



ISTITUTO DI STUDI E ANALISI ECONOMICA

# **Export, Productivity and Product Switching: the case of Italian Manufacturing Firms**

by

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## **ABSTRACT**

During the first half of the current decade, with rising competitive pressures, Italian manufacturing firms were forced to undertake a process of restructuring which had positive repercussions on export performance. This paper carries out empirical analysis using a panel of exporting firms obtained by matching firm-level information gathered by ISTAT and ISAE surveys. Two main channels of adjustment are investigated: inter and intra-firm. On the inter-firm side, we find that exporters were actually more productive: exporting was an essential outcome of pre-existing productivity advantages that led to self-selection of more productive businesses in international markets. As for the intra-firm adjustment, we show that the high frequency of product switching behaviour within exporting firms was significantly correlated with firm-level productivity growth, and that it contributed to a reallocation of economic activity within firms to more productive uses.

## **NON-TECHNICAL SUMMARY**

In this paper we investigate the phenomena of both inter and intra-firm adjustment. The empirical analysis is carried out using a panel of exporting manufacturing firms obtained by matching firm-level information gathered by ISTAT and ISAE manufacturing sample surveys.

Two main channels of adjustment are identified in our study. Firstly, we find that, during the period considered (the first half of the current decade), Italian exporters were actually more productive than non-exporters: the greater export activity came about as a result of ex-ante productivity advantages which led the more productive businesses to self-select in the international markets. This implies that the direction of causation was mainly from productivity to export, rather than the reverse. This finding for Italy is by no means new, but the novel feature of this paper is the different empirical approach that it takes to control for productivity endogeneity.

However, even if productivity causes exporting activity, it is not a completely exogenous variable with respect to firms' behaviour. Rather, it is affected by within-firm reallocations of resources across products in reaction to competitive pressures. Hence, and this is the second contribution of the paper, we show that the high frequency of product-switching behaviour within exporting firms was significantly correlated with firm-level productivity growth, and that it led to a reallocation of economic activity within firms to more productive uses. Exploring this margin of adjustment is a rather novel approach in the empirical literature.

# **ESPORTAZIONI, PRODUTTIVITÀ E CAMBIAMENTI DI PRODOTTO: IL CASO DELLE IMPRESE MANIFATTURIERE ITALIANE**

## **SINTESI**

Le forti pressioni competitive degli ultimi anni hanno indotto le imprese manifatturiere italiane a realizzare processi di ristrutturazione, con ripercussioni positive sulla performance di esportazione. In questo studio si utilizza un panel di imprese ottenuto dalla combinazione di informazioni individuali raccolte dalle indagini ISTAT e ISAE per investigare due principali canali di adattamento: l'aggiustamento "tra imprese" e "dentro le imprese". L'analisi dell'aggiustamento "tra imprese" mostra che gli esportatori sono in stati effettivamente gli operatori più produttivi: in particolare, l'attività di esportazione risulta essere derivata da pre-esistenti vantaggi di produttività che hanno condotto a una auto-selezione delle imprese più efficienti nei mercati internazionali. Per quanto riguarda l'aggiustamento all'interno delle imprese, si mostra l'elevata e significativa correlazione tra i comportamenti di cambiamento di prodotto delle imprese esportatrici e la dinamica della loro produttività; tali comportamenti hanno contribuito alla riallocazione delle risorse all'interno dell'impresa verso gli usi (le linee produttive) più efficienti.

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# 1 INTRODUCTION

New data on Italian foreign trade recently issued by the Italian National Statistics Institute (ISTAT) show that export behaviour in volume terms since 2000 has been better than thought from the information previously available. Notably positive, according to the new figures, is export performance in the past couple of years, when the growth of Italian foreign sales, in a phase of euro appreciation, has not been too distant from that achieved by Germany, a well-known 'superstar' exporter<sup>1</sup>. These statistics make it possible to reconcile official aggregate information on (volume) exports with a number of analyses that recently pointed out the adjustment process that took place in Italian manufacturing in response to the competitive crisis of the last decade<sup>2</sup>.

However, whilst inconsistencies among indicators seem to have diminished, it is still necessary to investigate the channels through which more intense international competition has spurred firms to adapt in a search for higher efficiency/competitiveness. Aggregate data at the industry level show that, although some change in the sector mix of manufacturing output has taken place in the last few years, the shift has not been such to induce a radical transformation of the Italian specialization pattern: given the exceptional rise of competitive pressures coming from China and other emerging economies, a modification of specialization was to be expected, according to theories of international trade<sup>3</sup>. This suggests that mechanisms other than those predicted by traditional theories were probably in operation. The inertia of sector-specialization indicates that an important part of the adjustment did not come about through a movement of resources from contracting to expanding industries, but rather through within-industry shifts of resources from less to more productive firms, whatever the sector, and through within-firm reallocations from less to more productive lines of production.

In this paper we investigate the phenomena of both inter and intra-firm adjustment. The empirical analysis is carried out using a panel of exporting manufacturing firms obtained by matching firm-level information gathered by

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<sup>1</sup> Concerning the revised data, see ISTAT, "I nuovi indici di commercio estero", nota informativa, 25 febbraio 2008. Although the new estimates are significantly higher than the old ones, analysts believe that volume of trade in the most recent period is still underestimated; see on this Bank of Italy, "Economic Bulletin", April 2008.

<sup>2</sup> For analyses, from different viewpoints, of restructuring by Italian manufacturing see de Nardis and Traù (2005), Cipolletta (2006), Rossi (2006), Lanza and Quintieri (2007), Baldwin et. al. (2007).

<sup>3</sup> For a recent assessment of the degree of inter-sector modification of Italian manufacturing see de Nardis (2007).

ISTAT and ISAE manufacturing sample surveys. The construction of this dataset has proved useful in gathering information on the micro-behaviour of producers, and it has made it possible to complement ISTAT micro-data with other information, drawn from ISAE surveys, not available in official statistics.

