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Endogenous Markups, International Trade, and the Product Mix

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Abstract We investigate the effects of import penetration on the estimated price–cost margins of more than 28,000 firms operating in the Italian manufacturing sector. In the period considered (1998–2003), we find on average broad evidence of pro-competitive gains from trade. However, when performing the same analysis at a more detailed industry level, we find substantial heterogeneity in the responses: in some industries the increased exposure to international trade is associated with higher, rather than lower, markups, while in others the relationship is not significant. In particular, the industries in which we find a positive impact of import penetration on markups exhibit, on average, a larger variation in the composition of their product-mix.

Keywords Price cost margins · Trade openness · Product mix

JEL Classification F15 · L11

1 Introduction

"More than half of the surveyed manufacturing firms have changed strategy in the last 5 years. The 12 % of firms who have switched products in new industries have generated profits higher than the average."

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[translation from Mario Draghi, Bank of Italy Governor, Annual Relation, 31 May 2007, p. 8]

A survey on a sample of roughly 3,100 manufacturing firms undertaken by the Bank of Italy (2007) revealed that only 27 % of the surveyed firms were seeing themselves as having an advantage with respect to competitors. More specifically, international competition (particularly from low-cost countries such as China and others in South East Asia, Central, and Eastern Europe) is seen as a major source of potential weakness for the firms. Within the period between 2000 and 2005, more than 50 % of the surveyed firms changed their business strategy: 7 % of firms have internationalized their activities, 15 % have increased investment in core products, while 31 % of the surveyed firms have changed the range of products produced. Within the latter group, 88 % of firms have changed products within the same sub-sector, while the remaining 12 % have switched production to contiguous (10 %) or totally different (2 %) industries, thereby experiencing higher-than-average profits.

The international economics literature (see for example, the survey by Tybout 2003), has studied the effects of trade liberalization on average price–cost margins, exports, productivity, and net entry dynamics across countries and industries. More recently, starting from the seminal works of Bernard et al. (2003) and Melitz (2003), the 'new-new' trade models have also explicitly taken into account the heterogeneity of firms. Melitz and Ottaviano (2008) have combined the supply-side features of the Melitz's (2003) model of firm heterogeneity with a demand system different than the traditional CES demand function, thus adding the dimension of heterogeneous markups into models of trade with imperfect competition. The further dimension of product heterogeneity, which seems relevant in the above quoted example, has also been increasingly explored: based on US data, Bernard et al. (2006) show that some firms might react to international competition endogenously by self-selecting into the production of a different product mix. Whether this is also leading to different reactions of the markups to pressure from international competition remains a relatively unexplored question.[1] In this paper, we take some steps in exploring this issue from an empirical point of view.

We have estimated price–cost margins for a sample of roughly 28,000 firms operating in the Italian manufacturing sector over the period of 1998–2003. In line with the standard results of the literature, on average, we have found broad evidence of pro-competitive gains from trade, i.e. firms' markups tend to be negatively associated with an increase of import penetration indices. However, when performing the same exercise at a more disaggregated level, the analysis has revealed a huge variation in the responses: in some industries we confirm the aggregate result of a negative effect of import penetration on the price–cost margin; however, in other industries (for instance, textiles), the standard pro-competitive result is reverted, and an increased exposure to international trade is associated with higher price–cost margins. [2] For a third group of industries, the effect does not seem to be significant.

We have then tried to relate this evidence to some structural characteristics of industries. We find that sectors displaying a positive impact of import penetration on price–cost margins exhibit, on average for the industry, a different variation in the composition of their product-mix, measured by an index of entropy.

These results allow us to contribute to the existing literature in at least three ways. First, we provide some evidence that might inform the literature on multiproduct firms. This literature has been recently blossoming: Eckel and Neary (2010) present a model of flexible manufacturing where an increase of international competition

[1] To the best of our knowledge, the only other paper dealing with this particular issue is De Loecker et al. (2012).
[2] These results are also consistent with evidence from India provided by De Loecker et al. (2012).

skews the range of products exported toward the firm's *core competencies*. Bernard et al. (2011) present an extension of the Melitz (2003) model featuring multiproduct firms. However, the assumption of CES preferences results in constant markups, which by definition cannot be affected by international competition. Mayer et al. (2014) present an extension of the Melitz and Ottaviano (2008) model featuring multiproduct firms where different level of competition in the export market endogenously affects the product mix exported, and through this channel, productivity. However, these models do not have a clear prediction on how trade liberalizations impact average industry markups. Our findings could stimulate further theoretical investigations on the interplay between trade liberalization, markups and the endogenous evolution of the product mix.

Second, we provide evidence, for given industries, of a positive correlation between import penetration and markups associated to product dispersion, rather than concentration. We link this result to another phenomenon detected at the empirical level by Bernard et al. (2006) for the US: firms might react to an increase of international competitive pressures by endogenously switching their product mix. The evidence for Italy shows that such an endogenous switch does not necessarily lead to a concentration of products, but rather, in given industries, to higher product dispersion. The novel implication of such a defensive strategy is that changes in product mix induced by increased trade pressures might have a positive impact on firms' markups, thus reverting in specific industries the traditional finding of pro-competitive effects of trade.

Finally, from a methodological point of view, the analysis capitalizes on Konings and Vandenbussche (2005) and Konings et al. (2005), who have refined an algorithm allowing to consistently estimate average price–cost margins starting from balance-sheet, firm-level observations. The algorithm overcomes the traditional critique of the Hall (1988) type of approach for estimating markups, i.e. a potential simultaneity bias between output growth and the growth in the input factors.[3] It also avoids relying on imperfect measures of firms' marginal costs in order to observe firms' markups, since price–cost margins can be estimated consistently starting from nominal balance sheet data on sales and input. We provide here a new application for this econometric technique.

