries seems to confirm that a large share of exports recorded by firms – also when the focus is just on manufacturing firms – concerns goods that are simply traded and not produced (Bernard, van Beveren, and Vandenbussche 2011; Bernard et al. 2012). The distinction between one's own produced goods and traded ones is important from a conceptual point of view in our study since we expect innovation to have a direct impact, if significant, on the ability of firms to penetrate foreign markets with their own products. Both product and process innovation affect the firms' production activity: the former drives the firm to introduce improved goods, or different varieties that foreign consumers may appreciate and would like to purchase, while the latter may help the firm to reduce production costs. Thus, both types of innovation may stimulate and ease the export of produced goods. There is no a direct link, instead, between a firm's innovative efforts and the selling activity of traded goods. As a consequence, our main focus will be on the export activity of a firm's own products.

4.2. The sample and the descriptive evidence

The 2008 wave of the CIS is composed of 2822 manufacturing firms.[14] When we keep in the data-set only those firms for which we have information from SBS and AIPS data-set we are left with 1569 firms that represent our final sample. This sample is biased towards medium and large firms. The median size – in terms of number of employees – is 159. In our view, this bias does not represent a serious concern since only a low number of small firms is engaged in innovation and export activity, which are the two phenomena investigated in this paper. However, it would be interesting to investigate the effects of innovative efforts made by very small firms, when suitable data become available.

Table 1 gives an overview of the diffusion of innovation practices across Turkish manufacturing firms. As above, in the rest of the paper we will label *Pd* the product innovation and *Pc* the process one. About 40% of firms in our sample are engaged in some innovative activities, and most of them are introducing both new/improved products and new production processes. It is worth stressing that a large part – about 40% – of product innovators in the 2008 CIS introduces products that are only new to the firm. Even if the introduction of radical innovations and brand new products has important consequences for the country's economy, the diffusion of innovation also plays a crucial role, especially in an emergent context. Imitation is, indeed, a relevant driver for productivity enhancement and economic growth. On the one hand, imitation requires the development of suitable capabilities and skills useful to absorb the technology and know-how to reproduce the new processes and products, and this boosts the efficiency of the local production structure. On the other hand, benefits from innovation are not confined to its introduction, but importantly rest on its diffusion across actors and over space. This point is somehow related to the recent evidence supporting the prominent role of incremental innovations, compared to path-breaking ones, for the country's growth (Puga and Trefler 2010).

Table 1. Share of innovators by type (%) – 2008 CIS wave.

Type of Innovators	*Pd*	*Pc*	Both *Pd* & *Pd*	Only *Pd*	Only *Pc*
Share (%)	39.32	36.84	28.87	10.45	7.97

Source: Own calculations on the sample obtained by merging Turkstat CIS, SBS, FTS and AIPS.
Notes: *Pd* and *Pc* denote the product innovators and process innovators, respectively. The shares refer to 2006–2008 three-year period.

Table 2 presents the superiority of innovators compared to non-innovators in a number of firm characteristics. More specifically, both product and process innovators are larger, more productive, more involved in both export and import markets, pay higher wages, are more likely to subcontract part of their production, but less likely to be subcontractors compared to non-innovative firms. When we go into detail, by classifying firms into four mutually exclusive groups – including both product & process innovators, only process innovators, only product innovators and non-innovators – firms involved in both kinds of innovation activities appear to dominate firms undertaking just one innovation activity, while product innovators, in general, appear to dominate process ones.

By combining information about the innovation activities and data on the firm's export involvement in Table 3 some interesting insights emerge. It is clear that firms engaged in some kind of innovative efforts are generally more likely to penetrate foreign markets with their own products. There is not a great difference in the advantage that product and process innovators enjoy compared to the population of non-process innovators and non-product innovators, respectively. However, when we focus on mutually exclusive firm groups it turns out that the introduction of new products seems to be a more rewarding strategy in terms of firm success in the international arena. The production of improved and/or

Table 2. Descriptive statistics by firm innovation status – 2008 CIS wave.

	l	*lp*	*w*	Imp_{Lic}	Imp_{Hic}	*EmpRD*	*multi*	Exp^T_{Hic}	Exp^T_{Lic}	*subcont*	*outs*
						Allfirms					
Mean	5.03	9.65	9.15	0.61	0.80	0.79	0.36	0.67	0.58	0.10	0.65
Median	4.92	9.59	8.95	1	1	0	0	1	1	0	1
Min	2.77	4.44	6.88	0	0	0	0	0	0	0	0
Max	8.97	13.00	11.73	1	1	34.38	1	1	1	1	1
Sd	1.23	0.92	0.61	0.49	0.40	2.64	0.48	0.47	0.49	0.30	0.48
						ByPd					
Non-*Pd*	4.90	9.52	9.07	0.56	0.76	0.43	0.34	0.63	0.52	0.11	0.60
Pd	5.23	9.84	9.28	0.68	0.85	1.33	0.40	0.73	0.68	0.08	0.73
T-test	−5.16	−6.69	−7.00	−5.05	−4.49	−6.68	−2.26	−4.07	−6.39	2.01	−5.23
						ByPc					
Non-*Pc*	4.92	9.52	9.07	0.57	0.77	0.51	0.35	0.65	0.54	0.11	0.60
Pc	5.23	9.87	9.30	0.66	0.84	1.25	0.39	0.72	0.66	0.08	0.73
T-test	−4.89	−7.32	−7.63	−3.55	−3.37	−5.40	−1.66	−3.02	−4.80	1.89	−5.23
						By innovation status					
Non-innovator	4.88	9.50	9.04	0.56	0.76	0.41	0.35	0.63	0.52	0.11	0.60
Only *Pc*	5.09	9.69	9.26	0.50	0.75	0.62	0.30	0.63	0.52	0.11	0.62
Only *Pd*	5.12	9.63	9.19	0.62	0.82	1.07	0.35	0.70	0.63	0.10	0.63
Both *Pc* & *Pd*	5.27	9.91	9.32	0.71	0.87	1.43	0.42	0.74	0.70	0.07	0.76

Source: Own calculations on the sample obtained by merging Turkstat CIS, SBS, FTS and AIPS.
Notes: *Pd* and *Pc* denote the product innovators and process innovators, respectively. The shares refer to 2006–2008 three-year period. Descriptive statistics on the following variables are shown: the log of the number of employees, *l*; the log of labour productivity, *lp*, the log of the unit wage, *w*; the share of R&D workers in total firm employment, *EmpRD*; dummy variables for the previous experience in the low- and high-income import, Imp_{Lic} and Imp_{Hic}, and export markets (as any kind of – regular, CAT and mixed – exporters), Exp^T_{Lic} and Exp^T_{Hic}; a dummy variable for multi-plant firms, *multi*; a dummy variable for firms subcontracting part of their production, *outs*; and a dummy variable for the status of subcontractor, *subcont*. *T*-test reports the *t*-test statistic of the significant difference of the corresponding variable among the two groups of firms reported just above the test.