Two main channels of adaptation are identified in our study. Firstly, we find that, during the period considered (the first half of the current decade), Italian exporters were actually more productive than non-exporters: the greater export activity came about as a result of ex-ante productivity advantages which led the more productive businesses to self-select in the international markets. This implies that the direction of causation was mainly from productivity to export, rather than the reverse. This finding for Italy is by no means new (e.g., see Barba Navaretti *et al.* (2007)); but the novel feature of this paper is the different empirical approach that it takes to control for productivity endogeneity.

However, even if productivity causes exporting activity, it would not be a completely exogenous variable with respect to firms' behaviour - a primitive and fixed endowment that dictates selection of the successful and the unsuccessful producers in the face of fiercer global competition. Rather, it would be affected by within-firm reallocations of resources across products in reaction to competitive pressures. Hence, and this is the second contribution of the paper, we show that the high frequency of product-switching behaviour within exporting firms was significantly correlated with firm-level productivity growth, and that it led to a reallocation of economic activity within firms to more productive uses. Exploring this margin of adjustment is a rather novel approach in the empirical literature.

The paper is organized as follows. Section 2 reviews the recent literature on models of firm heterogeneity providing the framework for our analysis. Section 3 describes the construction of the reference dataset. The identification of a causal effect of productivity on export behaviour is analysed in section 4. Section 5 investigates the role of product switching as a source of firm-level productivity growth. Section 6 concludes.



## **2 HETEROGENEOUS FIRMS IN COMPETITION: FROM EMPIRICS TO THEORY**

In the first half of the 1990s (see e.g. Bernard and Jensen, 1995) a new approach was adopted in the study of the consequences of trade liberalization on the behaviour of producers. The framework emerged as an extension of the so-called new-trade-theory models of monopolistic competition (Helpman and Krugman, 1985) and led to a significant change of perspective in empirical analysis. The focus of investigations shifted from the question “what happens to industries engaging in trade (specialization)” to the question “what happens to firms engaging in trade”. The availability of firm-level databases, with detailed information on different types of production processes, made it possible to identify systematic differences among firms, even among those operating within the same industry.

Comparisons based on US data between exporters and producers selling only in the domestic market have highlighted that the former are systematically larger, more productive, able to pay higher wages, higher skilled and capital intensive, regardless of the pertaining industry (Bernard *et al.*, 2003). A central research question has been the nature of the positive correlation between export and productivity; that is, whether exporting activity leads to higher productivity or vice versa. Empirical investigation, broadly based on US firms, shows that exporters exhibit more favourable characteristics than non-exporters long before they start exporting. In particular, recent studies provide evidence for the selection of high productivity firms into exporting, and for the existence of significant sunk costs to entering foreign markets. As a result, only high-productivity firms are able to pay such costs and still yield a positive operative profit (Bernard and Jensen, 1999 and 2004).

Although the US experience shows that firm-level productivity is apparently unaffected by exporting activity, there is evidence that an exporting firm benefits from higher growth of both output and employment compared with a non-exporting producer. This leads to gains in aggregate productivity at the industry and the economy level: as foreign competition gets larger, the share of higher productivity (exporting) firms expands and boosting aggregate productivity.

Theoretical models of firm heterogeneity and international trade address these empirical findings. Trade liberalization achieved through a reduction of trade costs is the key to productivity improvement. It induces a shift of resources from low-productivity plants, which fail, to high-productivity survivors that begin to export and expand in terms of output and employment. The

models feature simultaneous job creation and destruction within industries which reflects the exit of the low-productivity producers and the expansion of the survivors. Three main models have been proposed in the theoretical literature. Bernard *et. al.* (2003) construct a Ricardian model of heterogeneous firms, imperfect competition with endogenous and incomplete markups, and exogenously fixed number of varieties produced and demanded. They show that this model can be calibrated to provide a good fit with the US micro and macro pattern of trade. By contrast, Melitz (2003) adopts a Dixit-Stiglitz structure of preferences with invariant markup, and shows that the number of produced varieties is endogenously determined depending on exposure to trade. Export market entry costs affect the way in which trade liberalization impacts across different types of firms which are heterogeneous in terms of marginal productivity randomly drawn from fixed distributions. Exposure to trade forces the least efficient firms out of the industry, while the more efficient ones gain in market shares. Yet another perspective is adopted by Melitz and Ottaviano (2008), whose model assumes a structure of preferences that produces a linear demand function and endogenous markups that are affected by the toughness of competition (number and average price of competing varieties). The above models have three main features in common: *a)* the fact that (heterogeneous) productivity discriminates between successful exporters and other producers; *b)* the fact that productivity is a primitive parameter, randomly drawn from a fixed distribution, unaffected by any change in firm-behaviour; *c)* the fact that opening to trade improves aggregate productivity through reallocations of resources stemming from the exit of the less efficient, and the expansion of the more productive exporting firms.

The assumption of time invariant productivity at firm-level is clearly a simplification of the real world. Quantitative evidence indicates that firms are able actively to influence their own efficiency levels by re-organizing lines of production and by innovating products and production processes. Until recently, the theoretical literature on firm heterogeneity and international trade overlooked this possibility: modelling within-firm investing (or re-organization) activity was not a priority in a framework aimed at highlighting mechanisms governing self-selection in exporting. However, some attempts in this direction have emerged in the recent literature. In the model proposed by Bernard *et al.* (2006b), firms manufacture multiple goods and productivity is the result of a combination of a firm-level component (“ability” common to all products) and a product-specific component (“expertise” in each product). Both components are randomly drawn from fixed distributions that are independent of each other. Trade liberalization fosters productivity rises within and across firms, and at the industry and the economy level by inducing firms to shed marginal products and

forcing the lowest-productivity firms to exit. Crucial to this approach is discarding the standard “one firm-one product” assumption. The central result of the model - firms focus on their core competencies when exposed to international competition - is particularly insightful for the intra-firm adjustment margin investigated in this paper<sup>4</sup>.

