DOES PERSISTENCE IN INTERNATIONALIZATION AND INNOVATION INFLUENCE FIRMS' PERFORMANCE?

Stefano Iandolo, Anna Maria Ferragina.

Department of Economics and Statistics (DISES),
University of Salerno.

One of the basic datum of the learning-to-innovate-by exporting (LIBE) theory is that exports may influence a firm's return in terms of technology. Since knowledge flows may materialize from long-lasting and not occasional interactions with foreign customers, our aim is to see if being permanently active on international markets, associated with being persistently innovators, increases firms' absorptive capacity, enhancing their ability of optimizing external knowledge flows, boosting the productivity (measured through the total factor productivity à la Levinsohn and Petrin). To our purpose, we use data on Italian manufacturing firms covering an eight-year time-span (1998-2006) and we will measure, through a partial adjustment model, the effect of different strategies both in innovation and in export, distinguishing between persistent and temporary exporting firms as well as frequent and temporary innovators, to test (through OLS and a two-step system GMM à la Arellano and Bond) the existence of any learning-by-exporting and learning-by-doing effect. Our estimation results are in favour of the hypotheses of learning-by-exporting and learning-by-doing: persistent innovation efforts must be associated with a permanent presence on foreign markets since firms that persistently innovate *and* persistently export have better results in terms of productivity than persistently exporting firms that do not innovate persistently and than firms that do not export persistently. If combining both strategies can be an opportunity, by contrast, not undertaking both strategies could transform persistent innovation in a factor of weakness for firms, even if they try to provide for it by internal R&D.

JEL Codes: F14, F10, F23, O30, D24
Keywords: Export, Innovation, Persistence, TFP, GMM

1. Introduction.

The ability of a firm to participate in export markets or to invest in innovation is often considered as a key element for competitiveness and as an indicator of success.

The nature of both investment decisions in innovation and in internationalization is, in fact, very strategic but it could be, at the same time, insidious. If it is true, indeed, that both decisions are undertaken according to their own expected returns, they entail some downsides because they are usually risky and costly.

In particular, small-medium enterprises (SMEs) could face more problems than their bigger counterparts since SMEs have to face stronger financial constraints to invest in both activities and their decision could be more affected by risk and uncertainty (Esteve-Pérez and Rodríguez, 2013). In addition, as pointed out by some authors (Cohen and Klepper, 1996), larger firms can split the costs associated with innovation and internationalization strategies over a larger output level.

Furthermore, in the analysis of the relationship between innovation and internationalization, it is worth studying two different aspects: how the temporal dimension of firms' exporting and innovating activities may influence performance and what kind of interrelation (if any) links these two dimensions.

Some recent literature, indeed, underlines that the firms need engagement in innovation to make sure that can take full advantage of foreign knowledge spillovers, because it has been provided evidence that foreign knowledge can improve the performance of already innovative firms increasing their absorptive capacity (e.g. Feldman and Koegler, 2010; Aw et al., 2007).

Some other authors argue that the temporal dimension of firms' exporting and innovating activities may influence the scope of the learning effects as well because the process of knowledge accumulation increases over time as experience is accumulated (Andersson and Lööf, 2009). By persistently performing an activity over time (e.g. R&D investments), accumulating skills and knowledge on how to organize such activity in an always more efficient way, firms can develop new technologies and routines for production to progressively better adapt to the external business environment (Nelson and Winter, 1982).

One of the basic datum of the learning-to-innovate-by-exporting theory (LIBE) assumption is that exports may influence a firm's return in terms of innovation; but the persistency of a firm's export activity may also be important for these returns to materialize and to become important: knowledge flows, indeed, arise from long-lasting and not occasional interactions with foreign customers and competitors as well as the adaptation of better business processes is a consequence for firms exporting regularly.

The reasons why firms decide to continue exporting over time or why they choose between exporting or innovating can be different, as we will see in

the next paragraph, and they have been formalized by the economic literature in different ways.

Table 1 - Matrix of strategies

		Export strategies	
		Persistent	**Non persistent**
Innovation strategies	Persistent Innovators	Persistent Innovators	Persistent Innovators
	Start Innovators	Start Innovators	Start Innovators
	Stop Innovators	Stop Innovators	Stop Innovators

So the interdependence between innovation and internationalization could be a possible explanation for some post-entry effects on productivity to appear, if we consider that time lags could be important for experience accumulation.

In the previous chapter we have highlighted that there is a learning-to-innovate-by-exporting effect for Italian firms and this is also confirmed if we consider some destinations of export.

What we want to analyze in this chapter is a different aspect of the relationship between innovation and internationalization: how the persistence in innovation activity influences the performance of the firm (measured through the total factor productivity) and if this relationship is different for firms that export persistently or not.

To our purpose, as the panel structure of our dataset and the information provided allow to implement a study that accounts both for persistence and for firms' heterogeneity, we will distinguish firms between persistent and temporary exporters as well as frequent and temporary innovators. It is important to consider that innovation and internationalization can be interrelated and productivity-enhancing learning effects activity over time can be linked to the temporal dimension (thus the persistence) of the firms' activities.

So, moving from an initial unbalanced dataset, we build a balanced one with all the firms observed in all the three waves we consider, on which we test

our assumptions to have a first glance of the effect of different innovation strategies, without considering the exports.

From this intermediate step, we will distinguish firms between persistent and temporary exporters , building two different dataset in which we will measure the effect of different strategies both in innovation and in export, to test (through OLS and a two-step system GMM à la Arellano and Bond) the existence of any learning-by-exporting and learning-by-doing effect.

The focus of our analysis is on the importance of the joint effect of persistency in both innovation and export. In particular, we want to see if being permanently active on international markets, associated with being

persistently innovators, increases firms' absorptive capacity enhancing their ability of optimizing external knowledge flows.

2. Literature review.

The analysis of the persistency in technological innovation and export, and the interrelation between these two dimensions is fundamental to understand the underlying mechanism of both industry dynamics and how to implement incisive policies to sustain growth at the firm, sector, and country levels.
In this section, we will go through the most common frameworks that have tried to explain the motivations behind persistence and the interrelation that could arise between innovation and internationalization.

2.1 Why, and How Firms Decide to persist?

As said in the previous paragraph, the motivations behind the decision of undertaking these strategies, singularly or both, can be several as well as different are the reasons of implementing them persistently or temporarily which have been analyzed and formalized by the economic literature over time.
Nevertheless, we don't have clear and univocal evidence (theoretical and empirical) on how firms have to choose their strategies to perform better.
Some recent studies, for example, provide evidence that the costs of undertaking innovative activities are larger than the costs of exporting (Aw et al. 2007) which explains why innovation is undertaken by fewer firms than exporting, but other authors (Grossman and Helpman, 1991; Aw et al., 2011) have provided theoretical foundation for the interdependence of internationalization and innovation decision at the firm level.
The starting point can be to consider that different strategies can reward firms differently in terms of productivity and, in most of the cases, average outcomes are higher for firms that implement a strategy continuously than for firms that interrupt them, even if we consider the exporting strategy (e.g. Aw et al., 1998[1]) or the innovation strategy.

---

1 The authors, by comparing productivity of a group of firms which have undergone different patterns of exporting strategies, identify 4 different status for their sample firms: stay out (*firms which do not export neither in period t, nor in period t + 1*), entry (f*irms which do not export in period t and export in period t + 1*), exit (f*irms which export in time t and do not export in time t + 1*), stay in (*firms which export both in t and t + 1*).

However, the persistence of both strategies can be due to different reasons: getting involved in both of them is usually due to investment decisions that firms make according to their own expected return (profits) but there can be some motivations occurring that are not always related to gains in performance.

A firm, indeed, has to face some sunk cost of entry in each activity and uncertainty about its payoff: if we consider the exporting strategy, for example, the existence of sunk costs necessary to enter foreign markets may induce firms to stay into the foreign market, even at the cost of reducing profit margins. Then, exporting experience increases substantially the probability of exporting next year (Roberts and Tybout 1997; Basile 2001). So the decision to export turns out to be a dynamic decision that creates inter-temporal linkages (Esteve-Pérez and Rodríguez, 2013).

The same can be said if we consider the comprehensive level of persistency in innovation, and the availability of firm-level micro data on innovation activity has increased the possibility to explore sources and effects of innovation persistence.[2]

Many scholars have contributed to understanding the existence of persistence in innovation by applying an incentive-based approach to different research frameworks that can be summarized in three main crucial settings: the "knowledge accumulation" approach, the "success-breeds-success" hypothesis and the concept of sunk costs in R&D activities.

