International trade and the competition dynamics of multiproduct firms

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Abstract

We investigate the effects of import penetration on the observed price-cost margins using an unbalanced panel of some 70,000 firms, on average, operating in the Italian manufacturing sector from 2000 to 2007, controlling for the potential endogeneity of the trade measure and the multi-product characteristics of firms. Using an error correction model to distinguish the short vs. long-run adjustment path of the PCM, we find that, in the short-run, multi-product firms have a more sluggish adjustment of their PCM to the trade shock. In the long-run we find a robust negative relationship between the PCM and import penetration, while no significant role is played by the multi-product characteristic of the firm. This finding suggests that the pro-competitive effect of trade shocks affect steady-state industry equilibria, with the characteristic of being a multi-product firm endogenous to the market structure. However, in the short run the adjustment process of multi-product firms to the trade shock might be significantly more sluggish.

**JEL classification:** F15, L11

**Keywords:** price cost margins, trade openness, firms’ heterogeneity

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1 Introduction

The effect of trade liberalization on firm performance has received widespread attention in the literature over the last years, thanks to an increasing numbers of liberalisation cases, progresses in the underlying theories and the ability to test them throug a growing availability of detailed firm-level data. Tybout and Westbrook (1995), for example, find that the Mexican trade liberalization of 1984-1989 decreased average costs in most industries with the reduction in part attributed to productivity gains. Another survey by Tybout (2003) explores the effects of trade liberalization on average price-cost margins, exports, firm sizes, productivity and net entry dynamics in a number of cases.

More recently, driven by the results of new trade models which explicitly take into account a number of different dimensions according to which firm are heterogeneous (e.g. Melitz, 2003; Melitz and Ottaviano, 2008; Eckel and Neary, 2009) empirical studies have begun to exploit the availability of micro-based datasets to test the effect of trade liberalisation on a broader set of firm-performance measures. Among others, Bernard, Jensen and Schott (2006) (henceforth BJS), use a plant level panel from the Longitudinal Research Database of the US Census Bureau and analyze the effect of import penetration on the reallocation of US manufacturing firms, finding that exposure to imports from low-wage countries affects negatively plant survival and employment growth. Their evidence also shows that skill and capital abundant firms are two thirds less sensitive to such low-wage country imports. Chen, Imbs and Scott (2009) use industry level data (aggregated at the Nace2 level) for a set of industries in seven European countries. Using a difference in difference model they find that international differences in sector level inflation rates, productivity growth and markups are all ascribed to international differences in openness to trade, in line with the theoretical model of Melitz and Ottaviano (2008)\(^1\). In particular, using an error correction model they disentangle long from short run dynamics, finding that pro-competitive effects are most effective in the short run, while in the long run there is evidence that some effects of trade liberalization may be reversed\(^2\).

A further dimension of firm heterogeneity has been pointed out by a number of recent studies (Bernard et al., 2010; Mayer, Melitz, Ottaviano, 2009; Eckel and Neary, 2009; Iacovone and Javorcik, 2008; Baldwin and Gu, 2009), which have discussed theoretically and empirically how multi-product firms might react to international competition endogenously changing their product mix towards their ‘core competence’ products, characterised by lower costs and higher markups. In particular, in Mayer, Melitz and Ottaviano (henceforth MMO 2009) a change in trade openness not only induces the traditional self-selection of the most efficient firms but, within the varieties produced by a firm, opens the way for the selection of the "most efficient"

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\(^1\)In this framework, monopolistically competitive firms produce one variety of a single product with heterogeneous productivity levels; markups, rather than being driven exogenously by the distribution of firms’ marginal costs, are endogenous over the different product varieties, depending among others on the ‘toughness’ of competition across countries or industries and hence on the exposure to international trade.

\(^2\)The latter derives from an assumption in Chen, Imbs and Scott (2009) according to which firms can respond to increased competition by relocating to more protected markets overseas, as the fall in trade costs makes it more viable to serve the domestic market through exports from there.
products. These effects might combine and strengthen the impact on productivity of an increased exposure to international trade of multi-product (MP) firms, with respect to a setting in which only single-product (SP) entities operate.

When looking at the same effects in terms of markups, the ensuing implication is nevertheless more ambiguous. The tougher competitive environment resulting from the trade shock induces the distribution of markups to shift down for all firms/products: thus, other things equal, the average firm-level PCM should decrease. However, a number of selection effects can arise that contrast the general downward shift of the PCM distribution after the competition shock. First of all, the self-selection of non-efficient, low markup firms and products increases the relative weight of core, high markup products within the firm as well as within the industry (as the less efficient firms characterised by relatively lower markups exit). On top of it, there is a further reallocation of production towards the products closer to the core competence.\footnote{A similar effect is discussed in Melitz and Ottaviano (2008) for single product firms. In this case, a competition shock is such that the less efficient firms, characterized by relatively lower markups, leave the market, thus leaving only more efficient firms with relatively higher markups. However, it can be shown that according to the parameterization of the cost function employed (Pareto), the downward shift of the distribution of markups for every firm (competition effect) outweighs the selection effect of firms.} Those effects might yield an uncertain outcome on the average PCM of surviving multi-product firms.\footnote{Note that an increase in price-cost margins is not necessarily welfare-reducing, as long as the effect is driven by the reallocation of resources from inefficient to efficient firms and, within firms, from inefficient to efficient products: the effects on productivity are in fact not ambiguous.}

This paper aims at testing the latter effect, studying the relationship between trade openness and the price-cost margins (PCM) of single vs. multi-product Italian manufacturing firms in the period 2000-2008. In particular we proxy foreign competition with a relatively disaggregated (at the NACE4 level) import penetration index, and analyze the short vs. long-term reactions to increased competition of firm-level price-cost margins, distinguishing single and multi-product firms. In doing so, to the best of our knowledge, we are the first to explicitly link PCMs measured at the firm level to changes in trade openness, controlling at the same time for the product mix margin as well as the speed of adjustment. Throughout the paper we also control for the potential endogeneity of the import penetration measure, instrumenting it through a geography-based variable, i.e. using the trade flows of neighboring countries as an instrument to calculate the Italian import penetration index.