### 3 DATA

Empirical analysis is carried out using a firm-level matched dataset involving information gathered, respectively, by ISTAT (the Italian national statistical institute) and ISAE (Institute for Studies and Economic Analyses)<sup>5</sup>. The data cover the time period 2000-2005. Specifically, micro-data from the PRODCOM surveys (ISTAT), used to collect and disseminate statistics on the production of manufactured goods, were linked with the corresponding information (at firm-level) contained in ISAE business surveys on exporting enterprises. The goal was to complement the *hard* data provided by the official statistics with those from qualitative surveys, thus providing original information on each firm’s export behaviour. The ISTAT statistical source is based on a product classification which consists of about 5,000 headings relating to manufactured goods. PRODCOM headings are directly derived from 2 nomenclatures: the basic building blocks for PRODCOM are NACE Rev. 1.1 (NACE Rev. 2 as from 2008) and the CPA (Classification of products by activity). The 8-digit PRODCOM code takes its first 4 digits from NACE and digits 5 and 6 from the CPA, thus enabling a consistent link to these two classifications. The PRODCOM database was chosen for two main reasons. Firstly, it allows the construction of an indicator of firm-level labour productivity, which is the crucial variable in the theoretical framework of firm heterogeneity. Secondly, this statistical source gives details on both the importance (in terms of total output) and the number of within-firm product lines. Consequently, it

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<sup>4</sup> In a quite different setting, endogenous within-firm investing activity is allowed for by Antoniadou (2008) and Borin (2008). Using different models, the authors assume that (single-product) firms not only choose whether or not to produce, but also decide whether to undertake (with an investment that has a cost) quality upgrades for their products.

<sup>5</sup> We are grateful to Emma De Angelis for her valuable assistance in integrating the different statistical sources and constructing the dataset. More details on the procedures used for matching are in ISAE (2008).

consists of a statistical source well-suited to investigate the relationship between changes in the product mix and efficiency at firm-level.

**Tab. 1** **Structure of the dataset**  
**(years 2000-2005)**

Variables	N	Average	Standard Deviation	Minimum	Maximum
<b>Export</b>					
Export/total turnover (%)	9,432	22.6	28.0	0	100
<b>Obstacles against exporting activity</b>					
Absence of obstacles	9,432	1.3	1.5	0	4
Presence of obstacles	9,432	0.8	1.3	0	4
- Cost/price	9,432	0.4	1.0	0	4
- Delivery time	9,432	0.1	0.4	0	4
- Financing constraints	9,432	0.1	0.3	0	4
- Administrative factors	9,432	0.0	0.3	0	4
- Quality	9,432	0.1	0.3	0	4
- Other hindering factors	9,432	0.4	0.9	0	4
Number of destination markets	9,432	2.9	3.0	0	8
Number of competing countries	9,432	1.0	1.5	0	8
Propensity to export	9,432	0.6	0.5	0	1
Entering exporting firms	9,432	0.0	0.1	0	1
Persistent exporting firms	9,432	0.6	0.5	0	1
Exiting exporting firms	9,432	0.0	0.2	0	1
Non exporting firms	9,432	0.3	0.5	0	1
<b>Production</b>					
Number of employees	9,432	159.5	514.4	3	10,082
Number of production lines	9,432	4.4	5.1	1	77
Capacity utilization rate (%)	9,077	76.0	12.9	30	100
Production for the final demand	9,432	0.9	0.4	0	1
Production for other firms	9,432	0.1	0.3	0	1
Production for final demand and firms	9,432	0.1	0.2	0	1
Turnover per employee	9,432	161.4	4,616.5	0.02	441,458.1
Production per employee	9,432	166.3	4,920.4	0.02	471,665.7
<b>Obstacles against production activity</b>					
Absence of obstacles	9,077	2.2	1.5	0	4
Presence of obstacles	9,077	1.4	1.5	0	4
- Insufficient demand	9,077	0.8	1.2	0	4
- Labour shortage	9,077	0.2	0.6	0	4
- Constraints to production capacity	9,077	0.1	0.3	0	4
- Other hindering factors	9,077	0.5	0.9	0	4

Source: computations on ISAE and ISTAT data.

The ISAE business survey on exporting firms provides specific information on the decision to export at enterprise level, the number of destination markets, the share of goods exported in terms of total turnover, and specific obstacles faced by entrepreneurs during both producing and exporting activity. Overall, the final matched dataset consists of about 5,000 manufacturing firms in each year of the time interval considered, covering both exporting and non-exporting enterprises (see Tab.1).

Specifically, two different datasets were defined for the purposes of the quantitative analysis. In the first, which was used to test the causal relationship between export activity and productivity, the firm is the reference unit and the dataset does not include any detailed information on firm-product heterogeneity. The latter information (number of products at firm-level) is available in the second database used to investigate the endogenous sorting of firms across products.