The "knowledge accumulation" hypothesis (or "the competence based-perspective") implies that, due to the intrinsic features of firms' knowledge base, firms build experience in innovation on previous innovation, and simultaneously laying foundations for future knowledge. So, starting from the two main characteristics of knowledge, cumulativeness and the non-exhaustibility, firms are more likely to be successful in future innovation because of learning-by doing or learning to learning effects (Nelson and Winter, 1982; Duguet and Monjon 2004; Latham and Le Bas 2006; Antonelli, Crespi, and Scellato, 2012). This process, most of the times, is set up by introducing a starting radical innovation followed by series of incremental

---

[2] From a theoretical point of view, the seminal work of this branch of research is the one by Arrow (1962) in which the author showed that if we compare a monopolistic setting with a competitive market, in the former case a monopolist would have a lower incentives to invest in innovation because it would have less output units to spread the fixed costs of innovation, and so she prefers to maximize profit by raising price and reducing quantity supplied compared with competitive markets.
According to this approach known as "replacement effect", indeed, the patentee's licensing in a perfect competition market could earn more profit than in a monopolistic market, and R&D activities would not decrease, since a firm in such a kind of market would have high output levels which it can spread fixed costs over and so it would be more inclined to undertake this activities bearing related costs.
Gilbert and Newberry (1982), instead, analyzed a different case: "the business stealing effect". They demonstrated that the choose about innovating or not is not a prerogative only of the potential entrants, but if the monopolist perceive the threat of the potential entrance of a competitor adopting an innovation, the incumbent has to face the decision to undertake innovation or to allow the rival to have it, facing the consequences of a possible competitive disadvantage. In this kind of setting, the incentives for the potential entrants could be lower than the monopolist's incentives, if only to deter possible successful rivals' entry (*"The monopolist will preempt if the cost is less than the profits gained by preventing entry"*).

improvements increasing the forswear of the primal innovation (Rosenberg, 1982) and through this process of progressive experience and learning ability accumulation, the firms can be more successful for future innovation (Weitzman, 1996).

Nevertheless, as said before, funding the innovation activities is a serious problem that firms frequently face because of financial constraints and also because innovation are capital-intensive, risky, and with a long-term payoff. Gaining market power and recording previous successful innovation can provide firms with internal funding raising the possibility of iterating innovation activities because of a long-lasting effect on profitability of past innovation (Antonelli, Crespi, and Scellato, 2012) .

Moving from this point, the second hypothesis ("success-breeds-success hypothesis" or "resource constraints perspective") gives a crucial role to the economic and commercial success. This approach, indeed, asserts that innovation can lead to profitability, which later funds innovation activities triggering off an iterative process of innovation (Flaig and Stadler, 1994; Latham and Le Bas, 2006). Innovating firms, therefore, can gain profits above the market average persistently and so with resulting internal cash flows, they can spend in innovation facing easier costs and reducing financial constraints to innovate persistently in the following years (Cefis and Ciccarelli, 2005; Hall, 2002; Brown et al. 2009).

The third theoretical perspective on the innovation persistence moves from one of the main limits of the "replacement effect" framework: to not consider the existence of start-up costs associated with undertaking R&D activities (among others: setting up an R&D laboratory; hiring and training specialized employees; collecting market information). Once invested in R&D activities, those entailed costs are sunk and this kind of activities implies also a long-term commitment. According to some authors *(*e.g. Antonelli, Crespi, and Scellato, 2012), these features can be barriers to entry, stay and exit from a specific regime of innovation configuring a sort of state-dependence (or inter-temporal stability) in innovation efforts. For previous non-innovators, indeed, the costs increase the risk of R&D and deter entry into innovation activities. For innovators, they reduce costs of future innovation activities and therefore make their pursuit more attractive (e.g., Máñez et al., 2009).

However, the different frameworks analyzed are more complementary than in competition and there is no uniform evidence or discriminatory testing that could give us a comparable measure of validity (Le Bas and Scellato, 2014).

The results are not consistent and they can vary according to the innovation indicator adopted: on one hand the persistence is weak if the indicator used is patenting, but using such indicator has been largely criticized for providing an incomplete information (Antonelli, Crespi, and Scellato, 2012, Clausen et al., 2013); on the other hand, if the indicator is drawn by a survey, the effect of innovation persistence is consistently stronger, particularly for the product innovation.

Furthermore, innovation persistence differs significantly across sectors, firms size classes, or if we consider different types of innovation: firms implementing mixed strategies of innovation (product *and* process) turn out to be more persistent than single innovators (product *or* process innovation).
The hypothesis above cited can also be self-reinforcing since they can interact in some way giving rise to a virtuous circle: for example, both the "knowledge accumulation" and the "success-breeds-success" hypotheses can create a scenario in which profits generated by the economic success fund R&D activities that can give the floor to the learning process to continue (Latham and Le Bas, 2006; Le Bas and Scellato, 2014).
It is worth to note, in conclusion, that the frameworks we have analyzed with respect to innovation persistence, can be extended to the export strategy. For example, the knowledge based dimension of exports is given by the regular interaction with foreign consumers, or the experience accumulated that increase returns to scale of production. But the decisions of investing in innovation or of starting to export are interrelated and can be conditioned one by the other (e.g. Ito and Lechevalier, 2010): expected returns form export participation are higher for those firms that have accumulated internal knowledge through innovation and R&D investments but previous exporting experience generates knowledge flows that enhance the innovative capability of firms.

2.2 Innovation and Internationalization: a Two-Way Relationship and the Role of Productivity.

An important aspect can be the interrelationship between exports and innovation and the existence of any possible pathways linking them since most of the empirical studies using firm-level data has frequently overlooked the relationship between export and R&D activities focusing on either innovation or export engagement, whilst considering the other activity as one of its determinants.
As it has been recently pointed out by Aw et al. (2008, 2011), export and technology decisions are interdependent and both can influence a firms' future profitability explaining why exporters usually show better performances than non-exporters.
In their structural model, they have started from the assumption that technology investments and export are undertaken depending on their expected returns but they are interrelated since, on one side, technology investments may spur firms' productivity raising expected (net) profits from exporting, and, on the other side, trade with foreign countries could increase the return to the firms' technology investment.
Apart from that, this kind of framework can lead to persistence in each activity a we have already discussed. Another important issue of this work is that they highlight two important features: the existence of a two-way

relationship between engagement in export and R&D activities (that is, past participation in export (innovation) raises the expected return from innovation (exporting), propelling current participation) and the crucial role played by productivity. Both innovation and export decisions increase future productivity but they are based on past levels of productivity itself and so the net benefits of any strategy varies according to changes in productivity levels.

The importance of the productivity in dynamic models of export participation is highlighted by different authors (Melitz, 2003; Bernard and Jensen, 2004) arguing that firms draw their productivity level from a known statistical distribution (the productivity are not derived endogenously in these models) and more productive firms start export while less productive do not export or leave the market. These ex-ante productivity differences between exporters and non-exporters can be explained by previous involvement in technological activities since they can be useful to build an absorptive structure for external knowledge.

Empirically, there is a growing number of studies that examine this relationship finding that different strategies reflect differences in productivity. (e.g. Cassiman and Martínez-Ros, 2007; Damijan et al, 2010, 2015; Becker and Egger, 2013).

More recently, Lööf et al. (2015) found that persistently innovating and persistently exporting firms grow (in terms of productivity) faster than persistently exporters that switch from being innovator to not. They distinguished different strategies of internationalization and innovation, finding that a persistent engagement in innovation investments enhances the capacity of the firms to absorb the knowledge they acquire from international activities. This absorptive capacity is influenced also by the local and regional environment: the more knowledge-intensive the social milieu, the more the firms benefit from exporting.

Some other papers, instead, try to explain how mixed strategies may enhance firms productivity. A more recent study by Damijan et al. (2015), instead, by exploring the learning effects of firms' participation in both importing and exporting through innovations, finds that both may have important beneficial effects on firm performance. The authors argue that *"a firm may learn through its international contacts and demand-supply linkages, which may, in turn, be reflected in its innovation efforts, in terms of new products or new processes"*. This learning process, however, does not translate immediately into productivity boosts, and could have an impact on productivity growth only in the long run. They highlight that there may be an exact sequence of firm's participation in trade and subsequent learning effects, starting either by trading status (importing/ exporting) or by innovator status (product, process or joint product-process). The results indicate that smaller firms benefit from import links to learn production process, and this may help them to get prepared for entering to foreign markets.