In our baseline specification, where both PCM and trade openness are measured in levels, we find some evidence of the pro-competitive effect of trade liberalization, especially when controlling for the potential endogeneity of our trade measure. However, the interaction between the import penetration and the multi-product status of firms is positive, thus indicating that the pro-competitive effect of trade is attenuated for MP firms.

Although we always control for the domestic level of industry-concentration, the specification in levels might be affected by an omitted variable bias, leading to both higher firm-level PCM and import penetration. However, first differencing is not likely to solve the problem, due to the high persistence of our dependent variable (the price-cost margin), as revealed by a number of tests performed using different dynamic panel specifications. Hence, following Chen, Imbs
and Scott (2009), the most appropriate specification to study the relationship between trade openness and PCM, even at the firm level, seems to be an error correction model of the PCM, modified in order to account for the different behavior between single vs multi-product firms.

Once we allow firms to trend to different equilibria through the ECM, we find that the short run pro-competitive effects of trade openness are on average not significant, but the interaction of the latter with the PCM of MP firms remains positive and significant. However, in the long run we do find a negative relationship between markups and import penetration. The latter finding is also robust to our control for endogeneity. Moreover, when instrumenting import penetration both multi-product firms and their single-product competitors seem to tend to the same long run equilibrium. This finding suggests that structural long-run relationships exist between firm-markups and market characteristics, in which firms adjust both their range of products and their PCM. In the long run, in other words, the characteristic of being a multi-product firm is endogenous to the market structure, while in the short run the adjustment process between SP and MP firms is different.

The structure of the paper is as follows: Section 2 presents a review of the literature on multi-product firms in international trade, Section 3 introduces our econometric specifications, Section 4 discusses the source of data and the variable construction while Section 5 presents results and the relative robustness check. Section 6 concludes.

2 Multi-product firms and international trade

Multi-product firms are dominant in modern world economies especially when international dynamics are involved. Understanding the forces that drive their choices has thus become a relevant issue not only for traditional industrial organization theory but also for international economics. Recent works by Bernard, Redding and Schott (2010) and Goldberg et al (2008) have empirically assessed the importance of this kind of firms in two very different countries like the US and India; they have shown the pervasiveness of their presence in all industries and their relevant contribution to total production and exports.

From a theoretical point of view, the first international trade model analyzing the endogenous choices of heterogeneous multi-product firms has been set up by Bernard et al. (2010). This model modifies Melitz (2003) splitting the sources of firm heterogeneity into two channels. Productivity arises from the combination of two stochastic (and independent) components: a firm-level ability (as in Melitz, 2003) and an idiosyncratic firm-product ‘expertise’. Some of the prediction of the model point in the direction of the superiority of the performance of MP firm. Since there is a monotonic relationship between firm-level ability and the range of varieties produced, and a positive correlation between scope and size, we can expect MP firms to be more productive and have higher revenues. Iacovone and Javorcik (2008) and Baldwin and Gu (2009) have indeed found empirical evidence of these effects for the case, respectively, of Canadian and

Mexican firms under NAFTA.

Of course what we observe in our data is not the firm "true ability", but rather an average of firm-level ability and the various product expertises. As a result, the MP superior ability may not be reflected in a higher firm-average productivity. Once a competition shock occurs, MP firms act on their product mix dropping varieties for which their expertise is low. Thus a double process of selection arises in the market: a selection across firms and one across products within the firm. However, since CES utility function are used in Bno conclusion on the behavior of PCM after the competition shock can be drawn.

Mayer, Melitz and Ottaviano (henceforth MMO, 2009) capitalizing on Melitz and Ottaviano (2008), build a model that incorporates endogenous markups and a flexible manufacturing technology in a monopolistic-competition environment. Flexible manufacturing means that firms typically have one "core competence", i.e. a key variety associated with the marginal cost initially drawn from the productivity distribution, while they are less efficient (higher marginal cost) in the manufacturing of products outside their core competence. The firm's products are ordered by their distance from the core competence: the further away the variety, the more it is produced at higher marginal costs. The authors show that increased competition (e.g. a fall in trade barriers, an increase in market size, technology improvements or an increase in product substitutability) shifts downward the distribution of markups across products, thus skewing firm's sales towards its best performing products. When competition is stronger, the cutoff cost $c_D$ falls and all firms react to the tougher environment by reducing the number of goods produced and focusing on their core varieties.

Within-firm productivity increases both for the selection effect (more expensive, less core products are dropped) and for the effect of a reallocation of resources across products within firms (products closer to the core, thus characterized by lower costs, are produced in higher quantities). It then follows that aggregate productivity rises for the combined effect of the traditional across firms and the new within-firm selection effects. So the model predicts an effect on productivity greater than models encompassing only single-product firms.