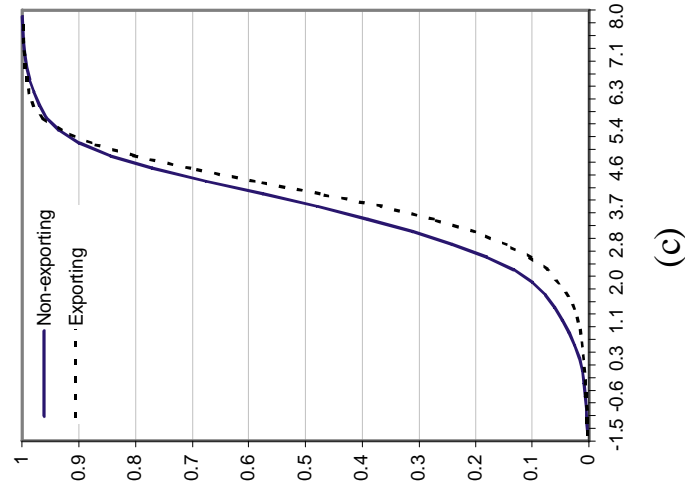
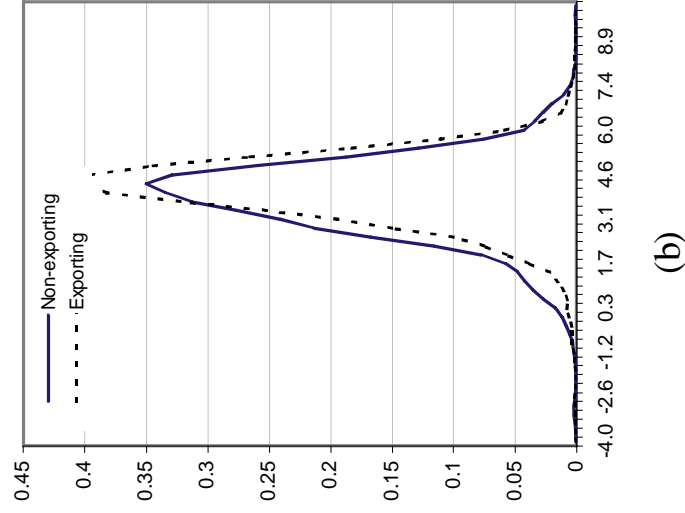
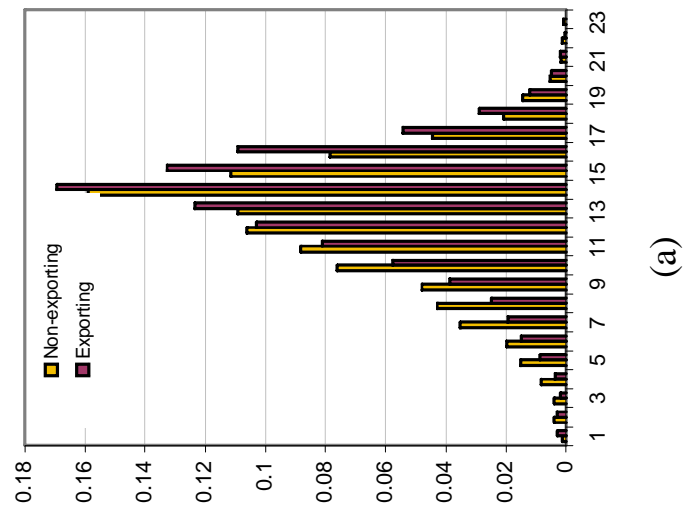
## **4 EXPORTING ACTIVITY AND PRODUCTIVITY**

The hypothesis that ex-ante productivity advantages induce more productive firms to self-select into export markets is one of the most debated issues in the literature on exporting firms. A natural starting point is the evaluation of stylized facts concerning certain efficiency measures for two subsets of firms, those which export and those that produce exclusively for the domestic market. We find that not only are plants heterogeneous in whether they export or not but, that they also differ substantially in measured productivity.

Starting from the dataset of firms described in the previous section, we follow the procedure described in Bernard *et al.* (2003) by segregating exporters and non-exporting firms and, subsequently, standardizing for each of the two sub-samples a measure of firm-level productivity (real output per worker) with respect to corresponding sample mean (Fig. 1.a). We also obtain a non-parametric distribution of the above measures (Fig. 1.b). Finally, as in Castellani and Zanfei (2006), the cumulated distribution of sampling units is accounted for (Fig. 1.c). All the above distributions are computed considering a pooling of observations in the period 2000-2005. They provide a first synthetic description of the relationship between decisions to export and the level of efficiency of Italian firms in the first half of the current decade. While there is substantial

**Fig. 1**

**Frequency distribution of labour productivity**



heterogeneity in both productivity and export performance (even within industries), the distributions highlight the striking association between the two statistics. The exporters' productivity distribution exhibits a substantial shift to the right with respect to the distribution of non-exporters, indicating a greater probability of being positioned at higher efficiency levels (output per worker). This is clear-cut in the three types of distributions and, particularly, in the case of the cumulated and non parametric ones.

Other than this preliminary evidence, the nature of the causal impact of productivity on the exporting behaviour of Italian manufacturing firms is investigated over the period from 2000 to 2005. A number of studies have evaluated the causality relationship between productivity and exporting decisions by adopting the approach described in Bernard and Jensen (1999).

Specifically, their procedure consists in testing for the Granger-causality condition by estimating whether one variable precedes the other(s) in time. In this section, the aim is to identify productivity changes exogenous with respect to exporting activity, controlling for the endogeneity of the export-productivity relationship through instrumental variables estimates in a panel data framework. The identification strategy is made possible by the availability of information on obstacles restraining exporting and production activities which are gathered through ISAE business surveys. The latter also provide firm-level data on export flows as a percentage total sales and, an assessment on whether specific impulses (obstacles) have helped (hindered) both exporting behaviour and production activity. Specifically, we argue that certain obstacle typologies are exogenous with respect to firms' export performance and can be used as instruments for actual productivity. As a result we are able to identify variation in output per worker which is exogenous with respect to export behaviours. Although this identification strategy enables us to test whether productivity causes exports, it does not allow for the separate estimation of the reverse effect. The model used for the empirical analysis is the following:

$$w_{it} = \alpha + \beta_1 \pi_{it} + \beta_2 \text{lemp}_{it} + \beta_X X_{it} + \sum \delta_j S_{ij} + \sum \gamma_n R_{in} + \sum \eta_p T_p + u_i + \varepsilon_{it} \quad (1)$$

where  $w_{it}$  is the export share in total sales of firm  $i$  at time  $t$ ,  $\pi_{it}$  is the labour productivity,  $\text{lemp}_{it}$  is the firm size in terms of the number of employees (log transformed),  $X_{it}$  is the matrix of other explanatory variables including the instruments,  $S$  and  $R$  are sectoral and regional fixed effects,  $T$  is the matrix of temporal fixed effects (which should account for time-varying unobservable effects constant across firms),  $u_i$  stands for the  $i$ -th firm-specific unobservable

effects (i.e., strategy, organization, managerial skills, etc.),  $\varepsilon_{it}$  is the idiosyncratic random error term.