Table 3. Firm export involvement by innovation activity.

	Exp	Exp_{Hic}	Exp_{Lic}
All sample	48.37	39.32	39.13
Non-*Pc*	45.41	36.23	35.22
Pc	53.46	44.64	45.85
Non-*Pd*	43.59	34.14	33.40
Pd	55.75	47.33	47.97
Non-innovator	43.77	34.22	32.89
Only *Pc*	42.40	33.60	36.80
Only *Pd*	53.66	46.34	46.95
Both *Pc* & *Pd*	56.51	47.68	48.34

Source: Own calculations on the sample obtained by merging Turkstat CIS, SBS, FTS and AIPS.
Notes: *Pd* and *Pc* denote the product innovators and process innovators, respectively. Exp captures the general firm export status, while Exp_{Hic} and Exp_{Lic} indicate the export activity to high- and low-income countries, respectively.

new goods is related to a higher probability of being an exporter. On the contrary, process innovators are only engaged in international markets slightly less than non-innovators and the renewal of production processes seems to play a role only when combined with a new product introduction. Finally, looking at destination countries, Table 3 shows that innovators are more likely than non-innovators to export to low-income destinations and that although product innovators are more likely to export both to high- and low-income countries,[15] they are slightly more likely to export to low-income countries. In addition, whereas pure process innovators are more involved than non-innovators in exporting to low-income countries, they are less involved in exporting to high-income economies. Nevertheless, when process innovation is adopted in conjunction with product innovation the firm's export probability is enhanced, regardless of the destination area income level. It is worth mentioning, indeed, that among the *favourite* destination countries of Turkish exporters there are both developed countries – such as Germany, Greece, UK, France and Italy – and low-income ones – Bulgaria, Romania, Azerbaijan, Syria, Georgia and Iraq. Thus, the presence of Turkish firms is fairly equally distributed between the two income level country groups.

The overall evidence from Table 3 points at some heterogeneity across the innovation strategies and destination markets that should be rigorously accounted for in empirical work. Resting on the above theoretical framework and on this evidence, the following sections are devoted to the empirical dissection of the impact of product, process and product & process innovation on the firm export probability.

5. Empirical strategy

In order to shed light on the causal effect of innovation on export activity, we use the propensity score matching approach in a multiple treatment framework (Lechner 2001, 2002).[16] Building on our theoretical background, we focus on both product and process innovation, which, as highlighted in Section 3, may differently affect the firm's operations, and we consider a set of mutual exclusive treatments the firm may undergo: (0;0) is the no treatment case, no innovation activity; (Pd;0) represents product innovation only; (0;Pc) represents process innovation only; and finally (Pd;Pc) represents the case of both product and process innovation.

Our aim is to assess the Average Treatment effects on the Treated (ATT) for each treatment a, that is the outcome a firm in the different state b would experience if it underwent treatment a. However, each participant receives just one treatment and the remaining ones are potential counterfactuals. Then, the comparison of each state S with the other ones leads us to a full set of ATT effects

$$\gamma^{a,b} = E(Y^{a}_{\text{post}}|S = a) - E(Y^{b}_{\text{post}}|S = a) \tag{19}$$

that denote the expected (average) effect on outcome Y of treatment a, in the post-treatment period, relative to treatment b for a participant drawn randomly from the firms undergoing treatment a. As $E(Y^{b}_{post}|S = a)$ is not observable, it is proxied by the outcome of the units that actually undergo the treatment of comparison b, $E(Y^{b}_{\text{post}}|S = b)$.

In particular, we can obtain different ATT effects, for each variable of interest, for each of the following pairs:

- (0;Pc)/(0;0) – process innovators only/non-innovators;
- (Pd;0)/(0;0) – product innovators only/non-innovators;

- (*Pd*;*Pc*)/(0;0) – product and process innovators/non-innovators;
- (*Pd*;*Pc*)/(0;*Pc*) – product and process innovators/process innovators only; and
- (*Pd*;*Pc*)/(*Pd*;0) – product and process innovators/product innovators only,

where the first group of firms represents the treated group, while the second group of firms builds up the control group.

In order to find the control units to be matched with the treated units, we estimate a multinomial logit model from which we recover the propensity scores for each of the four states defined above. The multinomial logit-dependent variable is the probability to introduce a process/product/process & product innovation in *t*, that is in the period 2006–2008, and we include the value of the following variables retrieved by the FTS and the SBS in *t*–1, that is, in 2005, and for which we have shown in the previous section the existence of significant differences among firms with different innovation status: the log of the number of employees, *l*; the log of labour productivity (value added per employee), *lp*; the log of the unit wage (total wage bill divided by the number of employees), *w*; the share of R&D workers in total employment, *EmpRD*; dummy variables for the previous experience in the low- and high-income import, Imp_{Lic} and Imp_{Hic}, and export markets, Exp^T_{Lic} and Exp^T_{Hic}; a dummy variable for multi-plant firms, *multi*; a dummy variable for firms subcontracting part of their production, *outs*; and a dummy variable for the status of subcontractor, *subcont*. Finally, we include two-digit Nace Rev. 1.1 sector fixed effects.

It is worth stressing that Exp^T_{Lic} and Exp^T_{Hic} measure a firm's overall – as a regular, a CAT or mixed exporter – export status. Inclusion of the firm's previous export activity in high- and low-income economies in the logit model avoids any potential innovation impact on exporting to be driven by previous activity in international markets. As a matter of fact, in the matching procedure we will select controls with a similar experience in export activity to the one of treated units.

Table 4 presents the results of the logit for the selection of the control units. It is worth highlighting that, apart from firms' size that positively affects the probability to innovate, regardless of the type of innovation activity, from Table 4 it emerges that the drivers of process and product innovations are rather different. On the one hand, the former is positively related to firm wage and negatively related to firm import activity from low-income economies. The cost-saving nature of these innovations suggests that importing inputs from low-income economies reduces the need to introduce cost-saving process innovations, so that an increase in a firm's average wage may push the firm to adopt cost-saving process innovations to compensate the higher unit labour cost. On the other hand, the probability to introduce a new product is positively and significantly related to the share of R&D workers in the firm. This is rather consistent with the idea of product innovation being related to an invention stemming from firms' research efforts. Firm size and share of R&D workers are also positively and significantly associated with the probability to introduce product and process innovation at the same time. Nevertheless, this complex activity appears to be also driven by firm productivity and outsourcer status. In this respect, process innovation could be essentially directed to the introduction of the new product: firms outsource the less R&D-intensive production phases, while retaining the more knowledge-intensive ones which are directed to the creation of a new product. Finally, as far as productivity is concerned, strangely enough it only affects the joint adoption of product and process innovation. This result, however, might depend on the use of labour productivity which is highly related to the firm's capital labour ratio and could not properly proxy for the firm's Total Factor Productivity.[17]

Table 4. Multinomial logit estimates.