The remainder of the paper is structured as follows: Section 2 presents our methodological framework in detail, relating a proper estimation of markups to the effects of trade penetration. Section 3 discusses the dataset and its validation with respect to official data. Section 4 presents our results on the relationship between import penetration and price–cost margins, as well as the relative robustness checks. Section 5 discusses our product mix hypothesis in further detail, while Section 6 concludes.

2 Methodological Framework

Our methodology is similar to the one introduced by Roeger (1995), who built on the work of Hall (1988). More recently, the methodology has also been used by Gorg and Warzynski

[3] The refinement is originally due to Roeger (1995), who overcomes the problem by subtracting the dual Solow residual from the primal, thus being able to eliminate the unobserved productivity shock, source of the bias, from the estimating equation. Konings and Vandenbussche (2005) and Konings et al. (2005) exploit the algorithm in order to estimate, respectively, the effects of anti-dumping protection and of changes in the corporate governance on domestic firms' markups.

(2003), Konings and Vandenbussche (2005), and Konings et al. (2005). These authors all start from a standard production function:

$$Q_{it} = A_{it} F(N_{it},\ M_{it},\ K_{it}) \tag{1}$$

where Q_{it} is the output of firm i at time t. N, M, and K are the labour, material, and capital inputs and A is the firm's productivity. Hall (1988) suggests an expression for the marginal cost that can be adapted to our context as follows:

$$c_{it} = \frac{P_n \Delta N_{it} + P_k \Delta K_{it} + P_m \Delta M_{it}}{\Delta Q_{it} - g_{it} Q_{it}} \tag{2}$$

where c_{it} is the marginal cost, P_J (with J=N,M,K) is the unit cost of input factor J and g_{it} is the rate of growth of technical progress (A) of firm i at time t. Using (2), it is possible to express the output growth rate as follows:

$$\frac{dQ_{it}}{Q_{it}} = \frac{P_n N_{it}}{c_{it} Q_{it}} \frac{dN_{it}}{N_{it}} + \frac{P_k K_{it}}{c_{it} Q_{it}} \frac{dK_{it}}{K_{it}} + \frac{P_m M_{it}}{c_{it} Q_{it}} \frac{dM_{it}}{M_{it}} + g_{it} \tag{3}$$

The weights that multiply the input changes are the shares of each input in total costs. Since, under constant return to scale (CRS), the cost shares sum to one, it is possible to rewrite Eq. (3) as:

$$\frac{dQ_{it}}{Q_{it}} - \frac{dK_{it}}{K_{it}} = \frac{P_n N_{it}}{c_{it} Q_{it}} \left(\frac{dN_{it}}{N_{it}} - \frac{dK_{it}}{K_{it}} \right) + \frac{P_m M_{it}}{c_{it} Q_{it}} \left(\frac{dM_{it}}{M_{it}} - \frac{dK_{it}}{K_{it}} \right) + g_{it} \tag{4}$$

where we used the fact that $\frac{P_k K_{it}}{c_{it} Q_{it}} = 1 - \frac{P_n N_{it}}{c_{it} Q_{it}} - \frac{P_m M_{it}}{c_{it} Q_{it}}$. If now we introduce imperfect competition, with a mark-up of output price (P_{it}) over marginal cost (c_{it}) so that $\mu_{it} = \frac{P_{it}}{c_{it}}$, then Eq. (4) may be written as:

$$\frac{dQ_{it}}{Q_{it}} - \frac{dK_{it}}{K_{it}} = \mu_{it} \left[\alpha_{Nit} \left(\frac{dN_{it}}{N_{it}} - \frac{dK_{it}}{K_{it}} \right) + \alpha_{Mit} \left(\frac{dM_{it}}{M_{it}} - \frac{dK_{it}}{K_{it}} \right) \right] + g_{it} \tag{5}$$

where now $\alpha_j = \frac{P_j J_{it}}{P_{it} Q_{it}}$ (with J=N,M) are shares in the value of production. If we now divide both sides of Eq. (5) by $\mu_{it} = \frac{1}{1-\beta_{it}}$ and rearrange, we get:

$$\frac{dQ_{it}}{Q_{it}} - \alpha_{Nit} \frac{dN_{it}}{N_{it}} - \alpha_{Mit} \frac{dM_{it}}{M_{it}} - (1 - \alpha_{Nit} - \alpha_{Mit}) \frac{dK_{it}}{K_{it}} = \beta_{it} \left[\frac{dQ_{it}}{Q_{it}} - \frac{dK_{it}}{K_{it}} \right] + (1 - \beta_{it}) g_{it} \tag{6}$$

where the expression now written in terms of $\beta_{it} = \frac{P_{it} - c_{it}}{P_{it}}$, is the Lerner Index or price–cost margin (PCM) of firm i at time t.[4]

Equation (6) thus decomposes the Solow residual into two terms: a pure technology component (g), and a markup factor. The problem in estimating Eqs. (4) or (6) as in Levinsohn (1993) is that unobserved productivity shocks g may be correlated with the input factors. The latter is the traditional critique to the Hall's (1998) approach for estimating markups, which is difficult to overcome since instrumental variables are hard to find at the firm-level. However, the potential endogeneity of the error term can be overcome following Roeger (1995), who is

[4] In the remaining of the paper we will use indifferently the terms markup and price–cost margin, although, given our econometric specification, we will be referring to the latter.