As far as the average firm-level PCM is considered, however, the tougher competitive environment is such that the distribution of markups shifts down for all varieties and thus, other things equal, the average firm-level PCM should decrease. However, we have two effects that contrast the general downward shift of the PCM distribution after the competition shock. First of all, the drop of non-efficient, low markup products (selection effect) increases the relative weight of core, high markup products within the firm. On top of it, within the surviving products we have a further reallocation of production towards the products closer to the core competence. While the authors are able to show that the PCM should decrease for all the exported products (i.e. for those firms who are productive enough to afford exports), the latter two effects might

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A similar effect is discussed in Melitz and Ottaviano (2008) for single product firms. In their case, a competition shock is such that the less efficient firms, characterized by relatively lower markups, leave the market, thus leaving only more efficient firms with relatively higher markups. However, it can be shown that according to the parameterization of the cost function employed (Pareto), the downward shift of the distribution for every firm outweighs the selection effect of firms.
yield an uncertain outcome on the average equilibrium PCM (the one calculated on the entire product mix) of the surviving firms in the economy.

An alternative multi-product-firm model with endogenous markups is the one by Eckel and Neary (henceforth EN 2009). The main difference with respect to Mayer, Melitz and Ottaviano (2009) is that EN 2009 build a model under an oligopolistic, rather than monopolistic competition, setting. In particular, their model incorporates both supply and demand linkages that capture important differences between multi-product and single-product firms. The basic idea is that multi-product firms in an oligopoly, when deciding the production of each individual variety, would not take the demand of the other varieties they produce as given, but rather internalize the demand linkages among all the varieties they manufacture: they will take into account that the total output they produce affects negatively the sales of each individual variety. This effect is called "cannibalization effect". Cannibalization does not exist in a monopolistic competition environment (like the one assumed in MMO 2009) but requires that firms are large in their markets and behave like oligopolists. On the supply side, as in the previous model, production is described by a flexible manufacturing technology, marginal costs are constant within the production of one particular variety but there are diseconomies of scope when expanding the product range. Firms are assumed to play a single-stage Cournot game so they take as given the strategic choices of the rivals and choose simultaneously the range of products and each variety optimal quantity. The latter will be also a negative function of firm’s aggregate output reflecting the cannibalization effect. Since multi-product firms internalize demand linkages, they have incentive to reduce the production of their individual varieties: other things equal, they produce less of every variety with respect to single-product firms. More competition reduces the prices which firms can charge in Cournot markets, but this is partly (though not fully) offset by the weaker effect of cannibalization, which encourages multi-product firms to charge higher prices on all their varieties, and also allows them to earn higher margins. In particular, when the number of countries participating in the global economy increases, EN 2009 show that there are two channels through which the competition shock operates. The first effect is a market-size effect, i.e. globalization boosts the number of worker/consumers in the economy: this induces an equi-proportionate increase in the output of each variety and of total output, but no change in firm scope. The second is a competition effect: as the number of active firms rises (because of a higher number of countries, although the number of active firms per country remains constant), there is a uniform decline in the production of each good, a fall in total firm output and a reduction of firm scope, but an increase in industry output thanks to the higher number of firms. The net effect is an increase in output but a reduction in the number of varieties per firm.

As in MMO 2009, competition will lower mark-ups for a given variety and push down firm average PCM; but at the same time high-cost-low-margin varieties are not produced anymore and, among surviving varieties, the weight of low-cost varieties decreases because of the cannibalization effect, inducing a rise in the PCM. An increase in competition thus induces a selection effect on varieties similar to the one analyzed by MMO 2009, according to which the non-core varieties are dropped. Moreover, EN 2009 also show that, when the increase in market-size is
added to the picture, there is also a reallocation effect within firms (again as in MMO 2009): their production will be lower for relatively high cost goods, while output for varieties with cost equal or below the average will rise. It then follows that also in this model the effect of trade liberalization on the average PCM of surviving firms can be ambiguous.

3 Model design

We start from a reduced-form equation of the price-cost margin at the firm-level, in which the PCM at time $t$ of a given firm $i$ ($\mu_{it}$) is regressed against different measures of competition (domestic or foreign), usually lagged one period to partly control for endogeneity problems. In particular, import penetration calculated at a given industry-level $I$ of aggregation at time $t$ ($impen_{It-1}$) can be used as a measure of foreign competition, while the domestic level of market concentration can be proxied by the Herfindahl or the C4 indexes, calculated over the same industry $I$ and time $t$ ($comp_{It-1}$), as in the following equation (1):

$$
\mu_{it} = \alpha_i + \beta impen_{It-1} + \gamma comp_{It-1} + X_{it} + \varepsilon_{it}
$$

Such a specification is generally enriched by the inclusion of firm fixed effects, which account for time invariant unobservables, as well as a number of time-varying firm-level characteristics ($X_{it}$), such as the initial firm size, the distance of the firm from the Minimum Efficiency Scale (MES), the K/L ratio.

Clearly, the main limitation of this approach is that it captures a "static" equilibrium relationship, ignoring changes in firms' behavior, and thus momentary deviations from the equilibrium. Moreover, the specification in levels might be affected by an omitted variable bias, leading to both higher firm-level PCM and import penetration, and thus a spurious correlation among our variables of interest.

An alternative approach would be to first difference equation (1), estimating the impact of changes in import penetration on changes of margins (see equation (??)). However such specification would be flawed in an opposite direction, as it restricts the effect on firm-level PCM only to shocks in the import penetration index, ignoring the effects of the persistence of import penetration on firms' behavior.