In conclusion, the study of the interrelationship between all the different strategies (in terms of both trade participation and innovation) is still

characterized by heterogeneity and it needs further research to accumulate a body of empirical evidence to serve as basis for an unquestioning acceptance of the phenomenon.

3. Data and descriptive statistics.

In this chapter we will use the data from Capitalia, now taking up a different design with respect to the previous chapter.
As said previously, our main purpose of analysis is to go into a different aspect of the relationship between innovation and exports: we want to see if the persistence in both of them influences the firms performance in terms of productivity.
The panel structure of our dataset and the information provided allow to implement a study that accounts for persistence, so starting from the initial unbalanced dataset, we build a balanced one with all the firms observed in all the three waves we consider. Moving from this intermediate step, we will distinguish firms between persistent and temporary exporters[3], building two different dataset in which we will measure the joint impact of different strategies (already summarized in the Table 1) on the categories of firms. We considered three different strategies of innovation activity: first of all, we identify as a *persistent innovator* a firm which persistently innovate over the time span we consider; second, a *start innovating firm* is a firm that has not innovated at time *t-1* and starts innovating a *t*; finally, we identify the *stop innovating* firms as those innovating at *t-1* but that do not show any innovation at time *t*.
The starting dataset is a dataset with 14.106 observations (more than 4.700 observations, on average, per wave) covering an eight-year period (1998-2006); it is unbalanced and it contains observations on more than 10.700 firms. As already said, we combined the data obtained by merging the three different waves, initially separated, by using an identifying number for each firm, that allowed us to add also balance sheet information to our dataset.[4]

---

[3] In this chapter we do not distinguish between different internationalization strategies as in previous chapter. This would be interesting but the structure and the number of observation at our disposal do not allow to identify persistency in other international activities (e.g. FDI and outsourcing).

[4] As in the previous chapter, also in this case, balance sheet data are gathered from CERVED dataset. Moreover, firms included into the surveys are in part renewed at a three-years time interval, given the particular design of the panel (stratified and rotating). This kind of approach is carried out for two different motivations: on one hand, to analyze variations of firms observed, for the part of the survey that is kept constant; on the other hand, to analyze any structural change of the Italian economy, for the part of the sample varying in each wave.

Figure 1

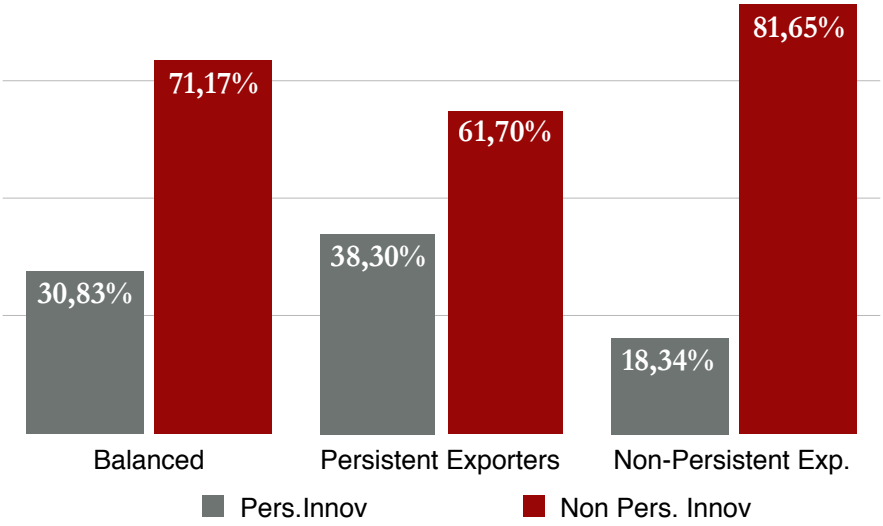


Table 2 - Comparing the datasets

DATASET	Balanced Panel	Persistent Exporters	Non Persistent Exporters
Observations	1.353 *(100%)*	846 *(62, 53%)*	507 *(37,47%)*
Unique firms	451	282	169

As we can see from Table 2, in the sub-datasets of the balanced panel we have isolated the persistent exporters, that representing the majority of the firms (62,53%) of the starting balanced panel, whilst the remaining (37,47%) has not exported permanently.
Looking at innovation, instead, firms that innovate persistently is, as expectable, the minority compared to persistent innovators. Results from Table 3 suggest that exporting over time is somehow associated more frequently with innovation since the percentage of persistent innovators grows in this case, whilst the non persistent innovators' percentage is higher in the case of non persistent exporters.

Table 3 - Comparing the datasets - Persistent innovators

DATASET	Balanced Panel		Persistent Exporters		Non Persistent Exporters	
	Pers. Inn.	Non-Pers. Inn	Pers. Inn.	Non-Pers. Inn	Pers. Inn.	Non-Pers. Inn
Observations	417	936	324	522	93	414
Unique firms	139	312	108	174	31	138

Source: own calculation.

If we compare the two groups through summary statistics[5] (Table 4), we can see that if we do not make any distinction about the innovation strategy, on average, persistent exporters are slightly more mature but significantly larger than their counterparts and they are also more capital intensive and productive.

Table 4 - Summary statistics: Persistent vs. Non-Persistent exporters (1998-2006)

	Persistent Exporters			
	Mean	**Std. Dev.**	**Min**	**Max**
Average age (in years)	33,638	19,11	0	242
Average Number of Employees	225,8	710,81	7	9097
Average capital intensity (in thousands of €)	145,73	460,37	0	8171,4
Average productivity (Value added per employee)	64.335,58	204.625	339,06	532.6621
	Non-Persistent Exporters			
	Mean	**Std. Dev.**	**Min**	**Max**
Average age (in years)	31,899	20,769	0	175
Average Number of Employees	113,03	408,45	4	6337
Average capital intensity (in thousands of €)	114,07	317,36	0,002	3.141,3
Average productivity (Value added per employee)	54.568,53	54.183,42	3.294,936	767.304,6

Source: own calculation

It turns out that similar results come up if we compare firms' characteristics without any distinction about exporting strategies[6]. Firms that undertake permanently innovation strategies seems to be more mature and bigger besides being more capital intensive and productive (Table 5).

[5] In this table, the first four rows are computed as in the Table 4 of Chapter 2 to ensure the comparison of these characteristics between the datasets used. These features are in keeping with those of the firms present in the unbalanced panel.

[6] These summary statistics are computed on the Balanced Panel.

Table 5 - Summary statistics: Persistent vs. Non-Persistent Innovating (1998-2006)

	Persistent Innovating			
	Mean	**Std. Dev.**	**Min**	**Max**
Average age (in years)	33.619	19,445	0	133
Average Number of Employees	212,732	416,386	7	5.128,667
Average capital intensity (in thousands of €)	118,516	271,444	0,002	2764,69
Average productivity (Value added per employee)	77.891,45	289.709,9	5.891,242	5.326.621
	Non-Persistent Innovating			
	Mean	**Std. Dev.**	**Min**	**Max**
Average age (in years)	31,899	20,769	0	175
Average Number of Employees	113,03	408,45	4	6337
Average capital intensity (in thousands of €)	114,07	317,36	0,002	3.141,3
Average productivity (Value added per employee)	54.568,53	54.183,42	3.294,936	767.304,6

Source: own calculation

Now we investigate the characteristics of the firms crossing the strategies, through the (unconditional) distribution (on a log-scale) of the total factor productivity[7] (Figure 2), of the age (Figure 3), and of the size (Figure 4). There are several ways to estimate distributions following both parametric and non-parametric frameworks, with different advantages and disadvantages. We decide to use a non-parametric approach because ,unlike the parametric one (that focuses typically on two different moments of the distribution: the conditional mean and the variance), it allows to see the evolution of the entire distribution of the variable over time distribution. Moreover, the non-parametric approach is much more suitable when the object of analysis are large and heterogeneous samples of firms (Iona et al., 2013).

There are several alternative kernel functions that can be used according to different purposes. We use the Gaussian kernel[8] because of its property of monotonicity that turns out to be useful when comparing distributions over time is of interest (Silverman, 1986). The bandwidth is set according to the

7 In this case, as in our estimations, the TFP is calculated à la Levinsohn-Petrin, as we will see in the next paragraph.