Since the endogenous variable is censored (as it is not observed for the sub-sample of non-exporting firms), the empirical analysis is carried out using a panel Tobit estimator. The random effect estimator turns out to be a consistent if the correlation between individual (time invariant) specific effects  $u_i$  and other regressors (denoted as  $\Gamma_{it}$ ) is not statistically significant. Conversely, if we assume that  $\text{Cov}(u_i, \Gamma_{it}) \neq 0$ , a subset of explanatory variables is correlated with covariates omitted from the reference specification. As an example, labour productivity or firm size could be correlated with choices internal to the firm which are not adequately accounted for in model specification.

Additionally, in the non-linear framework of equation (1), the standard method used to remove the fixed effects by differencing the data from its individual mean over time is not feasible. Thus, we follow the alternative approach developed by Mundlak (1978) and Chamberlain (1980, 1984), in which the correlation between regressors and unobserved time-invariant effects is modelled in terms of a linear function of the (yearly) mean of time-varying exogenous variables. The final model is:

$$w_{it} = \alpha + \beta_1 \pi_{it} + \beta_2 \text{lemp}_{it} + \beta_x X_{it} + \sum \delta_j S_{ij} + \sum \gamma_n R_{in} + \sum \eta_p T_p + \sum_{h=1}^T \lambda_{zh} Z_{ih} + (e_{it} + \varepsilon_{it}) \quad (2)$$

where the assumption is that  $\text{Cov}(u_{it}, e_{it}) = 0$ . When estimated on the pooled dataset, equation (2) is fully identified. Efficiency can be enhanced by estimating (2) as a random-effects model, which accounts for the correlation over time of the individual error term  $u_i$ . Mundlak's approach is still consistent under these conditions, and is sometimes called as 'correlated random-effects' Tobit.

A second econometric issue concerns the potential endogeneity of labour productivity with respect to firm's export performance. The aim of the econometric analysis is to identify, using a valid set of instruments, changes in productivity which are exogenous with respect to export shares in total sales. If this effect is estimated positive and significantly different from zero, we find evidence of a self-selection mechanism of productivity into exporting.

To this aim, we use the information on specific obstacles collected in ISAE manufacturing surveys. We argue that certain obstacles related to firms' production activity can be viewed as being exogenous with respect to the error term of the export equation. Specifically, we assume (identifying assumption) that two kinds of obstacles – rationing of labour supply (obstacles against



expanding production due to labour shortage) and capacity constraints (obstacles against expanding production due to capacity constraints) – are strictly related to output per worker and substantially uncorrelated with the export share. Tests of endogeneity and of robustness of the selected instruments broadly confirm the ex-ante assumptions. Results obtained by means of 2SLS fixed-effects panel estimates are reported in table 2.

**Tab. 2 Test of endogeneity and robustness of instruments**

	Employees (log)	Productivity (log)
DM	1.741	5.518
DM - <i>p</i> -value	0.187	0.019
Sargan – $\chi^2$	0.051	0.639
Sargan - <i>p</i> -value	0.821	0.887

DM: Davidson-McKinnon exogeneity test. Sargan: over-identification test.

Obstacles against expanding production give rise to a quasi-experimental identification that splits firms into a ‘treatment group’ and a ‘control group’ in a way that is random with respect to firms’ export behaviour. We address this problem by using an instrumental variable approach. The Tobit model is adapted to an instrumental variables framework using a procedure outlined in Newey (1990). In the first stage, the endogenous explanatory variable (labour productivity) is regressed on the full set of exogenous instruments, assuming random effects. The second stage consists is an estimate of the reduced-form equation (1) by maximum likelihood Tobit, including the set of exogenous instruments and the residuals from the first stage within the right-hand side variables. This is in the spirit of the work by Vella and Verbeek (1999), who show that, conditional on the first-stage residuals, the error term  $u_i$  in equation (1) is a random effect and can be estimated using random-effects Tobit procedures by integrating out individual heterogeneity. Overall results are presented in table 3.

Other than the usual right-hand side variables (productivity and firm size), the models include, as additional regressors, the number of goods produced by each firm and the number of destination markets (in the case of exporting firms), the main activity of the firm (being a firm operating on behalf of a third-party firm or a firm selling to final demand). The results show a positive and significant effect of productivity on export performance.

The causal effect of productivity is significantly downward revised in random effects estimates (column 2) and is not very distant from the *correlated* RE Tobit (column 3). IV estimates allow for the measurement of the amount of the correction due to the use of additional exogenous regressors (column 4 *vis-*

à-vis column 1) and, secondly, the adjustment related to the use of the more efficient estimator in a random-effect framework (column 5). As reported in Table 3, also the IV-panel estimates identify a positive and significant causal effect of productivity on the decision to export, even though its magnitude is lower and slightly less significant than in other estimates. These results are consistent with the evidence reported in Barba Navaretti *et al.* (2007) (who consider the same time interval) and Serti and Tomasi (2007). Our findings are instead divergent from the evidence presented in Castellani (2002), who finds no self-selection of firms and, on the contrary, discusses in favor of a significant influence of past exporting activity on productivity levels.