More in general, as already pointed out by Melitz and Ottaviano (2008) theoretically, and confirmed empirically by Chen, Imbs and Scott (2009), it seems important to distinguish between the short-run, almost contemporaneous reaction of PCM to a trade shock, and the long-run static equilibrium relationship between firms’ price-cost margins and the competitive environment. The latter is particularly important also from an econometric point of view, to the extent that the firm-level PCM displays (as data discussed in the next section show) a high degree of persistence over time.

Thus, we start from a simple model which considers $\mu$ as a function of its lagged value, and present and lagged value of the competition variables, as well as the already discussed firm-level
controls:

\[ \mu_{it} = \alpha_i + \delta_{10} \text{impen}_{it} + \delta_{11} \text{impen}_{it-1} + \lambda \mu_{it-1} + X_{it} + \varepsilon_{it} \]

Subtracting from both sides of the equation the lagged value of PCM, and adding and subtracting the terms \( \delta_{11} \text{impen}_{it} \), we can write:

\[ \mu_{it} - \mu_{it-1} = \alpha_i - \mu_{it-1} + \delta_{10} \text{impen}_{it} + \delta_{11} \text{impen}_{it-1} + \lambda \mu_{it-1} + \delta_{11} \text{impen}_{it} + X_{it} + \varepsilon_{it} \]

Which becomes:

\[ \Delta \mu_{it} = \alpha_i - (1 - \lambda) \mu_{it-1} + (\delta_{10} + \delta_{11}) \text{impen}_{it} + \delta_{11} \Delta \text{impen}_{it} + X_{it} + \varepsilon_{it} \]

Changing notation we finally obtain:

\[ \Delta \mu_{it} = \phi(\mu_{it-1} - \theta_0 - \theta_1 \text{impen}_{it}) + \delta_1 \text{impen}_{it} + X_{it} + \varepsilon_{it} \]

where \( \phi = -(1 - \lambda), \theta_0 = \frac{\alpha_i}{1 - \lambda}, \theta_1 = \frac{\delta_{10} + \delta_{11}}{1 - \lambda} \).

The advantage of equation (??) with respect to the other models adopted in the literature consists in the possibility of obtaining a rich set of information from the data at hand, imposing a minimum structure on the variables. Indeed, such a model design allows to explicitly control for the persistence of the firm-level PCM (a strong characteristic of the data, as it will be shown in the next section), assuming at the same time that both lagged as well as contemporaneous values of the competition variables have an effect on \( \mu \).

More specifically, equation (??) can be read as an error correction model. This implies that coefficients can be interpreted as follows: \( \phi \) is the error correction speed of adjustment, \( \theta_0 \) are firm fixed effects, \( \theta_1 \) is the long run coefficient for \( \text{impen}_1 \) and \( \delta_1 \) is the short run coefficients for import penetration.

The latter property of such a model specification is particularly suited for the problem at stake, as it allows us to distinguish between the short-run effects of the trade shock, in which one can assume that the total number of product/firms is constant, and the long run effects of the same shock, in which firms can endogenously change their product mix as a reaction to the trade shock and thus vary their markup\(^7\).

In particular, in order to correctly identify the (necessary) long run relationship between dependent and independent variables for the problem at stake, we will augment the baseline econometric model allowing for different response of MP firms, both in the short and in the long run. That is, we will interact in the above specification our domestic and foreign competition measures with the multi-product dummy, assessing the effect for both the short (\( \delta \)) and the long-run (\( \theta \)) coefficients of interest.

\(^7\)A similar error correction model has been used by Chen, Imbs, Scott (2009) to study the relationship between relative prices, openness and the number of firm partecipating in the economy.
4 Data description

4.1 Sources of data

Firm-level data are retrieved from the ORBIS database, which collects balance sheet data and ownership data for almost 65 million companies around the world, including about 18 millions firms active in Western European countries (2010 version). The dataset, compiled and updated by the consultancy firm Bureau van Dijk, has the advantage of delivering updated and comparable balance sheet information across industries and countries. Uniform inclusion criteria are ensured so that absence in bias coverage is guaranteed. In terms of coverage of data, the ORBIS database includes overall about 180,000 Italian companies operating in the manufacturing sector each year.

We clean our data by removing all those entries for which data in our variables of interest are missing or negative values of costs, revenues and employees are reported (a very small minority of data entry errors). Overall, we are able to construct price-cost margins for an average of 71,000 firms in Italy spanning from 2000 to 2007.

Table 1 reports the size distribution of the firms of the final sample. As it can be seen, the database covers also medium and small enterprises -a feature extremely important for the analysis of the Italian economic activity.

<table>
<thead>
<tr>
<th>n° of employees</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>n°&lt;10</td>
<td>31.5%</td>
</tr>
<tr>
<td>10&lt;n°&lt;30</td>
<td>35.6%</td>
</tr>
<tr>
<td>30&lt;n°&lt;50</td>
<td>13.9%</td>
</tr>
<tr>
<td>50&lt;n°&lt;100</td>
<td>10.5%</td>
</tr>
<tr>
<td>100&lt;n°&lt;200</td>
<td>4.9%</td>
</tr>
<tr>
<td>n°&gt;200</td>
<td>3.7%</td>
</tr>
</tbody>
</table>

Unfortunately, the ORBIS database does not directly include data on firms’ product mix choices. However, it includes different activity codes identifying the various industries in which a firm operates at a reasonably disaggregated level.