	(0;*Pc*)	(*Pd*;0)	(*Pd*;*Pc*)
l_{t-1}	0.261**	0.231**	0.222***
	[0.112]	[0.099]	[0.072]
lp_{t-1}	0.034	−0.076	0.262***
	[0.143]	[0.122]	[0.095]
w_{t-1}	0.604**	0.205	−0.044
	[0.235]	[0.210]	[0.153]
$\mathrm{Imp}_{\mathrm{Lic}\,t-1}$	−0.595**	−0.217	0.15
	[0.262]	[0.236]	[0.170]
$\mathrm{Imp}_{\mathrm{Hic}\,t-1}$	−0.136	0.054	0.11
	[0.299]	[0.284]	[0.210]
EmpRD_{t-1}	0.047	0.089**	0.114***
	[0.051]	[0.035]	[0.028]
multi_{t-1}	−0.224	−0.003	0.148
	[0.220]	[0.192]	[0.136]
$\mathrm{Exp}_{\mathrm{Hic}\,t-1}$	−0.055	−0.008	−0.127
	[0.265]	[0.242]	[0.178]
$\mathrm{Emp}_{\mathrm{Lic}\,t-1}$	−0.114	0.117	0.235
	[0.242]	[0.220]	[0.160]
$\mathrm{subcont}_{t-1}$	0.255	0.176	−0.24
	[0.332]	[0.302]	[0.238]
outs_{t-1}	−0.035	−0.046	0.522***
	[0.221]	[0.198]	[0.150]
Cons	−26.945	−20.607	−4.887***
	[0.000]	[0.000]	[1.362]
Obs	1569	1569	1569
Pseudo-R^2	0.091	0.091	0.091
LR chi^2	322.081	322.081	322.081
Log-likelihood	−1617.93	−1617.93	−1617.93

Notes: (0;*Pc*), (*Pd*;0) and (*Pd*;*Pc*) denotes the status of process only, product only and both process and product innovator, respectively. While the dependent variable concerns the firm innovation activity over the span 2006-2008, labelled as period *t*, regressors refer to $t-1$, which is year 2005. Two-digit sector dummies are included, but not shown for brevity.
*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

In conclusion, the multinomial logit results confirm that the three strategies are heterogeneous and highlight the need to tackle them separately, one from the other. Our MPSM empirical framework, then, can be considered particularly suitable for this task.

Making use of the propensity scores resulting from the multinomial logit estimates, we apply Kernel matching, and in Table A1 in the appendix we show some tests revealing the quality of the matching. The latter significantly reduces the median standardized bias, that is the distance in marginal distributions of the covariates between treated and control units. Also, only a low number of treated firms lie out of the common support. Finally, Figure A1 shows that the distribution of the propensity score for matched controls overlaps the one of treated firms after the matching procedure for all treatments. Even if the goodness of our strategy is slightly worse when the control group is composed of process innovators only, (0;*Pc*), or product innovators only, (*Pd*;0), because of the small size of these two groups, evidence confirms the general validity of the matching.

One of the advantages of kernel matching when compared to other matching algorithms, especially Nearest Neighbour matching, is the exploitation of as much information as possible from the control group and this is important in our context due to the general low number of firms in all the four groups described above.[18] Radius Matching is another possible alternative that we present in our robustness checks.

6. Results

Table 5 gives the ATT effects for our outcomes of interest: a firm's first time export entry, Exp_{Start}, and export status, *Exp*, at time t and $t+1$, that is in 2008 and 2009. We define as an export starter a firm that exports in t ($t+1$) and did not export in t–1, that is a firm that exports in 2008 (2009) and did not export in 2005. We define as an exporter any exporting firm, regardless of previous export activity. It is worth remembering that the latter is properly accounted for by the matching procedure. While the export entry allows us to capture the role of innovation in overcoming national barriers and penetrating foreign markets for the first time, the export status may tell us about the importance of the firm's innovative efforts in preserving their position on the foreign market.

In Table 5, analytic, A.s.e., and bootstrapped, B.s.e., standard errors are shown below the ATT estimates (Lechner 2001; Caliendo and Kopeinig 2008). From the latter, it emerges that process innovation alone does not seem to importantly stimulate the firm's export activity, with a relevant role on the export status only at time $t+1$. Product innovation, instead, allows firms to preserve their presence in foreign countries. Furthermore, the joint involvement in product and process innovation directly affects the export status, but no impact is disclosed for a firm's ability to cross the borders and enter foreign markets for the first time. From these results, we can infer that innovation could help firms to stay, preserve and strengthen their position in the international arena, but it is not the main determinant for their export market first time entry.[19] In general, overall returns from the joint adoption of both strategies are rather similar to the ones stemming from the sole introduction of product innovation and both sets of ATTs are higher than the ones estimated for the sole introduction of process innovation. However, when the impact of process innovation is active in $t+1$ the joint innovation strategies are superior to the single ones, as discussed in our theoretical framework.

When we allow for diverse effects across destination markets, some interesting findings emerge. Although results on export probability mimic the previous ones, it turns out that complex innovative strategies may have an immediate role in enhancing the firm's probability to start exporting to high-income economies. We find, indeed, a significant ATT effect at time t, that becomes non-significant at time $t+1$. Thus, the joint adoption of product and process innovation efforts may allow firms to face competition in high-income markets. In addition, it is worth noticing that, whereas product innovators are less likely to penetrate such markets, switching from being a product innovator to being a two-way innovator increases the firm's probability to start exporting to these destinations both in t and $t+1$. As previously mentioned in our theoretical framework, this evidence suggests that product innovation per se is not a sufficient strategy to penetrate these markets for the first time and needs to be complemented by the adoption of new production processes. The marked preference for quality in developed countries goes with a higher production of quality goods in these economies. The latter tend to specialize in higher quality good exports and to intensively exchange among them (Schott 2004; Hallak 2006, 2010) resulting in a higher thickness of the market for quality, as more quality goods are traded in these economies. This requires a firm willing to start exporting to those destinations and

Table 5. ATT effects: baseline results.