8 We also estimated densities with the Epanenchnikov kernel function, setting the bandwidth according to the "optimal" rule from Silverman (1986), and the results were very similar. See appendix

"optimal" rule from Silverman (1986) that works well when the Gaussian kernel density function is applied (Iona et al., 2013).

We report the kernel density to compare, among the two groups of persistent and non-persistent exporters, these characteristics of persistent innovators and firms that start or stop innovating.

At a first glance, if we look at Figure 2, we can see that in the case of persistent exporters (left), the densities tend to display a tent-shape and fatter tails especially in the case of start-inventing firms. This kind of evidence is in support of the application of regression techniques that can account for the heterogeneous role of innovation strategies.

Figure 2 - Kernel densities of total factor productivity (TFP) for persistent exporters (left) and non-persistent exporters (right), by different innovation strategies.

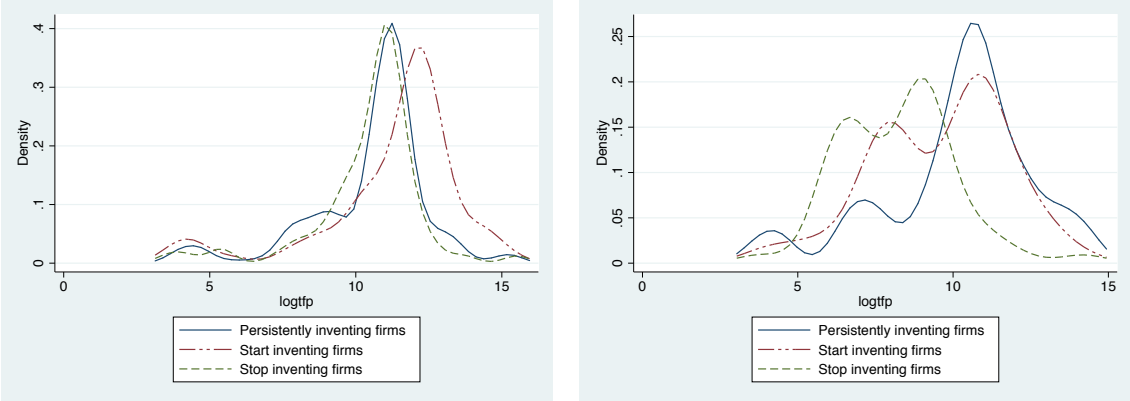
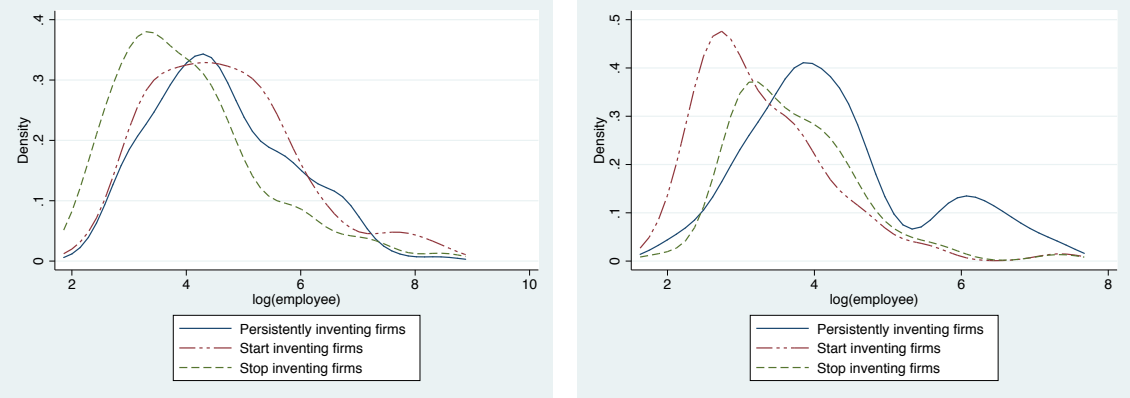


Figure 3 - Kernel densities of average number of employees (in log) for persistent exporters (left) and non-persistent exporters (right), by different innovation strategies.

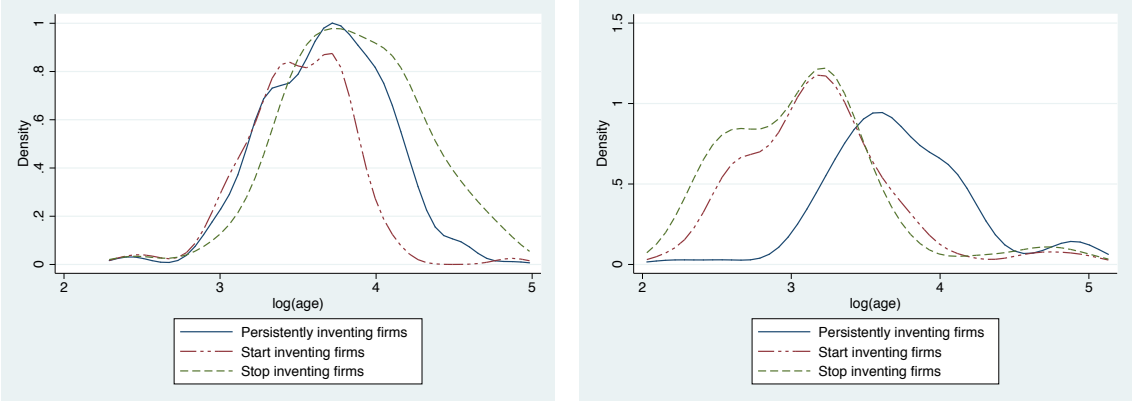


It is worth, also, to highlight that kernel estimates show some kind of different results for different strategies of innovation and, in particular, in both groups, persistent innovators show less dispersed TFP values.

Looking at the distribution of the densities, if we consider firms' size (Figure 3) they are left-shifted, confirming that the Italian entrepreneurial scenario is built on SME, and also in this case, a greater "uniformity" is displayed in the case of persistent exporters (left) than non persistent exporters (right).

Finally, comparing the densities by firms' age (Figure 4), here the densities

Figure 4 - Kernel densities of age (in log) for persistent exporters (left) and non-persistent exporters (right), by different innovation strategies.



are right-shifted and in the case of persistent innovators (in the non persistent exporting group) this difference is more apparent.
In conclusion, the persistent innovators appear, in distributional terms and from the very preliminary summary statistics computed, more productive, larger and older and this is both if they are persistent exporters or not.

4. Empirical specifications and estimation strategy: From Innovation to TFP.

In this session we deepen the analysis of the role of innovation in enhancing firms' productivity to examine, by econometric tools, whether differences in learning-by-exporting can be explained by differences in persistence of firms' innovation activities.
So, first, we exploit the classification of firms into persistent exporters vs. non-persistent exporters and, second, we measure the effect of different strategies of innovation on productivity over the available time-span (1998-2006).
Our approach is based, first of all, on the estimation of the productivity that will be our variable of interest. Specifically, we measure the total factor productivity at sector level (henceforth, TFP) à la Levinsohn and Petrin (2003)[9]. Moreover, we use a dummy variables as proxy of innovation, identifying the innovation strategies. Despite the existence of a considerable stream of literature that uses other indicators of innovation (e.g. patents), there has been a discussion about the advantages and disadvantages of using patents (e.g. Grilliches, 1990; Lööf , 2015): even if patents can be more objective, the innovation does not always lead to patent applications.

9 Considering that according to the authors the productivity follows a first-order Markov process, we include the lagged *tfp* and a vector of firm characteristics which includes firms' size measured by the logarithm of the average number of employees, the logarithm of total real assets, and the logarithm of the inputs.

Then, to explore at which extent the learning by exporting effect varies across different types of firms, we next take into account the heterogeneity that characterizes firms in our dataset. We focus on three dimensions of heterogeneity that affect the knowledge acquisition process: the ownership; if firms have undertaken any foreign direct investment; the investments in innovation. Concerning the ownership, we control for foreign ownership through a dummy variable that indicates if the controlling stake of the firm is owned by a foreign agent. Moreover, we next consider if the firm is part of a group and if the firm has invested abroad through FDI through two different dummy variables. For the investment in innovation, we use two dummy variables indicating if the firm has invested in ITC or in R&D. Investing in this kind of activities, indeed, enhances the absorptive capacity of the firm i.e. the ability of internalizing the knowledge flows that come from the contact with foreign consumers. Finally, we include a set of controls for firms' age, localization, and industry and we control for firms' size using both the number of employees and its square to control for collinearity. The variables in the two datasets we use are summarized[10] in Table 5.