Information on trade flows has been provided by the COMEXT database of EUROSTAT. Values on imports and exports of the manufacturing sector were collected at a detailed product level according to the CN 8-digit classification used for custom purposes, for the period 2000-2007, considering the trade flows of Italy with the rest of the World. Data were then reclassified at the 4-digit NACE rev. 1.1 level, using the relative correspondence tables provided by EUROSTAT. Data on production in manufacturing were collected directly at the 4-digit NACE level using EUROSTAT’s structural business statistics (SBS).

An alternative source to retrieve information on production and trade flows is the PROD-
COM database, always provided by EUROSTAT, which contains data on total production, import and export at the 8-digit product level. Although this database presents the data in a way immediately convertible at the Nace level, it suffers from severe missing data issues since often production figures are not reported due to confidentiality, leading to a bias in the measure at the industry level.

Finally, we have checked the robustness of the import penetration measure with respect to the source of trade data, using the OECD’s Structural Analysis (STAN) database. STAN provides data at the 2-digit NACE level and it includes annual measures of output, labour input, investment and international trade including, but not limited to, production, import, export, and value added.

4.2 Variable construction

The Price cost margin (PCM) is defined as the distance between a firm’s price and marginal cost. One obvious difficulty in computing the firm-level PCM is the impossibility to retrieve marginal cost measure from balance sheet data. Two different methodologies are available in the literature to calculate the empirical Lerner index at firm-level: with the first method, adopted by Aghion et al. (2005) and Nickell (1996), the operating revenue (net of depreciation and financial cost of capital) is divided by sales. The second approach, used by Tybout (2003), is the one we adopted throughout the analysis; he suggest to compute PCM as sales net the expenditure on material and labor over sales, proxing marginal costs with variable cost. As a result for firm $i$ at time $t$ PCM can be estimated as

$$\text{PCM}_{it} \approx \frac{\text{sales}_{it} - \text{variable costs}_{it}}{\text{sales}_{it}} = \frac{(p - c)_{it}}{(p - c)_{it}} = \frac{p_{it} - c_{it}}{p_{it}}$$

where quantity is simplified within the ratio, leaving in the expression unit price $p$ and unit variable cost $c$. The latter represents the sum of costs for materials and costs for employees, therefore excluding the cost of capital that is considered as a fixed cost.

As far as the independent variables are concerned, the firm characteristic of being a multi-product firm is summarized by a time-varying dummy variable taking value 1 if the firm is considered multi-product, and 0 otherwise. As already mentioned, ORBIS does not have information on the company product mix but in the database are reported the codes of the primary and secondary activities of the firm according to different classifications. We have used the US-SIC classification at the 4 digit, since the reporting on secondary activities of firms is more accurate. Based on these data, we have singled out firms that operate in more than one US-SIC industry, and have considered those as multi-product firms. The US-SIC classification at the four digits indeed identifies sub-industries (for example "Production, processing and preserving of meat and meat products") and not individual products (an harmonized system 6-digit code for product in the food industry, is for instance, "sausages and similar product of meat, meat

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8Konings and Vandebussche (2005) use a similar measure in their analysis of the effect of international anti-dumping protection on the market power of domestic firms.
offal or blood; food preparation of these products"). However, the same US-SIC classification is more detailed than the corresponding NACE 4-digit classification, and thus more suited for a multi-product analysis. Still, it is likely that in our data some firms classified as single-product would in reality be multi-product firms manufacturing all their varieties in the same sub industry.

In any case, our aggregate statistics are comparable to the ones obtained by Bernard et al. (2010). Table 2 reports the percentage of firms always recorded as multi-product in our dataset. Our figure (34.5%) is comparable to the average number of multi-product firms recorded in the US (39%). In our case, however, since we are dealing with yearly observations, rather than long-term switches from one to another census period, almost a third of firms report altering their product status over time. The transition probabilities reported in the right-hand panel of Table 2 indeed show that around 20% of firms in our observation period are likely to become multi-product from a single-product status, while the opposite is true for around 11% of multi-product firms.

Table 2: MP vs. SP firms

<table>
<thead>
<tr>
<th>Status</th>
<th>always MP</th>
<th>34.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>always SP</td>
<td>32.9%</td>
<td></td>
</tr>
<tr>
<td>Product switchers</td>
<td>32.6%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Status</th>
<th>MP&lt;sub&gt;t-1&lt;/sub&gt;</th>
<th>SP&lt;sub&gt;t-1&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>always MP</td>
<td>89.25</td>
<td>10.75</td>
</tr>
<tr>
<td>Product switchers</td>
<td>19.98</td>
<td>80.02</td>
</tr>
</tbody>
</table>

Also consistently with the findings of Bernard et al. (2010), multi-product firms in our sample are on average bigger, more capital intensive, pay higher wages and have a higher labor productivity.

Table 3: MP Characteristics - Average values

<table>
<thead>
<tr>
<th></th>
<th>SP</th>
<th>MP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>9145</td>
<td>10553</td>
</tr>
<tr>
<td>Employees</td>
<td>48.4</td>
<td>68.0</td>
</tr>
<tr>
<td>Labor Productivity</td>
<td>120.0</td>
<td>144.7</td>
</tr>
<tr>
<td>K/L ratio</td>
<td>67.1</td>
<td>115.3</td>
</tr>
<tr>
<td>Unit wage</td>
<td>33.3</td>
<td>41.9</td>
</tr>
</tbody>
</table>

Thousands of Euros
Import penetration indexes have been constructed at the NACE 4-digit industry level as:

\[
IP_{It} = \frac{\text{import}_{It}}{\text{import}_{It} + \text{production}_{It} - \text{export}_{It}}
\]

where \(\text{import}_{It}\) (\(\text{export}_{It}\)) are the total imports (exports) of Italy in industry \(I\) in year \(t\), while \(\text{production}_{It}\) is the national output of industry \(I\) in year \(t\). As a robustness check, we have calculated the correlation between our NACE 4-digits import penetration indexes re-aggregated at the NACE 2-digit levels, and the same measure retrieved from the OECD STAN database. Reassuringly, the correlation is .91 and significant.