	All countries				High-income countries				Low-income countries			
	Exp		Exp_{Start}		*Exp*		Exp_{Start}		*Exp*		Exp_{Start}	
	t	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1
						(0;*Pc*)/(0;0)						
ATT	0.027	0.083	0.005	0.020	0.033	0.082	0.009	0.023	0.062	0.086	−0.042	−0.016
A.s.e	[0.049]	[0.050]*	[0.031]	[0.035]	[0.047]	[0.049]*	[0.029]	[0.033]	[0.048]	[0.048]*	[0.029]	[0.032]
B.s.e	[0.051]	[0.050]*	[0.034]	[0.036]	[0.048]	[0.045]*	[0.030]	[0.031]	[0.045]	[0.045]*	[0.032]	[0.035]
						Treated/controls: 120/827						
						(*Pd*;0)/(0;0)						
ATT	0.090	0.088	−0.017	−0.042	0.119	0.067	−0.001	−0.042	0.125	0.146	−0.013	−0.008
A.s.e	[0.044]**	[0.044]**	[0.025]	[0.026]	[0.044]***	[0.043]	[0.024]	[0.023]*	[0.044]***	[0.044]***	[0.029]	[0.030]
B.s.e	[0.037]**	[0.040]**	[0.026]	[0.028]	[0.036]***	[0.040]*	[0.024]	[0.024]*	[0.039]***	[0.039]***	[0.028]	[0.031]
						Treated/controls: 162 /827						
						(*Pd*;*Pc*)/(0;0)						
ATT	0.073	0.094	0.027	−0.002	0.084	0.097	0.041	0.016	0.080	0.085	−0.013	−0.014
A.s.e	[0.036]**	[0.036]***	[0.023]	[0.024]	[0.035]**	[0.035]***	[0.022]*	[0.023]	[0.035]**	[0.035]**	[0.023]	[0.024]
B.s.e	[0.033]**	[0.033]***	[0.020]	[0.024]	[0.032]***	[0.032]***	[0.020]**	[0.022]	[0.033]**	[0.034]**	[0.023]	[0.023]
						Treated/controls: 443/827						
						(*Pd*;*Pc*)/(0;*Pc*)						
ATT	0.014	0.019	0.009	0.004	0.021	−0.006	0.016	−0.019	−0.021	0.033	0.004	0.023
A.s.e	[0.058]	[0.059]	[0.037]	[0.041]	[0.056]	[0.058]	[0.034]	[0.038]	[0.057]	[0.057]	[0.033]	[0.037]
B.s.e	[0.058]	[0.058]	[0.040]	[0.039]	[0.057]	[0.058]	[0.040]	[0.044]	[0.058]	[0.062]	[0.038]	[0.034]
						Treated/controls: 437/125						

(*continued*)

Table 5. (*Continued*).

	All countries				High-income countries				Low-income countries			
	Exp		Exp_{Start}		*Exp*		Exp_{Start}		*Exp*		Exp_{Start}	
	t	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1
						(*Pd*;*Pc*)/(*Pd*;0)						
ATT	−0.014	0.041	0.049	0.047	−0.024	0.071	0.048	0.060	−0.017	−0.014	−0.004	−0.006
A.s.e	[0.050]	[0.050]	[0.029]*	[0.030]	[0.050]	[0.050]	[0.029]*	[0.026]**	[0.050]	[0.050]	[0.032]	[0.033]
B.s.e	[0.045]	[0.048]	[0.027]*	[0.029]	[0.046]	[0.049]	[0.025]*	[0.026]**	[0.046]	[0.047]	[0.031]	[0.031]
						Treated/controls: 441/164						
						(0;*Pc*)/(*Pd*;0)						
ATT	−0.085	0.006	0.015	0.061	−0.103	0.022	0.002	0.078	−0.070	−0.047	−0.031	−0.009
A.s.e	[0.062]	[0.062]	[0.036]	[0.040]	[0.060]*	[0.061]	[0.034]	[0.037]**	[0.061]	[0.061]	[0.036]	[0.040]
B.s.e	[0.060]	[0.065]	[0.039]	[0.043]	[0.057]*	[0.060]	[0.038]	[0.034]**	[0.059]	[0.058]	[0.038]	[0.043]
						Treated/controls: 119/164						
						(*Pd*;0)/(0;*Pc*)						
ATT	0.081	0.019	−0.018	−0.047	0.108	0.015	−0.013	−0.056	0.077	0.075	0.034	0.027
A.s.e	[0.062]	[0.063]	[0.038]	[0.041]	[0.061]*	[0.062]	[0.035]	[0.037]	[0.062]	[0.062]	[0.037]	[0.041]
B.s.e	[0.064]	[0.063]	[0.041]	[0.044]	[0.060]*	[0.061]	[0.040]	[0.038]	[0.064]	[0.064]	[0.040]	[0.045]
						Treated/controls: 162/125						

Notes: (0;*Pc*), (*Pd*;0), (*Pd*;*Pc*) and (0;0) denote the status of process only, product only, both process and product innovator and non-innovator, respectively. A.s.e and B.s.e stand for analytic and bootstrapped standard errors, respectively.
*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

to engage in a remarkable quality improvement effort in order to be competitive. For a middle-income country's manufacturing firm, then, pure product innovation might not be enough to break into a developed economy and needs to be sustained by an improvement of the firm's cost advantage. An alternative explanation of the importance of the joint adoption of the two innovation strategies for entry in developed countries could follow from the recent increase in offshoring practices led by the latter (Feenstra 1998). One of their consequences is the relocation of whole production processes in low and middle-income economies. Here, the product is only new to the firm that starts to produce it, nevertheless it already exists in the foreign market, as many other firms already produce similar varieties there. A middle-income economy firm, then, succeeds in entering the foreign market for the good thanks to the adoption of a new production process which delivers important cost savings, compared to the high-income market process. This interpretation highlights that the joint involvement in product and process innovation of middle-income economy firms may actually stem from cost-saving process innovations by high-income economy firms.

Turning to the export activity towards low-income destinations, in line with our theoretical sketch, product innovation proves rather relevant in exporting to such destinations. Reduction in costs driven by process innovation would not be enough in order to compete in low labour cost markets. On the contrary, the introduction of new varieties and new products, rather than cost reduction, may be the way for Turkish firms to survive and compete within economies characterized by similar technologies and costs.

Previous results disclose the impact of innovation on firms' export performance in each country's income level group, allowing for the possibility that firms already export to the other groups. As a large share of firms is indeed active in both destination markets, the identification of the effect in each subgroup rests on a fairly large sample of exporters. To further investigate the different impact of innovation across export markets, we focus on exclusive definitions of export destinations and define exporters to high-income countries only, to low-income countries only and to both country groups. This exclusive export status (start) definition reduces the number of exporters, especially in the sub-groups of firms exporting only to high- and of firms exporting only to low-income economies. Nevertheless, results, given in Table A2 in Appendix, confirm that innovation, especially product innovation, rather than fostering export entry, preserves export activity of firms exporting to both high- and low-income economies.[20] We find, however, a positive impact of the involvement in both product and process innovations on entry in developed economies only.[21] Looking instead at firms exporting either to high- or low-income countries, interesting evidence emerges in terms of the different effect across innovation options. Process innovation appears as more rewarding in terms of entry to high-income countries, while switching from process to product innovation fosters the entry in low-income economies (see the comparison of (0;*Pc*) versus (*Pd*;0) and vice versa). Furthermore, the introduction of process innovations by product innovators increases their probability to start exporting to high-income markets.