Table 5 - Summary statistics: Persistent vs. Non-Persistent exporters

	Persistent Exporters					Non-Persistent Exporters				
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
TFP[a]	734	10,28	1,931	3,086	15,55	439	9,625	2,073	3,531	16,42
Pers. Innov	846	0,383	0,486	0	1	507	0,183	0,387	0	1
Start Innov	846	0,128	0,334	0	1	507	0,148	0,355	0	1
Stop Innov	846	0,102	0,302	0	1	507	0,128	0,335	0	1
Inves. ITC	758	0,840	0,366	0	1	436	0,786	0,410	0	1
Inves. R&D	825	0,659	0,474	0	1	497	0,428	0,495	0	1
FDI	588	0,063	0,243	0	1	336	0,012	0,108	0	1
ForOwn	846	0,072	0,259	0	1	507	0,037	0,19	0	1
Group	841	0,299	0,458	0	1	505	0,194	0,396	0	1
Age	842	33,63	19,11	0	232	507	31,89	20,76	9	165
Size[b]	836	225,8	710,8	6,67	9097	496	113,1	408,4	4	6337

[a] The productivity is computed a la Levinsohn-Petrin.

[b] The size is computed as the average number of employees.

For the sake of brevity, industry and area dummies are not displayed.

Source: own calculation

10 In the Appendix (Table A1), the variables are also displayed for the balanced Panel.

So, starting from the idea that firms can undertake different strategies both on the innovation side and on the export side, we will proceed by steps: we want to see, separately, the effect on TFP, first of all, of exporting (persistently or not); second, we want to see how the different innovation strategies influence the productivity of the firm, without considering the effect of the export strategy; finally, to consider the effect of both strategies jointly, we will estimate our equation of interest on datasets divided according to the exporting strategy.

We start from the assumption the firm *i* desired productivity level at time *t*, TFP^*_{it} as function of international strategy (I_{it}), a set of firms specific characteristics (F_{it}).

$$TFP^*_{it}=TFP^*(I_{it}\,;\,F_{it}) \tag{1}$$

The drawback of our model is that firms are not assumed to change the level of the productivity easily since it would require some structural changes in capital, production process, workforce composition that would require time.

For this reason, our model can be considered as based on a partial adjustment model in which the changes in productivity could take place gradually and the difference in productivity between periods *t* and *t-1* is some fraction $0<\lambda\leq 1$ of the TFP desired level, that captures the delay in the adjustment process (Leonida et al. 2013).

$$(TFP_{it} - TFP_{it\text{-}1})= \lambda\,(TFP^*_{it} - TFP_{it\text{-}1}) \tag{2}$$

then,

$$TFP_{it} = (1\text{-}\lambda)\,TFP_{it\text{-}1} + \lambda TFP^*_{it} \tag{3}$$

So we combine the Equation (1) with Equation (3), considering the international strategy in the variable *Strategy* that can be different according to the strategy chosen, and we add the firms specific characteristics:

$$\begin{aligned} TFP_{it}= \alpha + \beta_1 TFP_{it\text{-}1} + \beta_2\, Strategy_{it} + \beta_3\, Ownership_{it\text{-}1} + \beta_4\, ITC_{it\text{-}1} + \\ + \beta_5\, R\&D_{it\text{-}1} + \beta_6\, FDI_{it\text{-}1} + \beta_7\, Group_{it\text{-}1} + \beta_8\, Size_{it\text{-}1} + \beta_9\, Size^2_{it\text{-}1} + \beta_{10}\, X_{it} + u_{it} \end{aligned} \tag{4}$$

So, we will estimate a specific version of Equation (1):

$$\begin{aligned} TFP_{it}= \alpha + \beta_1 TFP_{it\text{-}1} + \beta_2\, Pers\_Invent_{it} + \beta_3\, Start\_Invent_{it} + \beta_4\, Stop\_Invent_{it} + \beta_5\, Ownership_{it\text{-}1} + \\ + \beta_6\, ITC_{it\text{-}1} + \beta_7\, R\&D_{it\text{-}1} + \beta_8\, FDI_{it\text{-}1} + \beta_9\, Group_{it\text{-}1} + \beta_{10}\, Size_{it\text{-}1} + \beta_{11}\, Size^2_{it\text{-}1} + \beta_{12}\, X_{it} + u_{it} \end{aligned} \tag{5}$$

in which the innovation is considered through different strategies and the export is measured through splitting the dataset in persistent exporters and non exporters.
The dependent variable is the TFP à la Levinsohn-Petrin, but, since the contemporaneous productivity is closely related to productivity in previous periods, on one hand, it motivates the lagged structure of the model and, on the other hand, it is necessary to model the regression as an autoregressive process in which we will include on the right-hand side the 1-period lagged TFP.
After the dummies for innovation strategies (*Pers_Invent; Start_invent; Stop_Invent),* then we include a set of (lagged) variables to control for firms heterogeneity. In particular, we consider a dummy for the ownership identifying if the firm is foreign-owned or not (*Ownership*); two different dummies for investing both in information, technology and communication (*ITC*) and in research (*R&D*); moreover, we consider two more dummies, one indicating if firms have invested abroad (*FDI*) and if it is in a group of companies (*Group*). To control fo firms size, instead, we use the size of the firms computed as the number of employees and its square. Finally, we include a set of controls for firms' age (in logarithm), localization (North, South, South-East, South-West, and Islands), and industry (ATECO classification - 2 digit).
Firstly, we estimate this equation through a simple OLS regression just to have a simple clue of the existence of any relationship.
In our model, the presence of the lagged dependent variable, TFP_{it-1}, captures the adjustment process of the dependent variable; it is necessarily correlated to the firms specific characteristics even if the idiosyncratic component of the error term is serially uncorrelated and, so, the OLS estimator leads to inconsistent parameter estimates.
So, we make use of the two step system general methods of moments (GMM) estimator developed by Arellano and Bond (1991) which allows us to control for any possible simultaneity and endogeneity problem in our model and also because our panel present the typical structure "small T , large N ".
This methodology is useful because it makes the additional assumption that the first differences of the instrumenting variables are uncorrelated with the fixed effects (Leonida et al., 2013). The validity of the instruments is tested using the Hansen and Sargan statistics and the Hansen in difference test to test the validity of additional moment conditions.

5. Persistence vs Temporariness.

As said before, first of all we want to see how the different strategies influence firms' productivity, at a first stage separately and then jointly.

At a first stage, we consider the effect of exporting persistently, without making any distinction on the innovation decisions (Table 6). So we first estimate the equation (1) for the balanced panel without making any distinction about innovation and using a dummy that identifies if the firm has exported permanently (or not) over the time-span considered. We consider at first an OLS estimation and then the two-step system GMM[11].

The results in Table 6 show that exporting persistently seems to have a positive effect on TFP but it is not significant. If we focus on GMM results, it comes out that, even if all the variables considered show positive coefficients apart from being part of a group, investing abroad, and being more mature firms that export persistently which all have an higher return in terms of productivity.

Making a little step forward, we want to see if there could be an effect for firms that export (now we use a dummy just indicating if the firm exports or not) and innovate persistently. Looking at the results in Table 7, we can see that the strategies considered show not significant coefficient but, in the case of exports, it is also negative. In the GMM column, for firms that export and persistently innovate, only the age seems to have a positive effect on productivity since more mature firms may have acquired knowledge that allows to perform better.

Table 7 - Estimation results (B.P.) - Strategy: Pers. Inn. & Export; Dependent variable:TFP.

	OLS	**GMM**
TFP$_{it-1}$	0.159***	0.145**
	(0.053)	(0.060)
Pers. Innov$_{it}$	0.062	0.026
	(0.048)	(0.064)
Export$_{it}$	-0.058	-0.001
	(0.051)	(0.085)
ITC$_{it-1}$	0.037	-0.011
	(0.049)	(0.059)
R&D$_{it-1}$	0.129***	0.081
	(0.047)	(0.050)
FDI$_{it-1}$	0.134	0.065
	(0.107)	(0.094)
ForOwn$_{it-1}$	-0.028	-0.072
	(0.099)	(0.087)
Group$_{it-1}$	0.214***	-0.050
	(0.062)	(0.116)
Age$_{it-1}$	0.049	0.109*
	(0.037)	(0.059)

11 In all estimations, we consider the time invariant variables as instruments treating the time-variant ones as potentially endogenous, generating GMM-style instruments for them. We consider instruments lagged one time. Industry dummies, region dummies and age are always included in the instruments set.