The following Figure also shows how the average import penetration (as calculated for both measures) has been steadily increasing in Italy for the period considered, thus paving the way to an adjustment process of the underlying firms’ competitive dynamics.

Figure 1: Import penetration in Italy, 2000-2007

To control for domestic competition we use the C4 index, which is defined as the sum of the 4 highest market shares in the industry, where market shares have been computed on sales:

\[
C4 = \sum_{j=1}^{4} s_j
\]

Alternatively, as a robustness check, we adopt the Herfindahl-Hirschman Index or HHI, which is defined as:

\[
HHI = \sum_{i=1}^{n} s_i^2 = \sum_{i=1}^{n} \frac{SALES_{It}}{PRODUCTION_{It}}; \quad I = 1, \ldots, N \text{ indexes industries}
\]

We have constructed the \(HHI\) indexes both using total production of the Nace 4-digit industry retrieved from our sample (\(HHI\_1\)) and using the total production coming from EUROSTAT (\(HHI\_2\)). All our concentration measures are strongly correlated, as expected. However, since
the Herfindahl-Hirschman Index tends to be more sensible to sample characteristics we prefer the C4 measure.

Table 4: Import Penetration-Correlation between different sources of data

<table>
<thead>
<tr>
<th></th>
<th>HHI_1</th>
<th>HHI_2</th>
<th>C4</th>
</tr>
</thead>
<tbody>
<tr>
<td>HHI_1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI_2</td>
<td>0.9587***</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>0.855***</td>
<td>0.8744***</td>
<td>1</td>
</tr>
</tbody>
</table>

Our empirical strategy includes firm-level fixed effects, which control for time-invariant firm characteristics, plus a number of time-varying controls at the firm-level. We include firm size, size_{it}, which is defined as the logarithm of the number of employees. Additionally, we include the distance of each firm from the minimum efficiency scale (MES), which has been defined by the difference between the total assets of firm i at time t in a NACE 3-digit industry r and the average size of the n largest companies in industry r at time t which account for 50% of total sales. We also control for the K/L ratio of the firm, defined as the log of fixed assets per employee. Then, to partially take into account the "quality" expressed by the firm in the production process, which might affect the markup, we include the logarithm of unit wage, unit_wage_{it}, defined as the ratio of wage bill and number of employees, as well as the logarithm of unit intermediate input cost, unit_input_cost_{it}, defined as the ratio of the cost of materials and the number of employees.

5 Results

5.1 Baseline specification, endogeneity and PCM persistence

We first present some baseline results obtained with the traditional estimation methods, namely a panel regressions of firm-level PCM as of our Equation 1. Results are reported in the first two columns of Table 5. In this specification, the (lagged) level of import penetration does not seem to affect the PCM level of our average firm. On the contrary, domestic competition, as proxied by our concentration index, has an impact, but with the wrong sign. When controlling for the (time-varying) status of multi-product firms, we do find that the latter are on average characterised by a slightly lower PCM. Consistently with our hypothesis, foreign competition has a marginally positive effect on the PCM of multi-product firms, via the adjustment of the product mix. The results control for firm and time fixed-effects, as well as firms’ time-varying characteristics.\footnote{Interestingly, in all our specifications the coefficient on unit input cost is positive and significant, pointing in the direction of a PCM premium for firm employing better inputs (better quality).}
An obvious concern with these results is related to the potential endogeneity of the import penetration variable. In particular, the index we use to account for foreign competition could suffer from reverse causality if, for example, in some very concentrated industries, big firms can lobby for (non-tariff barriers) protection and keep imports artificially low. It can also be that the evolution of price-cost margins and the level of domestic competition influence the profitability of a given domestic industry, thus partially driving trade flows. These interactions might explain the non-significant or wrong signs of our domestic and foreign competition variables with respect to the PCM.

Different remedies have been proposed in the literature to correct for the endogeneity of the trade measure. Frankel and Romer (1999) proposed an instrument based on geography variables in a gravity equation in the contest of growth regression. Alcalà Ciccone (2003) also use a geography-based instrument to estimate productivity. More recently, Chen Imbs and Scott (2009) suggest an index constructed as a combination of instruments that condense inherent transportability and other characteristic of the product together with a gravity variable based on the export potential of neighboring countries.

In this work we capitalize on the idea of using trade of neighboring countries as IV, and thus instrument the Italian import penetration with the same index calculated for the major economies neighboring Italy, namely France, Spain and Germany. The latter exploits the fact that European import penetration indexes tend to be very correlated, a hardly surprising finding since about two thirds (67%) of the trade flow of EU countries occurs with European counterparts. Clearly, to completely purge from endogeneity, in constructing the neighboring countries’ IP we net their trade flows with Italy in order to completely rule out the possibility of reverse causality.