Summing up, innovation, namely two-way innovation, stimulates the export start to high-income economies only. Although our theoretical sketch assumes entry costs are uniform across destination markets, they may, indeed, differ according to importing countries' income level (Arkolakis 2010; Crinò and Epifani 2012). In this respect, high-income markets are tougher to penetrate due to the higher average productivity of firms and to their higher thickness. This could explain why process innovation becomes a crucial complement to product innovation in order to allow firms to break into these markets. On the contrary, the first time entry in low-income markets may not require a particular innovative effort and may be simply driven by firms' productivity level and size.

Table 6. Robustness checks.

	All countries				High-income countries				Low-income countries			
	Exp		Exp_{Start}		*Exp*		Exp_{Start}		*Exp*		Exp_{Start}	
	t	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1
					Radius matching, calliper 1%							
(0;*Pc*)/(0;0)	0.035	0.085*	0.011	0.025	0.038	0.083*	0.006	0.020	0.064	0.089*	−0.039	−0.012
(*Pd*;0)/(0;0)	0.091**	0.091**	−0.014	−0.038	0.118***	0.067	0.002	−0.039	0.132***	0.151***	−0.012	−0.009
(*Pd*;*Pc*)/(0;0)	0.082**	0.095**	0.026	−0.001	0.089**	0.094**	0.040*	0.018	0.086**	0.088**	−0.009	−0.012
(*Pd*;*Pc*)/(0;*Pc*)	0.043	0.035	0.029	0.005	0.036	0.005	0.038	−0.004	0.003	0.051	0.023	0.045
(*Pd*;*Pc*)/(*Pd*;0)	−0.015	0.016	0.055*	0.055*	−0.032	0.029	0.050*	0.066**	−0.033	−0.044	0.002	0.001
(0;*Pc*)/(*Pd*;0)	−0.095	0.028	0.003	0.060	−0.105*	0.042	−0.007	0.080**	−0.072	−0.028	−0.046	−0.011
(*Pd*;0)/(0;*Pc*)	0.098	−0.001	−0.012	−0.036	0.156**	0.059	0.002	−0.049	0.088	0.040	0.036	0.032
					Pooled, 2 waves							
(0;*Pc*)/(0;0)	0.031	0.091**	–	–	0.041	0.092**	–	–	0.065	0.086**	–	–
(*Pd*;0)/(0;0)	0.079**	0.075*	–	–	0.106***	0.059	–	–	0.111***	0.129***	–	–
(*Pd*;*Pc*)/(0;0)	0.069**	0.091**	–	–	0.079**	0.089***	–	–	0.071**	0.080**	–	–
(*Pd*;*Pc*)/(0;*Pc*)	0.025	0.027	–	–	0.026	−0.008	–	–	−0.015	0.029	–	–
(*Pd*;*Pc*)/(*Pd*;0)	0.010	0.049	–	–	−0.011	0.056	–	–	0.002	0.002	–	–
(0;*Pc*)/(*Pd*;0)	−0.054	0.039	–	–	−0.071	0.052	–	–	−0.048	−0.028	–	–
(*Pd*;0)/(0;*Pc*)	0.078	0.014	–	–	0.095*	0.002	–	–	0.074	0.067	–	–
					Produced goods, 6digit matching							
(0;*Pc*)/(0;0)	−0.039	0.039	−0.016	0.025	−0.023	0.044	0.001	0.032	0.018	0.079	−0.050	0.004
(*Pd*;0)/(0;0)	0.090**	0.062	0.006	−0.024	0.098**	0.066	−0.009	−0.027	0.130***	0.155***	0.004	0.013
(*Pd*;*Pc*)/(0;0)	0.085**	0.086**	0.058***	0.027	0.084**	0.085**	0.053**	0.027	0.099***	0.094***	0.029	0.022
(*Pd*;*Pc*)/(0;*Pc*)	0.097*	0.065	0.039	0.011	0.090	0.029	0.026	−0.019	0.042	0.040	0.024	0.013
(*Pd*;*Pc*)/(*Pd*;0)	0.003	0.056	0.055*	0.046	0.006	0.070	0.065**	0.053*	−0.003	−0.013	0.013	−0.006
(0;*Pc*)/(*Pd*;0)	−0.160***	−0.019	−0.030	0.054	−0.149**	−0.017	−0.001	0.071*	−0.129**	−0.070	−0.063*	−0.005
(*Pd*;0)/(0;*Pc*)	0.160**	0.053	0.012	−0.042	0.170***	0.075	−0.016	−0.054	0.131**	0.098	0.037	0.006

Notes: Significance levels rest on bootstrapped standard errors. (0;*Pc*), (*Pd*;0), (*Pd*;*Pc*) and (0;0) denotes the status of process only, product only, both process and product innovator and non-innovator, respectively.
*Significant at 10% level.
**Significant at 5% level.
***Significant at 1% level.

However, product innovation appears as a key activity to successfully survive in export markets, regardless of the latter's income level. In general, product innovation allows for increased product differentiation, higher mark up and revenues and variable profits. On the one hand, this becomes relevant when consumers value quality, as in high-income economies. On the other hand, quality upgrading becomes fundamental when competitors can easily imitate exporters' technology for low-quality goods, as in low-income economies. Finally, although we modelled two-way innovation as superior compared to each single innovation strategy, comparable returns seem to stem from product and product & process innovation strategies in high-income markets. The highest coefficient displayed for product innovation in low-income destinations could stem from a higher variable cost associated with the introduction of the new process directed to the production of higher quality products.[22] As a matter of fact, higher variable costs may dampen the positive effect of new product introduction, just as lower quality could dampen the cost advantage from process innovation.[23]

In conclusion, our results support our Hypothesis 1, as we find that a firm's innovative efforts in an emergent country positively affect the firm's export probability. However, the predicted sorting of innovation strategies summarized in Hypothesis 2 is not strongly supported by our empirical analysis, as product innovation is comparable or even superior to the joint adoption of both innovation activities. Finally, Hypothesis 3 is partially corroborated by our evidence. As a matter of fact, by directly comparing different innovation strategies as in Equation (18), we find that switching from product to process or to product & process innovation fosters export entry in high-income destinations. This result is confirmed when we focus on exclusive export destinations, for which we further show that switching from process to product innovation favours first time exporting to low-income economies.

When comparing innovators – involved in any kind of strategy – to non-innovators we find, instead, that product innovation dominates process innovation when exporting to low-income markets, while process innovation is relevant for entering high-income destinations only when adopted in conjunction with new product introduction.