	OLS	GMM
Size$_{it-1}$	0.001* (0.000)	0.001 (0.001)
Size$^2_{it-1}$	-0.000 (0.000)	-0.000 (0.000)
Industry	(Yes)	(Yes)
Region	(Yes)	(Yes)
cons	8.643***	8.978***
No. obs.	571	324
Sargan test		0.101
Hansen test		0.475
Difference in Hansen		0.293

Balanced Panel. *i* indexes firms and *t* time
* p<0.1; ** p<0.05; *** p<0.01
Standard errors in brackets.
Source: own calculation. Industry and area dummies included

In order to understand if the strategy reward firms more if they are undertaken jointly and persistently, it is fundamental to consider also the effect of the different innovation strategies on TFP without considering the export dimension.
Now we estimate the Equation (2) first of all on the Balanced Panel (Table 8) and then, as already said, splitting the sample in persistent exporters and non-persistent exporters (Table 9).

Table 8 - Estimation results (B.P.) - Strategy: Pers./Start/Stop Inn. - Dependent variable: TFP

	No distinction between exporting strategies	
	OLS	**GMM**
TFP$_{it-1}$	0.160*** (0.052)	0.157*** (0.059)
Pers. Innov$_{it}$	0.083 (0.068)	0.088 (0.058)
Start Innov$_{it}$	0.082* (0.049)	-0.057 (0.058)
Stop Innov$_{it}$	0.009 (0.044)	0.009 (0.054)
ITC$_{it-1}$	0.035 (0.048)	0.031 (0.050)
R&D$_{it-1}$	0.116** (0.050)	-0.014 (0.047)
FDI$_{it-1}$	0.128 (0.107)	0.205** (0.093)

Table 6 - Estimation results (B.P.) - Strategy: Pers. Exp.; Dependent variable: TFP.

	OLS	**GMM**
TFP_{it-1}	0.160***	0.177***
	(0.053)	(0.063)
Pers. $Export_{it}$	0.025	0.026
	(0.045)	(0.062)
ITC_{it-1}	0.034	0.002
	(0.047)	(0.055)
$R\&D_{it-1}$	0.123***	0.036
	(0.046)	(0.044)
FDI_{it-1}	0.127	0.203**
	(0.107)	(0.097)
$ForOwn_{it-1}$	-0.028	-0.044
	(0.099)	(0.090)
$Group_{it-1}$	0.205***	-0.103
	(0.060)	(0.114)
Age_{it-1}	0.046	0.114**
	(0.036)	(0.058)
$Size_{it-1}$	0.001*	0.001
	(0.000)	(0.001)
$Size^2_{it-1}$	-0.000	-0.000
	(0.000)	(0.000)
Industry	(Yes)	(Yes)
Region	(Yes)	(Yes)
cons	8.620***	8.651***
No. obs.	579	331
Sargan test		0.108
Hansen test		0.442
Difference in Hansen		0.249

Balanced Panel. *i* indexes firms and *t* time
* p<0.1; ** p<0.05; *** p<0.01
Standard errors in brackets.
Source: own calculation. Industry and area dummies included

	No distinction between exporting strategies	
	OLS	**GMM**
$ForOwn_{it-1}$	-0.029	-0.027
	(0.101)	(0.087)
$Group_{it-1}$	0.201***	-0.131
	(0.058)	(0.117)
Age_{it-1}	0.051	0.171***
	(0.036)	(0.058)

	No distinction between exporting strategies	
	OLS	**GMM**
$Size_{it-1}$	0.001* (0.000)	0.001 (0.001)
$Size^2_{it-1}$	-0.000 (0.000)	-0.000 (0.000)
Industry	(Yes)	(Yes)
Region	(Yes)	(Yes)
cons	8.587***	8.691***
No. obs.	579	331
Sargan test		0,108
Hansen test		0.470
Difference in Hansen		0.366

* p<0.1; ** p<0.05; *** p<0.01; *i* indexes firms and *t* time
Standard errors in brackets.
Source: own calculation. Industry and region dummies included

If we look at the column of OLS in Table 8, first of all, we can see that all the strategies introducing innovation persistently shows an higher coefficient with respect to other strategies, but only starting innovation shows a significant (although weakly) coefficient. Stop innovating, instead, shows a positive but not significant coefficient.
As expected, investing in ITC and R&D show positive coefficients (the latter also significant) since the involvement in these activities enforces the possibility of accumulating knowledge that can spur productivity.
Concerning the foreign ownership and being part of a group of companies, in the first case, the coefficient is negative and not significant, in the second it is positive and significant. These results suggest that firms could benefit in productivity from knowledge flows that arise from links and connections with other firms.
If we look at the column of GMM estimation, the lagged TFP shows a positive and significant coefficient and the results are pretty similar even though, in this case, the coefficient of innovation strategies loose significance.
Furthermore, investing abroad ensures a positive return in productivity since firms that are involved in this internationalization strategy can acquire competences that, once internalized, can have a positive impact on TFP and, moreover, seems that more mature firms perform better that younger firms.
What we are really interested in is the joint effect of innovation and export persistence and so we will estimate Equation (2) for two alternative panels corresponding to persistent exporters and non-persistent exporters (Table 9).

Table 9 - Estimation results for different exporting strategies - Dependent variable: TFP

	Persistent Exporters		Non Persistent Exporters	
	OLS	**GMM**	**OLS**	**GMM**
TFP_{it-1}	0.199**	0.329***	0.188***	0.542***
	(0.097)	(0.115)	(0.061)	(0.156)
Pers. $Innov_{it}$	0.075	0.215**	0.030	-0.201*
	(0.095)	(0.098)	(0.100)	(0.121)
Start $Innov_{it}$	0.068	0.028	0.089*	-0.023
	(0.081)	(0.095)	(0.052)	(0.084)
Stop $Innov_{it}$	0.001	0.135	0.022	-0.177
	(0.069)	(0.086)	(0.055)	(0.116)
ITC_{it-1}	0.043	-0.049	-0.029	-0.077
	(0.061)	(0.098)	(0.066)	(0.121)
$R\&D_{it-1}$	0.076	0.032	0.144**	0.252*
	(0.068)	(0.094)	(0.066)	(0.145)
FDI_{it-1}	0.137	0.310**	-0.023	0.183
	(0.116)	(0.138)	(0.296)	(0.310)
$ForOwn_{it-1}$	-0.008	0.039	-0.051	-0.144
	(0.106)	(0.102)	(0.199)	(0.206)
$Group_{it-1}$	0.271***	-0.124	0.055	-0.031
	(0.083)	(0.160)	(0.082)	(0.302)
Age_{it-1}	0.043	0.159*	0.023	-0.300*
	(0.043)	(0.086)	(0.067)	(0.155)
$Size_{it-1}$	0.000	0.001*	0.001*	0.002
	(0.000)	(0.000)	(0.001)	(0.001)
$Size^2_{it-1}$	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Industry	(Yes)	(Yes)	(Yes)	(Yes)
Region	(Yes)	(Yes)	(Yes)	(Yes)
cons	8.192***	6.770***	8.519***	0.000
No. obs.	360	211	219	218
Sargan test		0.156		0.231
Hansen test		0.888		0.289
Diff. in Hansen		0.644		0.289

* p<0.1; ** p<0.05; *** p<0.01; *i* indexes firms and *t* time
Standard errors in brackets.
Source: own calculation. Industry and area dummies included

When the assessment is restricted to different exporting strategies, the lagged TFP is positive and significant (in the GMM as in the OLS estimations) since, as said, the current value of productivity is influenced by previous values.

If we look, instead, at the at the column of GMM estimations, the innovation strategies show different coefficients. What comes out is that innovating persistently has a positive (and significant) effect on productivity, only if it is also associated with a continuous exporting strategy. By contrast, temporary innovation efforts do not show significance and this could be due to the fact that firms that switch from not innovating to innovating or viceversa can not benefit from the process of knowledge accumulation since the internalization of knowledge flows could require time to be turned into productivity gain.