able to decompose the price-based (or dual) Solow residual according to the following expression, comparable to Eq. (6):

$$\alpha_{Nit}\frac{dP_{Nit}}{P_{Nit}} + \alpha_{Mit}\frac{dP_{Mit}}{P_{Mit}} + (1-\alpha_{Nit}-\alpha_{Mit})\frac{dP_{Kit}}{P_{Kit}} - \frac{dP_{it}}{P_{it}} = \beta_{it}\left[\frac{dP_{it}}{P_{it}} - \frac{dP_{Kit}}{P_{Kit}}\right] + (1-\beta_{it})g_{it} \quad (7)$$

Konings and Vandenbussche (2005) and Konings et al. (2005) subtract Eq. (7) from Eq. (6), ending up with:

$$\left(\frac{dQ_{it}}{Q_{it}} + \frac{dP_{it}}{P_{it}}\right) - \alpha_{Nit}\left(\frac{dN_{it}}{N_{it}} + \frac{dP_{Nit}}{P_{Nit}}\right) - \alpha_{Mit}\left(\frac{dM_{it}}{M_{it}} + \frac{dP_{Mit}}{P_{Mit}}\right) \quad (8)$$
$$-(1-\alpha_{Nit}-\alpha_{Mit})\left(\frac{dK_{it}}{K_{it}} + \frac{dP_{Kit}}{P_{Kit}}\right) = \beta_{it}\left[\left(\frac{dQ_{it}}{Q_{it}} + \frac{dP_{it}}{P_{it}}\right) - \left(\frac{dK_{it}}{K_{it}} + \frac{dP_{Kit}}{P_{Kit}}\right)\right]$$

In Eq. (8), the unobserved productivity shock is canceled out and therefore the previously discussed simultaneity bias disappears. The Lerner index can thus be estimated consistently. Moreover, Eq. (8) implies that estimating the price–cost margin requires information about the growth rates of production value, wage bill, material costs, and the value of capital. Since no deflation is required, the omitted price variable bias is also not a source of trouble. As for the rental price of capital P_{Kit}, following Hsieh (2002) and Konings et al. (2005), it can be computed as $P_{Kit}=P_I(r_{it}+\delta_{it})$, where P_I is an investment good price index retrieved from the EU AMECO database, δ_{it} is a firm-level depreciation rate computed as depreciation over net tangible fixed asset in the previous year, and r_{it} is the firm-level real interest rate, an information retrieved from our dataset. Konings and Vandenbussche (2005) and Konings et al. (2005) label the LHS of Eq. (8) as DY and the RHS as DX, and thus obtain a very simple testable equation for estimating the price–cost margins:

$$DY_{it} = \beta DX_{it} + \epsilon_{it} \quad (9)$$

A potential shortcoming of this approach is that, in order to estimate Eq. (9), one has to assume constant markups over the group of firms considered, as without this assumption it would not be possible to have enough degrees of freedom for the regressions. The assumption is rather common in the literature (e.g. Levinsohn 1993 or Konings et al. 2005). Since we are also interested in assessing the evolution over time of the price–cost margins in order to gauge the impact of trade openness, we have modified Eq. (9) as follows:

$$DY_{ijt} = \beta_1 DX_{ijt} + \delta_t DX_{ijt}{*}T_t + \beta_2 DX_{ijt}{*}IMP_{jt} + \gamma_i + \epsilon_{ijt} \quad (10)$$

In Eq. (10) the dimension j represents the industry to which the firm i belongs at time t, T_t is a set of time dummies which allows us to control for cyclical demand effects, while IMP_{jt} measures the import penetration index in industry j at time t, calculated as:

$$IMP_{jt} = \frac{IMPORTS_{jt}}{IMPORTS_{jt} + PRODUCTION_{jt} - EXPORTS_{jt}} \quad (11)$$

Finally, γ_i stands for an unobservable firm-specific fixed effect. While Eq. (9) does not feature them explicitly, we follow previous literature and include them in the analysis in order to capture unobservable firm-specific attributes (e.g. the quality of the management).[5]

[5] Our main results, though, are not affected by excluding firm fixed effects from the regressions.

In Eq. (10), the marginal effect of the increase in import penetration of the estimate of the price–cost margin is represented by the coefficient β_2. A negative coefficient would signal presence of pro-competitive gains from trade.

Before turning to the description of the dataset and the results obtained, it is important to emphasize certain caveats that should be noted when considering this analysis. The first one is related to Eq. (9), in which, in principle, the error term should not appear. However, Roeger (1995) clarifies that although a variety of reasons justify the presence of an error term, in particular possible measurement errors in the variables employed, this should not affect the consistency of the estimates, thus allowing for the implementation of the model. The second criticism that may arise is related to the maintained assumption of constant returns to scale. As discussed by Konings et al. (2005), not allowing for varying returns to scale may generate an upward or downward bias in the markup levels, depending on whether returns to scale are respectively decreasing or increasing. In addition, in order to estimate Eq. (9), one has to assume constant markups over the group of firms considered, an assumption typical of all applications of this type (Levinsohn 1993 or Konings et al. 2005), as without this assumption it would not be possible to have enough degrees of freedom in the estimating equation. However, to the extent that returns to scale do not change dramatically over the sample period, the latter bias, if present, can be considered as relatively constant, and thus should not affect the validity of our results, since we are interested in the variation over time of the markup, rather than its point estimate. Finally, market-power might be product rather than firm-specific, while we base our estimates on firm-level data. These caveats imply that our results should be interpreted as the impact of import penetration on the average PCM of the group of firms considered.