Within the literature on emerging economies, our findings are at odds with the non-significant effect of innovation shown by Damijan, Kostevc, and Polanec (2010) in Slovenian manufacturing, nonetheless they are in line with the positive and significant impact found for Vietnam by Nguyen et al. (2008). This may be related to the different economic development level of Slovenia, on the one hand, and Vietnam and Turkey, on the other. Innovation could indeed prove to be fruitful in the penetration of export markets for firms operating in economies that still experience important technological and efficiency gaps compared to advanced economies. Compared to the existing literature, however, our contribution sheds light on the mechanism behind this causal nexus by supporting a different role of product and process innovation according to the destination market income level. Thus, while Becker and Egger (2009) find that in Germany product innovation is more relevant than process innovation in determining the firm's export performance, we highlight that their sorting in importance could depend on the market firms export to.

Robustness checks. In order to prove the robustness of our results, we implemented some checks. These estimations, in general, confirm all the above findings and are reported in Table 6. First, we make use of Radius matching instead of Kernel algorithm allowing a calliper of 1%. Second, we expand the sample including observations from the 2006 CIS wave. This test does not allow computing the ATT effects for the probability of starting to export because for the firms in the 2006 wave we did not have at our disposal the export activity of their own produced goods for the year *t*–1 (that is 2003).[24] Third, we report the ATT effects computed when we exploit the export status of own produced goods built by making use of matching trade and production data, implemented according to a correspondence table at a more aggregated level, that is, between six-digit Harmonized System trade codes and six-digit Classification of Products by Activity production codes. The final check, not reported for the sake of brevity, consisted in including the growth rate of labour productivity in the logit specification, in order to account for different growth paths between innovators and non-innovators in the pre-innovation period for the control group selection.

7. Concluding remarks

With this paper, we have contributed to the debate about the causal nexus between firm innovation activity and export performance. In particular, we have provided evidence on this topic in the context of an emergent economy, Turkey. Compared to previous work, our theoretical framework has demonstrated process and product innovation as affecting firm profitability through different channels. As a consequence, our empirical approach, based on an MPSM framework, has isolated the impact of each strategy and of their joint adoption on firms' export probability. Our evidence, first of all, has corroborated our assumption on the different channels through which product and process innovation operate, thus confirming the need for a separate treatment of the two activities. As a matter of fact, while process innovation is more likely to occur when labour costs are higher and imports from low-income economies are moderate, product innovation is highly probable when firms are intensively engaged in R&D. Furthermore, differently from other empirical papers on the topic, our work has distinguished between the impact of innovation on the export probability and first time entry into exporting. Results, indeed, have shown that product and process innovation only facilitate the latter activity, when they are jointly undertaken and destination markets are rich. Nevertheless, in general, innovation strategies have emerged as important practices to preserve a firm's position in export markets. Also, product innovation has appeared as more rewarding in terms of export performance than process innovation, especially for exporting to low-income economies, while it is the joint involvement of both activities that has displayed the largest significant impact on firms' export probability to high-income economies.

In conclusion, some policy implications spring from our work. The evidence emerging from our study implies that Turkish government's support of firms' innovation activities is an effective strategy for sustaining their international competitiveness. Other emerging economies may thus learn from the Turkish experience that sustaining innovation is rewarding in terms of preserving competitiveness and in accessing advanced economy markets. However, as emerges from this study, innovation alone is not the driver of firms' internationalization, further work should be addressed to shed light on the existence and work of other channels which usually foster the start of export activity – such as access to financial markets and expansion of firm size – in the emergent economies' context. This stream of research would highlight further intervention strategies that policy-makers should pursue in order to promote domestic firms' performance outside the national borders.

Notes

1. Wakelin (1998) for the UK between 1988 and 1992 finds quite a different result: being an innovator is negatively related to the firm export probability while the number of innovations is

positively related to the export probability of innovating firms indicating some heterogeneity among them.

2. However, other evidence on the same country shows that productivity still matters for non-innovators, so that other channels affect productivity out of product innovation (Cassiman, Golovko, and Martínez-Ros 2010).
3. Kirbach and Schmiedeberg (2008) further explore the firm-level export impact of innovation in East and West Germany between 1993 and 2003 and find that lower export propensity of firms in the Eastern part of the country is mainly driven by their lower productivity and propensity to innovate.
4. Extensive literature deals with the relationship between product quality and exports at the firm level. As an example, Verhoogen (2008) models the firm quality upgrading choice in a framework with quality differentiation in production and different preferences for quality in the North and South. More recently, Crinò and Epifani (2012) analyse the interplay between cross-firm differences in product quality and cross-country differences in quality consumption. In both settings, the quality choice is endogenous and depends on export market characteristics and shocks (e.g. a devaluation). Here, our aim is not to model the choice of quality, but to show how the introduction of new products, that are likely to be characterzed by a higher quality, can enhance export probability.
5. Comparable CIS data on European countries show that on average 60% of manufacturing innovative firms are involved in both product and process innovation.
6. Taking the difference between Equations (10) and (6) we get:

$$\pi_{PdPc} - \pi_{Pc} = \frac{r_{PdPc}(\phi)}{\sigma} - \frac{r_{Pc}(\phi)}{\sigma} + f_{Pc}(1-\lambda) - \lambda f_{Pd},$$

while, taking the difference between Equations (10) and (8) we obtain:

$$\pi_{PdPc} - \pi_{Pd} = \frac{r_{PdPc}(\phi)}{\sigma} - \frac{r_{Pd}(\phi)}{\sigma} + f_{Pd}(1-\lambda) - \lambda f_{Pc}.$$

These expressions hint at the introduction of one innovation strategy as favouring the adoption of the other one, compared to one-way innovators.

7. This cost is usually higher for the first time entry, as sunk costs need to be born when entering foreign markets for the first time. Nevertheless, if entry costs depend on the firm's degree of market penetration, it may well be the case that they increase in subsequent years, due to the firm's growing cost of maintaining and expanding market shares in foreign markets (Crinò and Epifani, 2012). Innovation could, then, prove more relevant to surviving than entering an export market for the first time.
8. However, to further check the validity of this assumption, on the basis of the BACI database on trade flows provided by Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) for 2006–2008 – our analysis time span – we ran a regression of log of export unit values on World Bank income level group dummies and within export country-product lower export unit values are recorded for lower income destinations. Results are not shown for the sake of brevity but they are available from the authors upon request.
9. The 2006 wave was also available, but few observations were left after matching with other data sources. For this reason, we preferred to focus on the 2008 wave, keeping the 2006 one only for a robustness check on the pooled 2006 and 2008 waves.
10. It is, also, worth noticing that we have no information on firms' innovation in the period preceding the survey. As a consequence, due to the lack of innovation data for a long time-span, our treatments, as usual in most of the mentioned literature, capture the engagement in innovative activity, but not the start of this activity.
11. PRODTR is the list of Industrial Products in Turkey, which is the national version of PRODCOM list. The PRODTR classification is the 2006 one, thus it is homogeneous across years and does not require any harmonization procedure.
12. We harmonized the codes of trade flows across years, since trade classification is updated every year. On the contrary, production data were recorded according to a uniform classification over our sample of analysis.
13. More details about the harmonization procedure of product classification and the matching between trade and production data is available in Lo Turco and Maggioni (2014).