A preliminary and tentative conclusion we can draw is that mature firms starting innovation activity get returns on TFP as well as that being involved in foreign direct investments can facilitate knowledge flows between firms triggering a learning-by-doing effect.

Also in this case, investing abroad has a positive and significant effect on productivity only if it is associated with persistent exports. Investing abroad, indeed, is usually a less preferred strategy since it is more complex, requiring higher investments and commitment and it usually comes in a second moment with respect to export.

Moreover firms that do not export permanently are more concentrated on internal R&D than their exporting counterparts since exporting in some cases can replace internal R&D.

Finally, if we look at the age of the firms, we can see that older firms that do not export persistently may suffer the competition of younger firms, whilst those that export, even older, may benefit from exporting persistently in terms of productivity by having access to knowledge keeping up with tastes of consumers. In all our estimations, no evidence of serial correlation in the error terms can be found: the null hypothesis that the population moment conditions are correct is not rejected because the p-value for both the Hansen and the Sargan statistics is >0.05. Further, the Hansen in difference test does not reject the validity of the additional moment conditions used by system GMM.

6. Concluding remarks.

In this chapter we have investigated the role of innovation and export in influencing productivity for Italian manufacturing firms for a eight-year time-span. We consider three different strategies in innovation that firms can pursue: firms can persistently innovate iterating their activity all over the period; they can start innovating if in previous period they have not

innovated; finally they can stop introducing innovation if they do not invent anymore when they have invented before.

After considering separately the effect of both innovation and export strategies on TFP, we have investigated the joint effect of persistence in both innovation and exporting, using two different dataset: one with only persistent exporters (firms that have exported permanently over the time-span) and non-persistent exporters (or temporary, firms that started or stopped exporting in the period considered).

Our aim was to see if different strategies in innovation or in export may have a different effect on TFP and if this effect is boosted by the joint effect of persistence in both strategies.

When we consider the strategies separately, their effects are not significant and they do not allow firms to gain productivity. Moreover, firms' permanent efforts in innovation activities have a positive and significant impact on TFP only if they are associated with a likewise enduring export activity, otherwise they could have a negative effect on productivity. This could be due to the crucial role in internalizing knowledge flows from long-lasting (and not occasional) interactions with foreign customers and competitors deriving from exporting regularly. If combining both strategies can be an opportunity for even older firms that can face the fiercer competition from younger, by contrast, not undertaking both strategies could transform persistent innovation in a factor of weakness for firms, even if they try to provide for it by internal R&D. Innovation activities, as said, are costly and the existence of start-up costs could "imprison" firms in a sort of state-dependence (or inter-temporal stability) in innovation efforts.

In conclusion, the most relevant results of our estimations are in favor of the hypotheses that persistently innovating *and* persistently exporting firms have better results in terms of productivity than persistently exporting firms that do not innovate persistently and than firms that do not export persistently. Furthermore, persistent innovation efforts must be associated with a permanent presence on foreign markets, to not transform opportunities in threats.

Appendix A1

In Table A1 there are summary statistics of the Balanced Panel.

Table A1 - Summary statistics: Balanced Panel

	No distinction among exporters				
	Obs.	**Mean**	**Std. Dev.**	**Min**	**Max**
TFP[a]	1173	10,037	2,011	3,086	16,42
Pers. Innov	1353	0,308	0,462	0	1
Start Innov	1353	0,135	0,342	0	1
Stop Innov	1353	0,112	0,315	0	1
Inves. ITC	1194	0,821	0,384	0	1
Inves. R&D	1322	0,573	0,495	0	1
FDI	924	0,044	0,206	0	1
ForOwn	1353	0,059	0,236	0	1
Group	1346	0,26	0,439	0	1
Age	1349	32,98	19,76	0	232
Size[b]	1332	183,81	618,05	4	9097,333

[a] The productivity is computed a la Levinsohn-Petrin.

[b] The size is computed as the average number of employees.

For the sake of brevity, industry and area dummies are not displayed.

Source: own calculation

Appendix A2

Epanenchnikov kernel estimations. The bandwidth is set according to the "optimal" rule from Silverman (1986).

Figure A1 - Kernel densities of age (in log) for persistent exporters (left) and non-persistent exporters (right), by different innovation strategies.

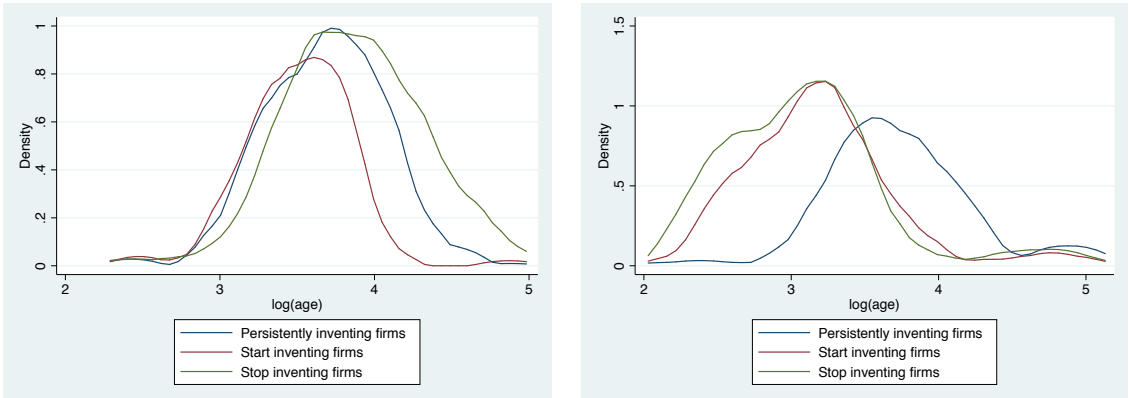


Figure A2 - Kernel densities of total factor productivity (TFP) for persistent exporters (left) and non-persistent exporters (right), by different innovation strategies.

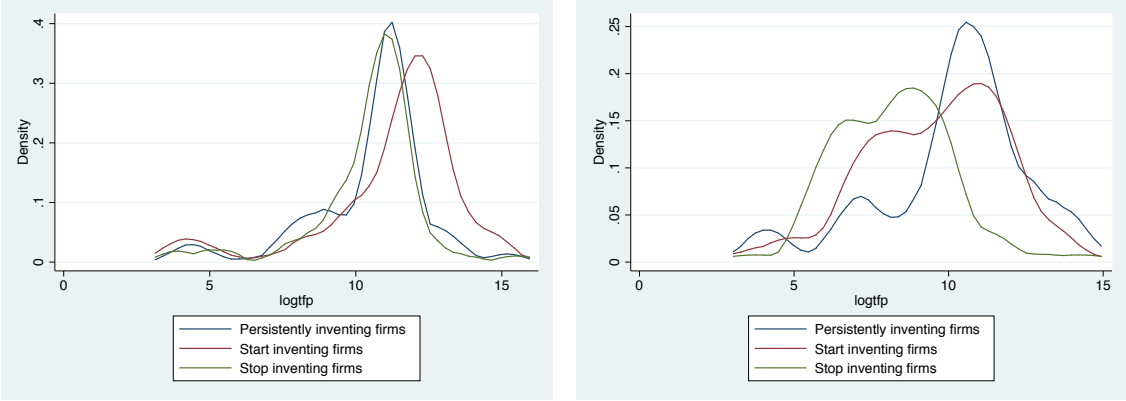
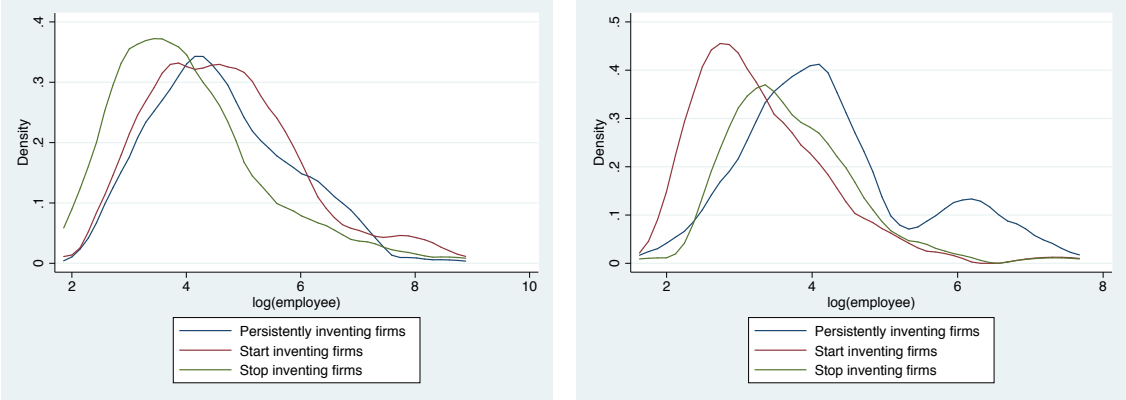


Figure A3 - Kernel densities of average number of employees (in log) for persistent exporters (left) and non-persistent exporters (right), by different innovation strategies.