**Tab. 3** **Export performance and productivity**

Explanatory Variables	Dependent Variable: export share in total sales				
	<i>Pooled</i> Tobit (1)	Tobit RE (2)	<i>Correlated</i> Tobit RE (3)	<i>Pooled</i> Tobit IV (4)	Tobit RE IV (5)
Employees (log)	7.239*** (0.422)	7.678*** (0.835)	7.473*** (0.844)	7.408*** (0.417)	7.321*** (0.820)
Output per worker (log)	3.793** (0.449)	0.923** (0.344)	0.846** (0.344)	1.611* (0.942)	0.592* (0.347)
Number of products (number)	-1.974 (0.595)	-0.566 (0.234)	-0.555** (0.233)	-1.945*** (0.589)	-0.579** (0.233)
Number of destination markets	8.232*** (0.308)	1.803*** (0.171)	1.817*** (0.171)	8.555*** (0.305)	1.738*** (0.168)
Firms producing for final demand	0.541 (2.052)	0.313 (1.721)	0.485 (1.933)	0.437 (1.886)	0.295 (2.177)
Firms producing on behalf of a third-party	-26.859*** (3.285)	-25.724*** (2.810)	-19.940*** (3.113)	-23.615*** (2.378)	-21.127*** (3.422)
Costant	-51.957*** (5.728)	-50.509*** (8.689)	-87.891*** (12.595)	-44.273*** (6.303)	-48.188*** (8.659)
Log-likelihood	-16946.449	-13994.576	-13981.613	-17531.47	-14429.598
N (obs)	4890	4890	4890	4890	4890
Individuals	840	840	840	840	840

Standard errors corrected for heteroskedasticity in brackets. \*= 10% significance; \*\*= 5% significance; \*\*\*=1% significance. Estimates include yearly, sectoral (2 digit) and regional *dummies* (not reported).

As for the other variables, being a firm operating on behalf of a third party is penalizing for exporting activity. These firms are probably less productive, denoting lower skills and organizational expertise, hence suffering more from increasing competition by low-cost producers located in emerging economies. Being a producer for the final market does not significantly affect exporting

performances. However, attention should be paid to this influence in future work, so as to account for the various forms of internationalization that a firm can put into effect (presence of a selling network; commercial agreements with foreign firms; other distribution channels; see Castellani and Zanfei 2005, Sterlacchini 2002). Interestingly, exporting activity reduces with the number of products realized by the firm. The higher the export shares in total sales, the lower the number of produced goods. This effect suggests that some sort of selection process in exporting took place within firms (with the elimination of marginal and less competitive products) in periods of increasing competitive pressures. This takes us to the next step of the analysis, which deals with the mechanisms of product switching and their role in shaping productivity increases.

## **5 PRODUCT SWITCHING AND PRODUCTIVITY GROWTH**

In light of the evidence of the former section, we investigate the role of business-specific activities internal to the firm and which are able to affect its productivity growth. Two main approaches have been put forward in the recent literature. Firstly, the role of investment expenditures, especially in terms of process/product innovation is investigated (see Helpman *et al.* 2004). Secondly, the effect of product switching activity is examined, consisting in the reassignment of resources of surviving firms as they drop and/or add products (*switching*) so as to increase their overall efficiency (selection within the firm). In this section, taking account of the recent studies by Bernard *et al.* (2006a, 2006b), we focus on the latter issue for the Italian case. To this end, we refer to a database in which the product-firm pair is the basic reference unit.

With regard to products, we define three levels of aggregation. We refer to two-digit ATECO2002 categories as sectors, five-digit categories as industries and eight-digit categories as elementary products. The large predominance of multi-product firms in the dataset is shown in table 4, which reports the share of both manufacturing firms and output accounted for by multi-product enterprises. Results are based on the pooled 2000 to 2005 sample. Almost all the firms considered (97.5%) produce several elementary goods (eight-digit category); the share in terms of output value is approximately the same (97%). Table 4 also shows that the multiple products realized by each businesses largely pertain to the same industry: multiple-industry firms represent only 6% of all

multi-product firms (2% in terms of output). The share of multiple-sector firms is even smaller. In our sample, it seems senseless to identify one firm with one product: single-product firms constitute only 2.5% of total firms (about 3% of total output).

**Tab. 4 Firms producing single and multiple products, industries, sectors**

Type of firm	Percent of firms	Percent of output
Single product	2.5	3.2
Multiple product	97.5	96.8
Multiple industry	6.3	2.9
Multiple sector	1.7	0.7

Source: computation on ISTAT data.

As regard to the decision to export, we document different types of product switching by dividing firms into four exhaustive and mutually exclusive groups based on the way their own product mix is modified across consecutive years. Possible actions are: (1) “None” - the firm does not change its mix of products; (2) “Drop” - the firm only drops products; (3) “Add” - the firm only adds products; (4) “Both” - the firm both adds and drops products. Actions aimed at changing the product scope of a firm (“Drop”, “Add”, “Both”) affect what can be called the ‘extensive margin’ of the firm output (i.e. that component of firm output represented by the number of products), as opposed to the ‘intensive margin’ (i.e. that component of firm output represented by the amount of output per each product)<sup>6</sup>.

The pooling of sample data shows that about 57% of exporting firms changed their product mix: 14% dropped at least one product, 20% introduced new products, and 23% both added and dropped at least one product. While “Add” and “Both” activities are less frequent within the exporting firms (producing both one or more than one good), the “dropping” of existing products is significantly more accentuated among the exporting rather than non-exporting firms (Tab. 5).

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<sup>6</sup> Indicating with  $Y$  the output of the firm and with  $N$  the number of products realized by the firm,  $Y = (Y/N) * N$ , where  $Y/N$ =intensive margin (output per product) and  $N$ =extensive margin: output changes are hence affected by modifications occurring along the two margins.

**Tab. 5** **Product switching in Italian firms**

	Non-exporting firms			Exporting firms		
	All	Single-product	Multi-product	All	Single-product	Multi-product
<i>Drop products</i>	3.5	-	3.6	13.5	-	13.1
<i>Add products</i>	20.4	16.8	20.5	20.2	12.2	20.3
<i>Both (drop/add)</i>	35.8	-	37.2	23.2	-	24.6
<i>None</i>	40.3	83.2	38.6	43.1	87.8	42.1

Source: computation based on ISTAT and ISAE data.

Additionally, descriptive evidence on productivity performance, obtained for the two-year period 2004-05, shows that the premium of exporters over non-exporters in terms of output-per-worker growth is actually positive but quite moderate (as much as 0.2 percentage points, weighting data in terms of firms' size; see table 6). Interestingly, the productivity premium of exporters was larger for the activities "Add" and "Both". Focusing on exporting firms, it emerges that exporters adopting some forms of product switching ("Drop", "Add", "Both") perform better than those that do not change the extensive margin (the productivity premium over the exporting firms characterized by "None" activity is on average as high as 2 percentage points over the considered period). Moreover, the exporting firms which changed their product compositions are larger in size than those which, though exporting, preserve their product mix unchanged (evidence not reported in table 6).