3 Data Description

3.1 Import Penetration Indexes

In order to compute import penetration indices according to Eq. 10, we need information on trade flows and production at the industry level. As for imports and exports, the Italian National Institute for Statistics (ISTAT) provides the value of import and export at detailed industry level according to the NACE Rev 1.1 classification for several years. Data on production are instead collected from EUROSTAT, whose detailed industrial statistics database reports several variables (such as value of production, value added, and employment) for the same industries, with a year coverage ranging from 1996 to 2003, which constitutes our period of reference.

Table 1 reports descriptive statistics on the calculated import penetration ratios at the NACE2-digit level of aggregation. The analysis reveals an ample heterogeneity in the exposure of each industry to international trade flows, with average import penetration ratios ranging from 57.2 % in sector 34 to 3.8 % in sector 22. Even within each NACE2 manufacturing industry the import penetration ratios might differ considerably when calculated at the NACE3 level of aggregation, as displayed by the standard deviation of the indices. As for the evolution over time of the import penetration ratios, we find a general upward trend, from 19 % in 1996 to 24 % in 2003, in line with the increasing exposure of the country to international trade flows. At the industry level, however, the growth rate of import penetration displays some heterogeneity, with clearly upward trends in some industries versus a more or less constant exposure in others.

Table 1 Import penetration ratios—descriptive statistics for NACE2 industries

	NACE_Description	Mean	1996	2003	Change
15	Manufacture of food products and beverages	17.8 %	17.0 %	18.2 %	1.20 %
17	Manufacture of textiles	26.1 %	20.3 %	29.5 %	9.20 %
18	Manufacture of wearing apparel; dressing and dyeing of fur	23.8 %	18.0 %	31.6 %	13.60 %
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	29.4 %	23.7 %	34.3 %	10.60 %
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and..	18.4 %	16.7 %	18.4 %	1.70 %
21	Manufacture of pulp, paper and paper products	28.7 %	25.9 %	28.8 %	2.90 %
22	Publishing, printing and reproduction of recorded media	3.8 %	3.6 %	3.4 %	−0.20 %
24	Manufacture of chemicals and chemical products	44.3 %	37.9 %	48.3 %	10.40 %
25	Manufacture of rubber and plastic products	18.6 %	17.3 %	18.5 %	1.20 %
26	Manufacture of other non-metallic mineral products	10.1 %	10.7 %	8.9 %	−1.80 %
27	Manufacture of basic metals	51.0 %	51.7 %	47.5 %	−4.20 %
28	Manufacture of fabricated metal products, except machinery and equipment	10.6 %	9.6 %	10.7 %	1.10 %
29	Manufacture of machinery and equipment n.e.c.	35.0 %	32.7 %	32.2 %	−0.50 %
31	Manufacture of electrical machinery and apparatus n.e.c.	25.7 %	22.7 %	28.4 %	5.70 %
32	Manufacture of radio, television and communication equipment and apparatus	55.5 %	41.2 %	57.9 %	16.70 %
33	Manufacture of medical, precision and optical instruments, watches and clocks	56.6 %	49.4 %	58.0 %	8.60 %
34	Manufacture of motor vehicles, trailers and semi-trailers	57.2 %	50.3 %	62.0 %	11.70 %
35	Manufacture of other transport equipment	43.0 %	27.3 %	45.5 %	18.20 %
36	Manufacture of furniture; manufacturing n.e.c.	18.4 %	15.5 %	18.5 %	3.00 %

Authors' elaboration on ISTAT and EUROSTAT data at the NACE3-digit level of disaggregation

3.2 A Sample of Italian Firms

A commercial dataset called AIDA, collected by the Bureau van Dijk, was used in order to retrieve firm-level information about production value, material costs, cost of employees, value added, tangible fixed asset, depreciation, and interest paid over debt and employment. The total sample consisted of 61,335 firms. Taking 2001 as the reference year and comparing the sample data with the 2001 Industrial Census, these firms accounted for the 73 % of total manufacturing value added and the 54 % of manufacturing employment. However, due to the quality of data, extensive data cleaning has been necessary in order to apply the methodology previously introduced. We adopted a multi-stage data cleaning procedure. First of all, we concentrated on those firms for which information was available for every variable of interest in at least 1 year. After having calculated the growth rate of each input variable, we controlled for possible outliers by dropping all those firms for which any percentage variation was larger than 200 %. We then computed the cost shares of different inputs and dropped from the analysis those firms with shares belonging to the first and the last percentile of the relevant distributions. After these steps, the resulting sample was almost halved to 28,076 firms, which are those employed in the analysis.

As for the validation of the cleaned sample, these firms account for 34.6 % of the total Italian manufacturing value added and for 25.8 % of total manufacturing employment. We then checked the representativeness of the sample along three dimensions: geographical location, industrial activity, and firms' size. Table 2 reports the distribution across regions of the firms included in the sample. The number of firms in each Region ranges from 33 (in Valle d'Aosta) to 8,128 (in Lombardy). When comparing this distribution with the distribution registered during the 2001 Industrial Census, the correlation obtained is 0.96, significant at the 1 % level. Table 3 shows the distribution of the cleaned sample across the NACE2 industries. Due to the lack of sufficient observations, we had to drop NACE2 industries 16 (Tobacco), 23 (Petroleum), and 30 (Office machinery). Table 3 shows the number of firms in each industry in our sample that ranges from 379 in sector 35 (Other transport equipment) to 4,259 in sector 29 (Machinery and equipment). The correlation between the sample's distribution and that of the Census (compared at the more detailed NACE3 level) is 0.71, always significant at the 1 % level. Finally, in terms of firms' size, Table 4 shows the distribution of our sample firms across the size classes adopted by the Italian National Institute of Statistics and measured in terms of employment. Looking at the data from 2001, in order to have a comparison with the Italian Census, in our sample there is a fair number of micro firms (11.4 %), although this type of firm accounts for more than 80 % of total firms in Italy. The relative over-representation of large firms in our dataset is clearly a drawback that must be taken in mind when discussing our results, which are probably more representative of the response to international trade of the pricing behavior of medium and large firms rather than of micro firms and small firms.