Results are reported in Columns 3 and 4 of Table 5. As it can be seen, the IV approach significantly improves with respect to our previous findings, with results in line with our hypothesis. Lagged levels of import penetration are now negatively and significantly associated to the PCM of our average firm, consistently with the standard pro-competitive effects of trade. The level of domestic concentration has instead a non-significant effect on the PCM of the average firm, a signal that firm-level heterogeneity within an industry is, not surprisingly, much larger than the heterogeneity in concentration levels across industries. Interestingly the reaction of multi-product firm is always in the direction which can be postulated by the theoretical models: the coefficient in the interacted term is always positive and significant, confirming that MP firm, thanks to their ability of changing their product mix, are less affected by foreign competition relatively to SP firms.

Although the IV regression clearly improves our results, the underlying model is still poorly specified, as shown from the extremely low value of the R statistics. As we have already hinted at, a possible problem in the model design is related to the likely persistence of the firm-level PCM itself. As a result, a correctly specified econometric model cannot abstract from such a
characteristic. To prove our point, we use dynamic panel techniques in which we regress the firm-level price cost margins on its lags and the usual bunch of firm level controls, using both the Arellano Bond (1991) and the Blundell Bond (1998) approach. We indeed observe that first, second and third lags of the price-cost margin are highly significant, in line with our hypothesis of a high persistence of the latter variable over time. Results are reported in Table 6.

Table 6: Dynamic panel specification of the PCM

<table>
<thead>
<tr>
<th></th>
<th>Arellano Bond (I)</th>
<th>Arellano Bond (II)</th>
<th>Arellano Bond (III)</th>
<th>Blundell Bond (IV)</th>
<th>Blundell Bond (V)</th>
<th>Blundell Bond (VI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCM_{t-1}</td>
<td>0.222 ***</td>
<td>0.480 ***</td>
<td>0.414 ***</td>
<td>0.214 ***</td>
<td>0.356 ***</td>
<td>0.369 ***</td>
</tr>
<tr>
<td>PCM_{t-2}</td>
<td>0.182 ***</td>
<td>0.194 ***</td>
<td>0.142 ***</td>
<td>0.142 ***</td>
<td>0.168 ***</td>
<td>0.168 ***</td>
</tr>
<tr>
<td>PCM_{t-3}</td>
<td></td>
<td>0.063 ***</td>
<td></td>
<td></td>
<td>0.006 ***</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.265 ***</td>
<td>0.115 ***</td>
<td>0.110 ***</td>
<td>0.267 ***</td>
<td>0.170 ***</td>
<td>0.134 ***</td>
</tr>
</tbody>
</table>

N Obs: 315690 219517 138335 430910 315690 219517  
N firms: 94884 81182 54236 111594 94884 81182

Note: Arellano Bond two step estimator in columns I-III. Arellano Bover/ Blundell Bond two step estimator in columns IV-VI. Robust standard errors
Legend: * 10%; ** 5%; *** 1%
5.2 Error Correction Model of the PCM

In order to account for the persistence of the firm-level price-cost margins and improve on the model specification, we follow Chen, Imbs and Scott (2009) and adopt an error correction model for the PCM as outlined in equation (??). The latter specification is indeed more closely related to the surveyed theoretical models, which essentially identify the effects of a trade shock as a comparison of two stationary equilibria: in fact, the specification allows to distinguish short-run deviations of the PCM induced by changes in import penetration (or by stochastic fluctuations) from the long-run equilibrium relationship between price-cost margins and competition levels, controlling at the same time for the persistent pattern of the same PCM.

To test our hypothesis, we enrich the error correction model with the interaction term between import penetration and the MP dummy (whose effects are tested both in the short and in the long run), controlling at the same time for the long-run equilibrium relation between PCM and domestic competition levels. We also include as additional controls the usual firm-level effects employed in the previous specification. Results are reported in the following Table 7, for both the original index of import penetration and the instrumented one.

First of all, we find evidence of the existence of a long-run stationary equilibrium for our variable of interest, as the coefficient (negative and significant) of the lagged value of the PCM implies a convergence (and a speed of adjustment) of the short-run PCM to its long-run value, for all our model specifications. The deviations from this long-run trend are captured by the coefficients reported under the ‘short-run’ part of Table 7. We do not have evidence of a systemic short-run effect from changes in the import penetration index beyond the already existing adjustment path of the PCM, at least for the average firm.\(^\text{11}\) However, when employing our IV specification, we find confirmation of the fact that changes in foreign competition have a marginally positive and significant effect on the PCM of multi-product firms. The latter reveals that MP firms have a different, more sluggish, path of adjustment in their long-run PCM dynamics.

Looking at the long-run effects, and always controlling for firm characteristics and industry concentration, we do find a robust negative (pro-competitive) long-run relationship between the firm-average PCM and import penetration, in line with the steady state equilibria postulated by theoretical models (Melitz and Ottaviano, 2008). The same long-run relationship is confirmed in our IV specification, with an even higher magnitude. Interestingly, when we look at the correct IV specification, the multi-product dummy does not seem to have a long-run impact, neither on the PCM steady-state equilibrium nor on the structural relationship it has with the foreign competition index. This finding suggests that, not surprisingly, structural long-run relationships exist between firm-markups and market characteristics, in which firms adjust both their range of products and their PCM. However, in the long run, the characteristic of being a multi-product firm is endogenous to the market structure.

\(^{11}\)Being the PCM measured at the firm-level, while the import penetration is measured at the industry-level, it could well be the case that shocks in the former variable are unable to significantly affect the behavior of the average firms, given the high cross-section heterogeneity of the data.
6 Conclusions

This paper aims at studying the relationship between trade openness and the price-cost margins (PCM) of single vs. multi-product Italian manufacturing firms in the period 2000-2008. In particular we proxy foreign competition with a relatively disaggregated (at the NACE4 level) import penetration index, and analyze the short vs. long-term reactions to increased competition of firm-level price-cost margins, distinguishing single and multi-product firms. In doing so, to the best of our knowledge, we are the first to explicitly link PCMs measured at the firm level to changes in trade openness, controlling at the same time for the product mix margin as well as the speed of adjustment.