14. The total number of firms, covering both service and manufacturing sectors, is 4891.
15. The definition of the two groups follows the World Bank country classification and is reported in the appendix.
16. We have also applied simple propensity score matching retrieving the effects of innovation on firm export activity when process and product innovation are treated as two separate, independent and different treatments. The relative results are available from the authors.
17. Unfortunately the lack of any information on the firms' capital stock together with the short time span at our disposal which is not suitable for the use of the perpetual inventory method, and prevented us from calculating such a productivity measure.
18. As a matter of fact, when we tried to apply the Nearest Neighbour matching the tests, we only presented for the kernel matching, as the quality of matching failed to confirm the validity of our procedure.
19. This evidence is confirmed even when we estimate ATTs for starting to export only on the sample of firms which were not exporting in *t*–1. By excluding firms exporting in *t*–1 from the control group, we avoid the possibility that non-significant ATTs may be driven by the presence of previous exporters in the sample.
20. We cannot exclude the possibility of a stronger impact of innovation on export entry in the long run which we are not able to capture due to the short time span at our disposal.
21. The negative ATT effect for exporting to high-income countries emerging from the comparison of product innovators and non-innovators could originate from the former's higher probability to be involved in both groups of destinations or in low-income countries only, as from our theoretical framework new products could indeed facilitate the penetration of developing rather than developed markets. By the same token, the negative impact of process innovation on entry in low-income markets could stem from process innovators being more likely to enter other markets.
22. Although our theoretical framework rests on the simplifying assumption of a lower marginal cost related to process innovation, both when adopted alone and in conjunction with product innovation, the production of a higher quality good may require a higher variable cost (Crinò and Epifani, 2012). If this is the case, variable profits may even be lower than those earned under the pure product innovation strategy.
23. This result is driven by exporters to both high-and low-income economies.
24. In order to build the status of exporter of one's own produced goods, we need information for production data that, unfortunately, are not available before 2005.

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Appendix 1. List of high-income countries

High-income countries are defined according to the World Bank classification: Andorra, Anguilla, Aruba, Australia, Austria, Bahamas, Bahrain, Barbados, Belgium, Bermuda, Bouvet Islands, British Virgin Islands, Brunei, Canada, Cayman Islands, Ceuta, Christmas Islands, Cook Islands, Croatia, Czech Republic, Denmark, Equatorial Guinea, Estonia, Falkland Islands, Faroe Islands, Finland, France, French Polynesia, Germany, Gibraltar, Greece, Greenland, Guam, Hong Kong, Hungary, Iceland, Ireland, Israel, Italy, Japan, Kuwait, Latvia, Liechtenstein, Luxembourg, Macao, Malta, Montserrat, Netherlands, Netherlands Antilles, New Caledonia, New Zealand, Norfolk Islands, North Mariana Islands, Norway, Oman, Pitcairn, Poland, Portugal, Qatar, San Marino, Saudi Arabia, Singapore, Slovakia, Slovenia, South Cyprus, South Korea, Spain, St Helena, St Pierree, Sweden, Switzerland, Taiwan, Tokelau Islands, Trinidad And Tobago, Turks And Caicos islands, U.A.E, USA, USA Minor Outlying Islands, USA Virgin Islands, UK, Vatican.

Appendix 2. Additional tables and figures

Table A1. Balancing tests.

	Treated Firms	Control Firms	% Treated firms Out of support	Median bias		% Drop Bias
				Before	After	
(*Pd*;*Pc*)/(0;0)	453	827	2.21	14.49	2.90	79.99
(*Pd*;0)/(0;0)	164	827	1.22	11.07	6.28	43.26
(0;*Pc*)/(0;0)	125	827	4.00	10.29	6.57	36.16
(*Pd*;*Pc*)/(*Pd*;0)	453	164	2.65	11.72	3.79	67.62
(*Pd*;*Pc*)/(0;*Pc*)	453	125	3.53	14.49	7.75	46.56
(*Pd*;0)/(0;*Pc*)	164	125	1.22	12.70	10.49	17.37
(0;*Pc*)/(*Pd*;0)	125	164	4.80	12.70	6.57	48.28

Notes: (0;*Pc*), (*Pd*;0), (*Pd*;*Pc*) and (0;0) denote the status of process only, product only, both process and product innovator and non-innovator, respectively. Treated firms are in the common support if their propensity score is lower than the maximum and higher than the minimum score of the control units. In the fifth and sixth column, we display the median bias across all the covariates included in the multinomial logit estimation before and after the matching for.