Table 2 Spatial distribution of the sample

Region	Firms	Frequency (%)
Abruzzo	546	1.94
Basilicata	100	0.36
Calabria	145	0.52
Campania	1,088	3.88
Emilia-Romagna	3,464	12.34
Friuli	815	2.9
Lazio	988	3.52
Liguria	344	1.23
Lombardia	8,128	28.95
Marche	1,227	4.37
Molise	71	0.25
Piemonte	2,391	8.52
Puglia	749	2.67
Sardegna	190	0.68
Sicilia	508	1.81
Toscana	2,338	8.33
Trentino-Alto Adige	403	1.44
Umbria	392	1.4
Valle d'Aosta	33	0.12
Veneto	4,156	14.8
Total	28,076	100

Table 3 Sample distribution by industrial activity

	Nace_Description	Firms	Freq. (%)
15	Manufacture of food products and beverages	2,804	9.99
17	Manufacture of textiles	1,557	5.55
18	Manufacture of wearing apparel; dressing and dyeing of fur	1,151	4.1
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	1,162	4.14
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and…	960	3.42
21	Manufacture of pulp, paper and paper products	683	2.43
22	Publishing, printing and reproduction of recorded media	1,213	4.32
24	Manufacture of chemicals and chemical products	1,264	4.5
25	Manufacture of rubber and plastic products	1,816	6.47
26	Manufacture of other non-metallic mineral products	1,938	6.9
27	Manufacture of basic metals	820	2.92
28	Manufacture of fabricated metal products, except machinery and equipment	2,951	10.51
29	Manufacture of machinery and equipment n.e.c.	4,259	15.17
31	Manufacture of electrical machinery and apparatus n.e.c.	1,305	4.65
32	Manufacture of radio, television and communication equipment and apparatus	396	1.41
33	Manufacture of medical, precision and optical instruments, watches and clocks	637	2.27
34	Manufacture of motor vehicles, trailers and semi-trailers	456	1.62
35	Manufacture of other transport equipment	379	1.35
36	Manufacture of furniture; manufacturing n.e.c.	2,325	8.28
	Total	28,076	100

4 Results

4.1 Average Results

We start by presenting the results obtained from pooling all our firms' observations. The corresponding results have to be considered as average results for all the firms in the sample. Table 5 reports the results for the baseline model of Eq. 10. In particular, the first column

Table 4 Size distribution of the sample

Size	Sample 2001		Census 2001		Firm coverage
	Firms (A)	Freq. (%) (B)	Firms (C)	Freq. (%) (D)	(A)/(C)
1–9	3,196	11.4 %	447,859	82.5 %	0.7 %
10–19	3,926	14.0 %	55,553	10.2 %	7.1 %
20–49	5,145	18.3 %	27,075	5.0 %	19.0 %
50–249	3,653	13.0 %	10,872	2.0 %	33.6 %
249–	644	2.3 %	1,517	0.3 %	42.5 %
N/A	11,512	41.0 %			
Total	28,076	100.0 %	542,876	100.0 %	5.2 %

reports the estimates using firm-fixed effects and time dummies to control for a possible time trend, and clustering the standard errors at firm level to avoid their possible downward bias induced by regressing firm-level observations on industry-specific import penetration ratios. The main effect of the estimated price–cost margin for the baseline year (1998) is 36 % and statistically significant, while the interaction term capturing the marginal impact of the import penetration index on the price–cost margin displays a negative and statistically significant coefficient, in line with the pro-competitive effect of trade postulated by the theory.[6] An average import penetration index in 1998 of 0.21 then leads to an actual estimated average Lerner index of around 34.3 %, i.e. around 1.7 % lower. The results obtained are not affected by alternative treatments of the panel dimension (random effects) and provide broad evidence of pro-competitive gains from trade in line with the standard results of the literature. In column 5, we perform the same analysis of column 1, but restricted to the balanced panel resulting from dropping all those firms that did not have data for every time period. As it can be seen, the negative impact of import penetration on the average price–cost margins still holds. We subsequently tested whether our results are sensitive to the methodology employed in the calculation of the import penetration ratio. The specification in the second column of Table 5 exploits a different indicator of import penetration, obtained as the ratio of total import over the sum of import and production, thus bounding the index between 0 and 1 avoiding subtracting exports. The impact of import penetration on price–cost margins is larger than before, but the sign and significance are unchanged. In order to rule out the potential endogeneity of the import penetration index, we have followed Konings et al. (2005) by employing a lagged value of this measure. The results, reported in Column 3 of Table 5, are again entirely similar to our baseline specification. Finally, in Column 4 we have added to our regression an interaction between our DX measure and the Herfindahl index, as well as a triple interaction terms including also import penetration, in order to assess whether import penetration has a different effect on price–cost margins in more or less concentrated sectors. The coefficients of both interactions terms, however, are not statistically significant.

Not surprisingly, our average results point to a pro-competitive effect of trade in Italian industries. However, given the great deal of heterogeneity present across industries and firms, it is interesting to perform the same analysis at a more detailed industry level.