**Tab. 6** **Output per worker, rate of growth  
(average of the two year period 2004-2005)**

	Non- exporting firms	Exporting firms	All firms
<i>Drop</i>	4.217	3.819	3.828
<i>Add</i>	-11.891	0.360	0.077
<i>Both</i>	-2.598	2.225	1.586
<i>None</i>	0.995	0.088	0.212
Total	0.445	0.635	0.619

Source: computation based on ISTAT and ISAE data.

To gain more insights into the relationship between product switching and firm outcomes, in the case of exporters, we estimate basic OLS regressions where the dependent variable (respectively, labour productivity, output, firm

size) is regressed against dichotomous variables capturing product switching behaviours. The estimated equation is:

$$Z_{it} = \alpha + \beta_1 Add_{it-1} + \beta_2 Both_{it-1} + \beta_3 Drop_{it-1} + u_i + \varepsilon_{it} \quad (3)$$

where  $Z_{it}$  is the log-transform of the firm characteristics, “Add”, “Drop” and “Both” are the above dichotomous variables,  $u_i$  is associated with individual time-invariant unobserved effects,  $\varepsilon_{it}$  is the usual error term. The estimates refer to firms declaring that they exported for at least one period over the 2001-2005 time interval. To account for potential endogeneity between the adjustment of the extensive margin and firm performance, explanatory variables are lagged by one period. Parameter estimates show a significant correlation between firm performance and changes in the extensive margin (Tab. 7). Dropping existing goods (“Drop”) and, to a lesser extent, product substitution (“Both”) positively affect both productivity and output levels. Introducing new goods (“Add”) does not seem to have significantly contributed to exporting firms’ characteristics.

**Tab. 7 Labour productivity/Output/Firm size and extensive margin (exporting firms)**

Variable dipendente	ADD	DROP	BOTH	Costante	R <sup>2</sup>
<i>log</i> (productivity)	-0.015 (0.037)	0.189*** (0.055)	0.055* (0.033)	4.090*** (0.010)	0.006
<i>log</i> (output)	-0.013 (0.036)	0.196*** (0.054)	0.069** (0.032)	8.495*** (0.010)	0.010
<i>log</i> (employment)	0.002 (0.008)	0.006 (0.012)	0.014** (0.007)	4.405*** (0.002)	0.010

N= 2977. Pooling estimates with sectoral and temporal fixed effects. Robust standard errors in brackets. \*= 10% significance; \*\*= 5% significance; \*\*\*=1% significance

Maybe surprisingly, “Drop” activity has a significantly positive effect on firms’ output. Though this may reflect the fact that the action of product pruning (“Drop”) is compensated by an increase in the intensive margin, the rise of output per surviving product more than offset the contraction of production relating to the range of goods excluded by the firm. This appears confirmed by the fact that the “Drop” activity has a positive influence on firm productivity and no significant impact on employment. Dropping products does not reduce the number of employees, probably because workers are reallocated towards the

manufacturing of the more productive surviving goods in larger amounts (increase of the firm's intensive margin)<sup>7</sup>.

The frequent adjustments of the extensive margin within firms, and the significant correlation between product switching and firm efficiency, entails investigation of the determinants of product changes. In the presence of product-specific fixed production costs, the manufacture of a given good is likely to be more efficient in the case of firms which retain its production than in the case of those choosing to drop it. According to Bernard *et al.* (2006a) decisions to cancel lines of production are negatively correlated with the share of output of that product in firms' total sales and with the length of time in which that line of production remained operative. This reflects the fact that older vintage products, with a long productive record (tenure), are the outcome of long-standing within-firm specialization processes (reinforced by knowledge accumulation induced by long-standing production) which reduce the probability of being dismissed.

In a different strand of the literature, the Jovanovic model (1982) shows that firm productivity is positively correlated with firm output, as well as with the age of the firm. Application of this relationship to product market entry suggests that firms opting to drop a product should have a relatively low output for that good. Additionally, the period of time in which the production is manufactured should result relatively short compared with the one observed (on average) for firms electing to continue manufacturing the product.

In what follows we focus on the potential determinants of the "Drop" choice, the activity which, according to the above evidence, is correlated with larger efficiency gains. The model:

$$Drop_{ij,t} = \alpha + \beta_1 ProductSize_{ijt-1} + \beta_2 Tenure_{ijt-1} + \beta_3 FirmSize_{it-1} + \beta_4 Nproducts_{it-1} + u_{ij} + \varepsilon_{ji,t} \quad (4)$$

is estimated where, for each firm  $i$ , *ProductSize* is the share in overall output of product  $j$  in time  $t-1$ , *Tenure* is the length of time in which the  $j$ -th production is carried out, *FirmSize* and *Nproducts* are the size of firm  $i$  and the number of products that the same firm produces. All product-related variables are normalized with respect to the corresponding yearly average values, while firm-related variables are standardized in terms of the sub-sample of firms with the same product mix. The effect of omitted variables (i.e., the age of the firm) is captured by the individual effect  $u_{ij}$ . Explanatory variables are specified with

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<sup>7</sup> Evidence of a positive influence of product menu renewal on Italian firm performance, during the same period analyzed in this paper, is also provided by Bugamelli *et al.* (2008). Rather than using direct information on changes in product range, the authors' inference is based on information obtained from an *ad-hoc* questionnaire administered to firms – as part of the Banca d'Italia survey INVIND – on modifications in their product mixture and other forms of internal re-organization.

respect to the year prior to the decision to drop a product. In table 8, the first column sets out the results of the pooled Probit estimation; panel inference is shown in column two.