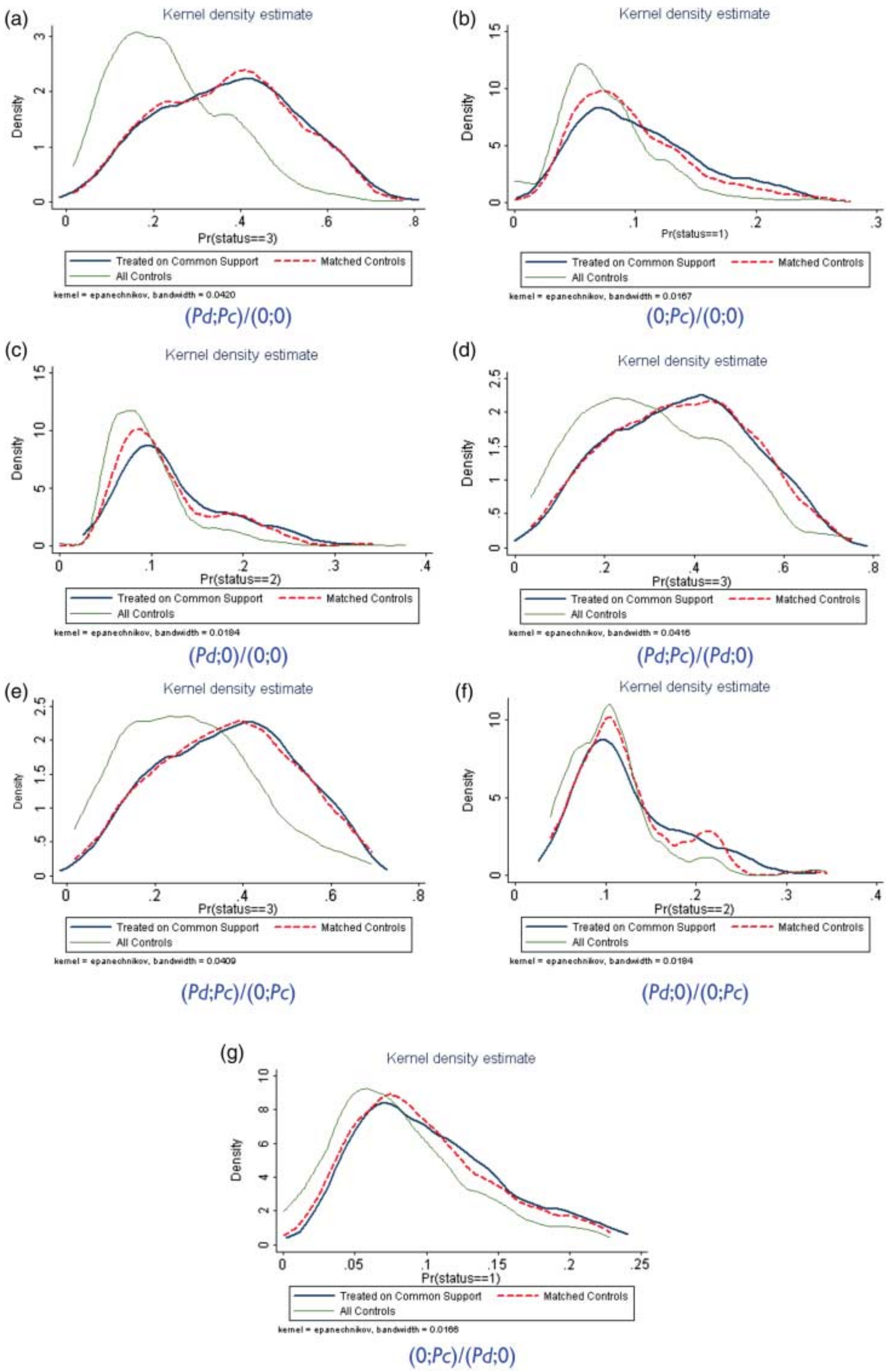

Figure A1. Propensity score densities for the treated, matched and unmatched controls.

Table A2. ATT effects: exclusive destination definitions.

	Both groups of countries				Only high-income countries				Only low-income countries			
	Exp		Exp_{Start}		*Exp*		Exp_{Start}		*Exp*		Exp_{Start}	
	t	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1	*t*	*t*+1
						(0;*Pc*)/(0;0)						
ATT	0.069	0.079	0.003	0.002	−0.035	0.003	0.006	0.021	−0.007	0.007	−0.046	−0.017
A.s.e	[0.045]	[0.045]*	[0.022]	[0.022]	[0.023]	[0.030]	[0.020]	[0.026]	[0.027]	[0.029]	[0.020]**	[0.025]
B.s.e	[0.031]**	[0.036]**	[0.024]	[0.021]	[0.025]	[0.029]	[0.019]	[0.024]	[0.026]	[0.029]	[0.021]**	[0.028]
						Treated/controls: 120/827						
						(*Pd*;0)/(0;0)						
ATT	0.151	0.124	−0.019	−0.011	−0.032	−0.057	0.018	−0.030	−0.025	0.022	0.006	0.003
A.s.e	[0.042]***	[0.042]***	[0.015]	[0.017]	[0.022]	[0.020]***	[0.020]	[0.015]**	[0.023]	[0.026]	[0.025]	[0.025]
B.s.e	[0.030]***	[0.031]***	[0.015]	[0.017]	[0.023]	[0.023]**	[0.020]	[0.017]*	[0.024]	[0.026]	[0.025]	[0.027]
						Treated/controls: 162 /827						
						(*Pd*;*Pc*)/(0;0)						
ATT	0.091	0.089	0.015	0.006	−0.007	0.009	0.025	0.009	−0.011	−0.003	−0.029	−0.020
A.s.e	[0.033]***	[0.033]***	[0.016]	[0.016]	[0.020]	[0.021]	[0.016]	[0.017]	[0.020]	[0.020]	[0.018]	[0.018]
B.s.e	[0.030]***	[0.030]***	[0.016]	[0.016]	[0.017]	[0.018]	[0.014]*	[0.017]	[0.021]	[0.020]	[0.017]*	[0.019]
						Treated/controls: 443/827						
						(*Pd*;*Pc*)/(0;*Pc*)						
ATT	−0.011	0.017	0.001	0.005	0.032	−0.023	0.014	−0.024	−0.010	0.016	0.002	0.018
A.s.e	[0.054]	[0.054]	[0.026]	[0.026]	[0.026]	[0.034]	[0.024]	[0.030]	[0.031]	[0.034]	[0.021]	[0.029]
B.s.e	[0.056]	[0.059]	[0.030]	[0.028]	[0.024]	[0.037]	[0.028]	[0.036]	[0.037]	[0.029]	[0.025]	[0.019]
						Treated/controls: 437/125						
						(*Pd*;*Pc*)/(*Pd*;0)						
ATT	−0.024	0.019	0.039	0.025	0.000	0.051	0.009	0.036	0.008	−0.033	−0.042	−0.031
A.s.e	[0.049]	[0.049]	[0.018]**	[0.020]	[0.025]	[0.022]**	[0.023]	[0.018]**	[0.026]	[0.030]	[0.027]	[0.028]
B.s.e	[0.046]	[0.046]	[0.015]**	[0.018]	[0.021]	[0.018]***	[0.021]	[0.020]*	[0.028]	[0.031]	[0.027]	[0.026]
						Treated/controls: 441/164						

						(0;*Pc*)/(*Pd*;0)						
ATT	−0.085	−0.038	0.019	0.019	−0.017	0.059	−0.018	0.059	0.015	−0.009	−0.051	−0.028
A.s.e	[0.058]	[0.059]	[0.023]	[0.026]	[0.028]	[0.032]*	[0.027]	[0.028]**	[0.032]	[0.036]	[0.029]*	[0.032]
B.s.e	[0.054]	[0.055]	[0.024]	[0.024]	[0.028]	[0.031]*	[0.029]	[0.025]**	[0.032]	[0.035]	[0.030]*	[0.034]
						Treated/controls: 119/164						
						(*Pd*;0)/(0;*Pc*)						
ATT	0.102	0.077	−0.031	−0.004	0.006	−0.062	0.018	−0.052	−0.026	−0.002	0.066	0.031
A.s.e	[0.059]*	[0.059]	[0.025]	[0.026]	[0.028]	[0.033]*	[0.027]	[0.028]*	[0.032]	[0.037]	[0.029]**	[0.033]
B.s.e	[0.056]*	[0.055]	[0.030]	[0.025]	[0.031]	[0.036]*	[0.027]	[0.030]*	[0.039]	[0.039]	[0.029]**	[0.036]
						Treated/controls: 162/125						

Notes: (0;*Pc*), (*Pd*;0), (*Pd*;*Pc*) and (0;0) denote the status of process only, product only, both process and product innovator and non-innovator, respectively. A:s:e and B:s:e stand for analytic and bootstrapped standard errors, respectively.

ATT effects are reported for the export performance in the three exclusive destinations: both low- and high-income countries, high-income countries only and low-income countries only.

*Significant at 10% level.

**Significant at 5% level.

***Significant at 1% level.