4.2 Industry-Level Results

We have estimated Eq. (10) for each NACE2 industry, always using firm-fixed effects and time dummies to control for a possible time trend, and clustering the standard errors to avoid their possible downward bias. Table 6 presents the results of this estimation reporting the estimated Lerner index (*PCM*) for the baseline year (1998), as well as the coefficient of the interaction term with the import penetration index (*PCM_IMP*). Moreover, Table 6 also reports the results obtained by running the industry-specific estimation only on the balanced sample of firms; this is in order to disallow our results to be driven by entry and exit dynamics of firms.

Based on these results, which are robust across the different specifications, it can immediately be seen that the estimated PCM are always significant and vary across industries, which is expected. However, it is quite striking to notice that the sign and significance of the interaction terms with the import penetration index display a huge degree of heterogeneity. In particular, three different groups of industries are present. In the first group, the impact of

[6] In order to ease the readability of all the tables, we have labeled there the term DX in Eq. (10) as “PCM”, to remind the reader that the estimated coefficients are the Lerner index and its interactions with time dummies and the measures of import penetration.

Table 5 PCM estimation and import penetration

Estimates of:	(1)	(2)	(3)	(4)	(5)
PCM (DX in Eq. 10)	0.361*** (0.0050)	0.343*** (0.0054)	0.359*** (0.0051)	0.345*** (0.0049)	0.347*** (0.0056)
PCM*99	−0.008 (0.006)	−0.008 (0.006)	−0.008 (0.006)	0.007 (0.0059)	0.006 (0.0059)
PCM*00	0.009 (0.006)	0.009 (0.006)	0.009 (0.006)	0.009* (0.0053)	0.007 (0.0053)
PCM*01	0.020*** (0.006)	0.019*** (0.006)	0.019*** (0.006)	0.020*** (0.006)	0.020*** (0.0058)
PCM*02	0.017*** (0.006)	0.017*** (0.006)	0.017*** (0.006)	0.017*** (0.006)	0.024*** (0.0055)
PCM*03	0.020*** (0.006)	0.019*** (0.006)	0.022*** (0.006)	0.020*** (0.006)	0.028*** (0.0056)
PCM*04			0.017*** (0.006)		
PCM*IMP	−0.054*** (0.0103)	−0.131*** (0.016)	−0.047*** (0.010)	−0.047*** (0.013)	−0.047*** (0.0130)
Const	−0.010*** (0.0009)	−0.010*** (0.0009)	−0.012*** (0.0009)	−0.010*** (0.0009)	−0.009*** (0.0009)
PCM*_Herfindahl	–	–	–	0.093 (0.222)	–
PCM*_Herf_IMP	–	–	–	−0.222 (0.253)	–
Firms fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes
R-squared	0.74	0.74	0.74	0.74	0.74
Obs.	68,327	68,327	85,801	68,327	50,421

Standard errors clustered at the firm level are reported in parentheses

(2) Import penetration calculated excluding exports; (3) Lagged import penetration

(4) As of Column 1 including Herfindahl index; (5) balanced panel

Table 6 Industry-specific results

Nace code	Nace description	PCM[a]	PCM*IMP[a]	PCM[b]	PCM*IMP[b]	Label
15	Food products and beverages	0.32***	−0.46***	0.32***	−0.44***	W
17	Textiles	0.33***	0.36***	0.32***	0.38***	S
18	Wearing apparel	0.38***	−0.05	0.35***	0.18	N
19	Leather	0.50***	−0.60***	0.47***	−0.49***	W
20	Wood and of products	0.27***	−0.16***	0.27***	−0.15***	W
21	Pulp, paper and paper products	0.30***	0.10**	0.32***	0.08**	S
22	Publishing & printing	0.37***	4.27***	0.36***	4.63***	S
24	Chemicals and chemical products	0.37***	−0.07*	0.38***	−0.09*	W
25	Rubber and plastic products	0.33***	−0.09	0.33***	−0.13	N
26	Other non-metallic products	0.39***	−0.03	0.37***	−0.02	N
27	Basic metals	0.29***	0.00	0.31***	−0.06	N
28	Fabricated metal products	0.38***	0.06	0.38***	0.06	N
29	Machinery and equipment n.e.c.	0.35***	0.05	0.35***	0.06	N
31	Electrical machinery	0.31***	0.03	0.32***	0.05	N
32	Communication equipment	0.27***	0.00	0.24***	0.05	N
33	Precision and optical instruments	0.38***	−0.02	0.39***	−0.03	N
34	Motor vehicles	0.23***	0.05	0.23***	0.14	N
35	Other transport equipment	0.50***	−0.05	0.49***	−0.01	N
36	Furniture; manufacturing n.e.c.	0.36***	−0.07***	0.36***	−0.10***	W

W "Weakened", *N* "Neutral", *S* "Strengthened"

[a] Coefficients on the terms DX and DX*IMP in Eq. 10. Firm FE estimator with time dummies and standard errors clustered at firm level

[b] Coefficients on the terms DX and DX*IMP in Eq. 10. Firm FE estimator with time dummies and standard errors clustered at firm level, balanced sample only

import penetration on the price–cost margin appears to be always negative and statistically significant across all specifications, in line with the standard results of the literature (the group is labeled "Weakened", in accordance with the impact of import penetration). A second group ("Neutral") is characterized by industries in which the impact of import penetration on the price cost margin is not significant. Finally, in a third group, which we refer to as "Strengthened" industries, a higher import penetration is always significantly associated to a higher price cost margin.