References.

- **Agostino, M., Leonida, L., & Trivieri*, F.** (2005). *Profits persistence and ownership: evidence from the Italian banking sector*. Applied Economics, 37(14), 1615-1621.
- **Andersson, M., & Lööf, H.** (2009). Learning‐by‐exporting revisited: The role of intensity and persistence. *The Scandinavian Journal of Economics*, *111*(4), 893-916.
- **Antonelli, C., F. Crespi, and G. Scellato**. (2012) "Inside Innovation Persistence: New Evidence from Italian Micro-Data." Structural Change and Economic Dynamics 23 (4): 341–353.
- **Arellano, M., and S. Bond.** (1991) Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Review of Economic Studies 58: 277–297.
- **Arrow, K. J.** (1962) "EconomicWelfare and the Allocation of Resources for Invention." In The Rate and Direction of Inventive Activity: Economic and Social Factors, edited by R. R. Nelson, 609–626. Princeton, NJ: National Bureau of Economic Research and Princeton University Press.
- **Aw B. Y., Chung S., Roberts M.J.**, (1998) "Productivity and the decision to export: micro evidence from Taiwan and South Korea". No. w6558. N*ational Bureau of Economic Research*
- **Aw BY, Roberts MJ, Winston T**, (2007) *"Export market participation, investments in R&D and worker training, and the evolution of firm productivity"*. The World Economy 30:83-104
- **Aw, B. Y., Roberts, M. J., & Xu, D. Y.** (2008). *R&D investments, exporting, and the evolution of firm productivity*. The American Economic Review, 98(2), 451-456.
- **Aw, B. Y., Roberts M. J., Xu D. Y.,** (2011) *"R&D Investment, Exporting and Productivity Dynamics", American Economic Review."* American Economic Association 101 (4): 1312–1344
- **Basile R.**, (2001) *"Export behaviour of Italian manufacturing firms over the nineties: the role of innovation"* Research Policy, Elsevier, vol. 30(8), pages 1185-1201, October.
- **Becker, Sascha O. and Peter H. Egger.** (2013) Endogenous Product versus Process Innovation and a Firm's Propensity to Export. *Empirical Economics*. 44(1). pp. 329–54.
- **Bernard, A. B., & Jensen, J. B.** (2004). *Exporting and Productivity in the USA*. Oxford Review of Economic Policy, 20(3), 343-357.
- **Blundell, R., and S. Bond.** (1998) Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87: 115–143.
- **Brown,W. M., and D. L. Rigby.** (2009) "Marshallian Localization Economies: Where Do They Come from and to Whom Do They Flow." *California Centre for Population Studies, Online Working Paper Series CCPR-2009-020*.

- **Cassiman, B., & Martinez-Ros, E.** (2007). Product innovation and exports. *Evidence from Spanish manufacturing, IESE Business School, Barcelona*, 1-36.
- **Cefis, E., and M. Ciccarelli.** (2005) "Profit Differentials and Innovation." *Economics of Innovation and New Technology 14 (1–2): 43–61.*
- **Clausen, H., and M. Pohjola.** (2013) *"Persistence of Product Innovation: Comparing Breakthrough and Incremental Product Innovation."* Technology Analysis & Strategic Management 25 (4): 369–385.
- **Cohen, W. M., & Klepper, S.** (1996). A reprise of size and R & D. *The Economic Journal*, 925-951.
- **Damijan J.P., Kostevc C.,** (2015) *"Learning from trade through innovation"* Oxford Bulletin Of Economics And Statistics, 77, 3 0305–9049.
- **Damijan, J. P., C. Kostevec, and S. Polanec.** (2010) "From Innovation to Exporting or Vice Versa?" The World Economy 30 (1): 374–398.
- **Duguet, E., and S. Monjon.** (2004) "Is Innovation Persistent at the Firm Level? An Econometric Examination Comparing the Propensity Score and Regression Methods." *Cahiers de la Maison des Sciences Economiques. Universit. Panth.on-Sorbonne.*
- **Esteve-Pérez, S., & Rodríguez, D.** (2013). The dynamics of exports and R&D in SMEs. *Small Business Economics*, *41*(1), 219-240.
- **Feldman, M. P., & Kogler, D. F. (2010)**. Stylized facts in the geography of innovation. *Handbook of the Economics of Innovation*, *1*, 381-410.
- **Flaig, G., and M. Stadler.** (1994) "Success Breeds Success. The Dynamics of the Innovation Process." *Empirical Economics 19 (1): 55–68.*
- **Gilbert, R., and D. Newberry.** (1982) "Pre-emptive Patenting and the Persistence of Monopoly." American Economic Review 72 (3): 514–526.
- **Griliches, Z.** (1990) "Patent Statistics as Economic Indicators: A Survey." Journal of Economic Literature, American Economic Association 28 (4): 1661–1707.
- **Grossman, G. M., & Helpman, E.** (1991). Trade, knowledge spillovers, and growth. *European economic review*, *35*(2-3), 517-526.
- **Hall, B. H.** (2002). The financing of Research and Development. *Oxford Economic Review of Economic Policy, 18, 35–51.*
- **Iona, A., Leonida, L., & Navarra, P.** (2013). *Business group affiliation, innovation, internationalization, and performance: A semiparametric analysis.* Global Strategy Journal, 3(3), 244-261.
- **Ito, K., & Lechevalier, S.** (2010). *Why some firms persistently outperform others: Investigating the interactions between innovation and exporting strategies.* Industrial and Corporate Change, 19, 1997–2039.
- **Latham, W., and C. Le Bas**. (2006) The Economics of Persistent Innovation: An Evolutionary View. Berlin: Springer.
- **Le Bas C., Scellato, G**. (2014) Firm innovation persistence: a fresh look at the frameworks of analysis. Forthcoming Economics of Innovation and New Technology, Forthcoming.

- **Hans Lööf, Pardis Nabavi Larijani, Gary Cook & Börje Johansson** (2015) *Learning-by-exporting and innovation strategies,* **E**conomics of Innovation and New Technology, 24:1-2, 52-64.
- **Leonida, L., Patti, D. M. A., & Navarra, P.** (2013). *Testing the political replacement effect: a panel data analysis.* Oxford Bulletin of Economics and Statistics, 75(6), 785-805.
- **Levinsohn, J. and Petrin, A.** (2003) Estimating production functions using inputs to control for unobservables. Review of Economic Studies 70: 317–341.
- **Máñez, , J. A., Rochina-Barrachina, M. E., Sanchis, A., Sanchis, J. A.** (2009) The Role of Sunk Costs in the Decision to Invest in R&D. The Journal of Industrial Economics, Vol. 57, Issue 4, pp. 712-735
- **Nelson, R., and S.Winter.** (1982)An Evolutionary Theory of Economic Change. *Cambridge, MA: The Belknap Press of Harvard University Press.*
- **Roberts, M. J., & Tybout, J. R.** (1997). The decision to export in Colombia: an empirical model of entry with sunk costs. *The American Economic Review*, 545-564.
- **Roodman, D.** (2006). How to do xtabond2: An introduction to difference and system GMM in Stata.
- **Rosenberg, N.** (1982) Inside the Black Box: Technology and Economics. *Cambridge: Cambridge University Press.*
- **Silverman, BW.** (1986). *Density estimation for statistics and data analysis.* Chapman and Hall: London, U.K.
- **Trinh, L. Q.** (2016). *Dynamics of Innovation and Internationalization among Small and Medium-Sized Enterprises in Viet Nam.* ADBI Working Paper Series - N.580
- **Van Beveren, I.** (2012). Total factor productivity estimation: A practical review. *Journal of Economic Surveys*, *26*(1), 98-128.
- **Weitzman, M. L.** (1996) "Hybridizing Growth Theory." *American Economic Review 86 (2): 207–212.*