**Tab 8** **Extensive margin determinants: DROP**  
**(exporting firms)**

	Probit	Probit - RE
<i>Product Size</i> (t-1)	-0.386*** (0.070)	-0.255** (0.106)
<i>Tenure</i> (t-1)	-0.028*** (0.014)	-0.503** (-0.219)
<i>Firm Size</i> (t-1)	0.0002*** (0.000)	0.075*** (0.025)
<i>Number of products</i> (t-1)	-0.003 (0.002)	0.029*** (0.004)
N	10,123	4,740

Robust standard errors in brackets. Estimates with sectoral and temporal fixed effects.

In both cases, parameter estimates are consistent with the implications of fixed sunk costs models to export, as products with lower turnover incidence and shorter tenure are more likely to be dropped. Moreover, the greater the number of goods produced and the larger the firm size, the more likely becomes the decision to undertake product pruning. To the extent that relative product size and tenure are positively correlated with firm-product productivity, our findings provide indirect evidence of a systematic reallocation of economic activity to higher productivity output, both across products within firms and across firms within manufacturing.



## 6 CONCLUSIONS

In this paper we have investigated the performance of Italian exporting firms in the years 2000-05. We have considered two possible forms of firm-level adjustment in response to the fiercer international competitive pressures that materialized during this period: *a)* inter-firm adjustment consisting in self-selection of the more productive Italian firms in exporting activity, such that successful exporters during the period considered were those endowed *ex ante* with higher efficiency; *b)* intra-firm adjustment consisting in a within-firm selection of “best” goods that affected company-level productivity and, hence, the self-selection of firms as successful exporters. As regards inter-firm adjustment, our main findings may be summarised in the following points.

- Evidence has been found of a significantly positive causal effect of productivity on the decision to export in the period 2000-05: in response to increasing competition, it took place a process of self-selection of the most productive manufacturing firms in exporting activity. Furthermore, we have accounted for the fact that labour productivity may be endogenous with respect to firm's export activity by using a valid set of instruments provided by ISAE business surveys.
- Evidence has been found of a positive and significant effect of firm size on exporting. This suggests that, during the period considered, larger firms were better able than smaller-sized firms to increase their export share in total sales.
- Being a contracting firm (that supplies products to other firms) was penalizing for exporting activity. We interpret this finding as indicative that firms of this type suffered most from the competition raised by low-cost producers.
- Evidence has been found of a negative correlation between the amplitude of product scope (number of goods produced) and share of exports in total sales. We interpret this as a possible indication that firms which prune marginal lines of production (reducing product scope) were those able to achieve better results in exporting activity.

This last finding induces us to investigate intra-firm adjustment processes. This is rather a novel undertaking, and it implies a significant detour from available theoretical schemes of firm heterogeneity. These models generally assume that firms manufacture a single product whose productivity is fixed;

hence it follows that the productivity of (single-product) firms is unaffected by increased international competition. Yet the single-product assumption across all firms is a simplification of the real world; most of the firms in our sample are multi-product (though multiple products largely pertain to the same industry). Consideration of the existence of an extensive margin within the firm (more than one good produced) removes the assumption that firm-level productivity is invariant. Firm-level productivity can change as the extensive margin within the firm modifies, involving the switching of products characterized by different levels of productivity. Neglect of theory regarding the within-firm extensive margin was also induced by scarcity of information on the relevant variable necessary for this kind of analysis. We solved this empirical deadlock by constructing a firm-level dataset in which information on lines of production (defined at the 8-digit level) is matched with other relevant information on enterprises' behaviour drawn from ISAE databases. The main findings of the analysis on intra-firm adjustment are summarized in the following points.

- According to the pooling of sample data, 57% of exporting firms changed their product mix during the period considered: 14% dropped at least one existing product, 20% introduced new products, and 23% both added and dropped at least one product.
- With reference to the two-year period 2004-05, the largest gains in productivity-growth were achieved by the exporting firms that re-shuffled their product mix (simultaneous adding and dropping activity) and added new products. Focusing only on exporters, firms that modified their extensive margins achieved higher productivity growth rates than those keep fixed to their product scope.
- Evidence has been found of a significant positive correlation between the performance of exporting firms and modification of the extensive margin. Product pruning and product substitution favoured the productivity and output of exporting firms with respect to the firms that did not adopt these actions. Curiously, dropping goods does not seem to have negatively affected firm-level output. On the contrary, it contributed to increasing the firm's output. This probably reflects an increase of the intensive margin in surviving products which more than compensated the reduction of the product range. When the introduction of new products was not accompanied by a simultaneous action of dropping, this did not determine significant differences in productivity growth between exporting firms.
- Investigation of the possible reasons for the decision to drop an existing product shows that products with lower turnover incidence and shorter

tenure are more likely to be pruned. Moreover, the greater the number of goods produced and the larger the firm's size, the more likely is the decision to undertake rationalization through product shedding. To the extent that relative size and tenure are positively correlated with firm-product productivity, our findings provide indirect evidence of a systematic reallocation of economic activity to higher productivity output both across products within firms and across firms within manufacturing.

In this paper we have presented the preliminary results of ongoing research on Italian firm-level restructuring. Our purpose is to conduct further studies of product switching processes, a much unexplored issue that warrants the attention of analysts. As the results reported in this paper suggest, this is a promising area that may yield insights into a crucial channel of firm adjustment in an increasingly competitive environment. This is clearly a field of inquiry whose scope is conditioned by the quality and quantity of the available data. By integrating different data sources, we believe that we have constructed an information set that can be fruitfully used for this purpose. Using this dataset, the main directions of our future research will be: *a)* analysing the influence of "active" firm behaviour (using information on investment in process and product innovation provided by the ISAE survey) on product switching and firm productivity<sup>8</sup>; *b)* investigating the role of quality upgrading in driving modifications to the extensive margins within the firm and its impact on firm productivity; *c)* analysing interactions between product switching and firm-level delocalization processes.

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<sup>8</sup> Firm-level evidence of the importance of rationalization investment for export activity is set out in de Nardis and Pappalardo (2007) and de Nardis (2007). These works, however, do not consider product switching.

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