Table 7 reports the results of regressions on the full sample, but only where we allowed the coefficients on the interaction terms between DX and the import penetration to be different in our "Strengthened" industries. As the first column shows, the average pro-competitive effect of trade is reverted in those industries, where a higher import penetration seems to lead to higher price–cost margins.

A possible explanation for our finding relies on the hypothesis that, in some industries, imports registered at the relatively aggregated NACE-3 level include not only substitute products directly competing with local ones, but also imports of (cheaper) intermediates. If this is the case, firms operating in industries where the relative presence of imported intermediates is higher should experience a reduction in their costs rather than prices, thus possibly leading to higher markups. In Column 2 of Table 7 we find that the positive effect of import penetration on markups in the "Strengthened" industries is robust to a measure of import competition at the NACE-4 digit, a

Table 7 PCM and import penetration, different industry groups

Estimates of:	(1)	(2)	(3)	(4)
PCM (DX in Eq. 10)	0.358*** (0.005)	0.350*** (0.0040)	0.368*** (0.005)	0.360*** (0.006)
PCM*IMP	−0.068*** (0.0105)		−0.060*** (0.011)	−0.069*** (0.013)
PCM*IMP_S	0.204*** (0.0207)		0.215*** (0.023)	0.188*** (0.027)
PCM*IMP4		−0.015* (0.008)		
PCM*IMP4_S		0.032*** (0.001)		
Const	−0.001** (0.0009)	−0.001** (0.0010)	−0.001*** (0.0009)	−0.009*** (0.0010)
Firms fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
R-squared	0.74	0.74	0.73	0.73
Obs.	68,327	57,400	85,801	50,421

Standard errors clustered at the firm level are reported in parentheses ***, ** or * significant at the 1, 5 or 10 % level. The interactions of DX with time dummies are included but not reported. (3) Lagged import penetration (4) Balanced Panel only

refinement which, arguably, should allow us to better focus on substitute products, thus limiting the effect of imported products acting as intermediates for the considered firms.

In Column 3 of Table 7, we have also run our specification using the lagged import penetration index in order to rule out the potential endogeneity, finding virtually identical results.[7] Finally, in Column 4 of Table 7, we confirm the result by using only the balanced sample.

5 Industry Markups and the Product Mix

We have tried to link the positive correlation between import penetration and average industry markups in some given industries with the recent evidence that firms adjust their product mix in response to trade pressures (Bernard et al. 2006). In particular, our hypothesis is that, in certain industries, firms are more likely to contrast an increase of foreign competition with a switch of their product mix towards products characterized by lower elasticity of demand, and thus ending up with higher average price-costs margins as a result of an increase in import penetration.

Unfortunately, we do not have firm-specific data on individual product choices. We can, however, rely on industry-specific measure of product heterogeneity. Particularly, in order to test our hypothesis, we have used the Eurostat PRODCOM database, which collects data in time series on production at the finest possible level of detail (8-digits) for every EU country.[8]

[7] Note that the general argument for a potential endogeneity of the import variable is not straightforward in our case, given the different sign that import penetration generates on the markups of different industries. Nevertheless, throughout the paper we always control for the robustness of the results to lagged imports.

[8] The PRODCOM list consists of about 4,500 headings relating to manufactured products. Products are detailed on an 8-digit level; 1 to 4 digits refers to the NACE classification in which producing enterprise is normally classified. Most headings correspond to one or more Combined Nomenclature (CN) codes used for trade data. For example, NACE4 code 17.72 refers to "Knitted pullovers or similar products"; within this category, the Prodcom list distinguishes 10 different products, e.g. the code 17.72.10.31—"Men's or boys' jerseys, pullovers, sweatshirts, waistcoats and cardigans, of wool or fine animal hair (excluding jerseys and pullovers containing >=50 % of wool and weighing <= 600 g)", the code 17.72.10.32, which refers to females' models for the same product, or the code 17.72.10.53—"Lightweight fine knit roll, polo or turtle neck jumpers and pullovers, of cotton".

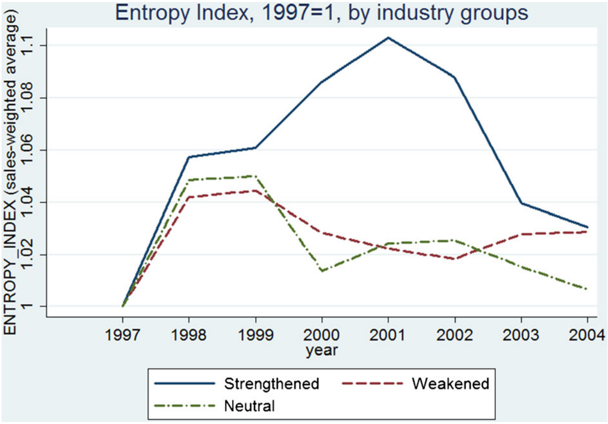

Fig. 1 Evolution of the entropy index, by industry

Then, we calculated a time-varying index capturing the dispersion/concentration of the product mix for our NACE2 industries, using as observational units the share of each product code in each industry and year. In particular, we have used an entropy index calculated over the individual product shares for each NACE-2 industry and year.