Throughout the paper we also control for the potential endogeneity of the import penetration measure, instrumenting it through a geography-based variable, i.e. using the trade flows of neighboring countries as an instrument to calculate the Italian import penetration index.

We find that the short run pro-competitive effects of trade openness are on average not significant, but its interaction with the PCM of MP firms remains positive and significant, also in the long-run. The latter finding is however not robust to our control for endogeneity, since when instrumenting import penetration both multi-product firms and their single-product competitors seem to tend to the same long run equilibrium.

We do find instead a robust negative long run relationship between markups and import penetration, evidence that the pro-competitive effects last in time and affects the long-run trend. This finding suggests that structural long-run relationships exist between firm-markups and market characteristics (the degree of foreign competition), in which firms adjust both their range of products and their PCM. In the long run, in other words, the characteristic of being a multi-product firm is endogenous to the market structure, while in the short run the adjustment process between SP and MP firms is different.
References


Appendix

Industries for which import penetration has been computed

Manufacturing industries: food products and beverages (15); textiles (17); wearing apparel, dressing, dyeing of fur (18); Tanning, dressing of leather, luggage (19); wood and products of wood and cork, except furniture, articles of straw and plaiting materials (20); pulp, paper and paper products (21); Publishing, printing, reproduction of recorded media (22); chemicals and chemical products (24); rubber and plastic products (25); other non-metallic mineral products (26); basic metals (27); fabricated metal products, except machinery and equipment (28); machinery and equipment n.e.c. (29); office machinery and computers (30); electrical machinery and apparatus n.e.c. (31); radio, television and communication equipment and apparatus (32); medical, precision and optical instruments, watches and clocks (33); motor vehicles, trailers and semi-trailers (34); other transport equipment (35); furniture; manufacturing n.e.c. (36)
Table 7: Error Correction Model of the PCM

<table>
<thead>
<tr>
<th>D. PCM</th>
<th>(a)</th>
<th>(b)</th>
<th>(IV-a)</th>
<th>(IV-b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCM t-1</td>
<td>-0.9392 ***</td>
<td>-0.9390 ***</td>
<td>-0.9500 ***</td>
<td>-0.9500 ***</td>
</tr>
<tr>
<td>D. Impen</td>
<td>0.0019</td>
<td>0.0030</td>
<td>0.0248</td>
<td>0.0286</td>
</tr>
<tr>
<td>D. Impen X MP</td>
<td>-0.0024</td>
<td>0.0076</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Impen</td>
<td>-0.0259 ***</td>
<td>-0.0468 ***</td>
<td>-0.1488 ***</td>
<td>-0.1490 ***</td>
</tr>
<tr>
<td>MP</td>
<td>-0.0058 ***</td>
<td>-0.0008</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Impen X MP</td>
<td>0.040293 ***</td>
<td>0.007199</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>L.Unit wage</td>
<td>-0.01904 ***</td>
<td>-0.01804 ***</td>
<td>-0.01339 ***</td>
<td>-0.01342 ***</td>
</tr>
<tr>
<td>L.Unit input cost</td>
<td>0.013662 ***</td>
<td>0.013908 ***</td>
<td>0.013718 ***</td>
<td>-0.01342 ***</td>
</tr>
<tr>
<td>L.Capital/Labor</td>
<td>0.001064 *</td>
<td>0.001093 *</td>
<td>0.000861</td>
<td>0.00085</td>
</tr>
<tr>
<td>L.Distance from MES</td>
<td>-0.00012</td>
<td>-0.00012</td>
<td>-5.9E-05</td>
<td>-5.9E-05</td>
</tr>
<tr>
<td>L.Labor</td>
<td>-0.00898 ***</td>
<td>-0.00838 ***</td>
<td>-0.00743 ***</td>
<td>-0.00737 ***</td>
</tr>
<tr>
<td>L.Labor productivity</td>
<td>-0.01394 ***</td>
<td>-0.01396 ***</td>
<td>-0.01598 ***</td>
<td>-0.01593 ***</td>
</tr>
<tr>
<td>C4</td>
<td>-0.00621 **</td>
<td>-0.01048 ***</td>
<td>-0.00529</td>
<td>-0.00481</td>
</tr>
<tr>
<td>cons</td>
<td>0.4035 ***</td>
<td>0.4024 ***</td>
<td>0.4216 ***</td>
<td>0.4217 ***</td>
</tr>
<tr>
<td>N</td>
<td>196148</td>
<td>196148</td>
<td>145909</td>
<td>145909</td>
</tr>
<tr>
<td>FE</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>time dummies</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>R²:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>within</td>
<td>0.4822</td>
<td>0.4826</td>
<td>0.4895</td>
<td>0.4897</td>
</tr>
<tr>
<td>between</td>
<td>0.0783</td>
<td>0.0784</td>
<td>0.0115</td>
<td>0.0115</td>
</tr>
<tr>
<td>overall</td>
<td>0.111</td>
<td>0.111</td>
<td>0.0964</td>
<td>0.0965</td>
</tr>
</tbody>
</table>

Notes: Robust standard errors
Legend: * 10%; ** 5%; *** 1%