Entropy is defined as:

$$ENTROPY_{jt} = \sum_{i} [\text{prod}_{it} * \ln(\text{prod}_{it})]/\ln(k) \qquad (12)$$

where prod_{it} is the share of each product code i in each NACE-2 industry j in year t, and k is the number of (8 digit) product codes in which each NACE-2 industry has been partitioned by the PRODCOM dataset. The index is bound between 0, corresponding to perfect concentration, and −1, indicating equal dispersion (i.e. a uniform distribution of product shares). In order to ease intuition, we computed the index in absolute value; so that 0 correspond to perfect concentration and 1 correspond to perfect dispersion. Compared to traditional measures of dispersion (e.g. the standard deviation of the product shares), entropy has the advantage of being less affected by the shape of the distribution of the observational units. In fact, in our case, our observational units (the product shares) have a heterogeneous support in each comparison group (a NACE-2 sector), because different sectors are partitioned in a different number of product codes. Moreover, the ordering of product codes, which have no particular ranking but the one coded by the statistical offices, might affect traditional measures of dispersion. Figure 1 reports the evolution over time of the entropy index, normalised to 1 in 1997 for each of the three industry groupings previously identified.[9] Consistent with our hypothesis, the "Strengthened" industries, i.e. those where we find a positive correlation between import penetration and average industry markups, are the only ones displaying a clear dynamics in the evolution of their product mix, which over time tends to become more dispersed at first and then more concentrated.

[9] We have calculated sales weighted averages of each industry measure in order to retrieve the group value. The normalisation allows us to capture the relative dynamics of each industrial group. For the "Strenghtened" industries the entropy index was −0.66 in 1998, and rose by 10 % to −0.72 in 2002–2003, i.e. signaling an increase in the dispersion of the product mix in these industries.

Table 8 PCM, import penetration and the product mix

Estimates of:	(1)	(2)	(3)	(4)
PCM (DX in Eq. 10)	0.393*** (0.027)	0.359*** (0.005)	0.357*** (0.005)	0.359*** (0.006)
PCM*99	−0.008 (0.006)	−0.008 (0.006)	−0.007 (0.006)	−0.10 (0.006)
PCM*00	0.008 (0.006)	0.009 (0.006)	0.009* (0.005)	0.010* (0.021)
PCM*01	0.019*** (0.005)	0.020*** (0.005)	0.020** (0.005)	0.021*** (0.007)
PCM*02	0.016*** (0.006)	0.017*** (0.006)	0.017*** (0.005)	0.008 (0.006)
PCM*03	0.019*** (0.006)	0.020*** (0.006)	0.021*** (0.006)	0.016*** (0.006)
PCM*IMP	−0.054*** (0.010)	−0.226*** (0.006)	−0.168*** (0.006)	−0.156* (0.080)
PCM*ENTROPY	−0.042 (0.035)			
PCM*IMP*ENTROPY		0.238*** (0.095)	0.139 (0.094)	0.120 (0.110)
PCM*IMP*ENTROPY*S			0.262*** (0.032)	0.241*** (0.036)
Const	−0.01*** (0.0009)	−0.01*** (0.0009)	−0.01*** (0.0009)	−0.009*** (0.0009)
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
R-squared	0.74	0.74	0.74	0.75
Obs.	68,327	68,327	68,327	50,421

Standard errors clustered at the firm level are reported in parentheses

***, ** or * significant at the 1, 5 or 10 % level

Subsequently, we assessed the significance of this finding within our econometric model, by modifying our Eq. (10) as follows:

$$DY_{ijt} = \beta_1 DX_{ijt} + \delta_t DX_{ijt}{}^*T_t + \beta_2 DX_{ijt}{}^*IMP_{jt} + \beta_3 DX_{ijt}{}^*ENTROPY_{jt} + \gamma_i + \epsilon_{ijt} \quad (13)$$

The specification is augmented with another interaction term ($DX_{ijt}*ENTROPY_{jt}$), capturing the marginal impact of each industry's distribution of the product mix on the average markup. We also insert in the regression a triple interaction term ($DX_{ijt}*IMP_{jt}*ENTROPY_{jt}$) to assess whether a different dynamics of the product mix can change the way import penetration affects the price–cost margins. Table 8 reports the results of the estimation across all industries, always using firm-fixed effects and time dummies to control for a possible time trend, and clustering the standard errors. The overall impact of product heterogeneity on the markup is not significant for the average industry (Column 1). However, column 2 shows a positive and statistically significant coefficient on the triple interaction term, indicating how a higher dispersion of the product mix can potentially mitigate the pro-competitive effect of trade. In the third column, we add a triple interaction term isolating the strengthened industries. Interestingly, precisely our strengthened industries (including textiles) are the ones in which this effect is most at play. In order to show that these results are not an artefact of compositional shifts, we also run the specification of column (3) only using the balanced panel, with a fixed composition of firms. The results are reported in column (4), and they confirm those of column (3).

While we cannot offer a definite proof , this result is consistent with the intuition that in some industries the product mix might have been partially switched towards products characterized by a lower elasticity of substitution, thus generating the detected positive correlation between higher import penetration and higher markups. Whether this change in product mix happened within a single firm, or due to shifts in the composition of firms within the industry, however, is impossible to determine in absence of detailed firm-level product data.

6 Conclusions

The present work applies to a large sample of Italian manufacturing firms a methodology capable of delivering consistent estimates of the markups in order to investigate the impact of import penetration on price cost margins of a large sample of Italian manufacturing firms. On average, broad evidence of pro-competitive gains from trade is found, in line with the traditional results of the literature. On the other hand, the industry-level analysis provides a great deal of heterogeneity of responses. In some industries, import penetration seems to have a negative impact on price–cost margins, while in other industries this result is reverted. In a third group, no significant impact is found. By exploring the possible structural characteristics of industries that might explain this result, the paper provides evidence that international trade pressures in certain industries are associated with changes in the product mix. These findings shed a new light on the effects of trade liberalization on firms' strategies, which may contrast with previously established results in which the endogenous product scope of the firm was not taken into account.

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