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THE PHENOMENAL CAT: FIRMS CLAWING THE GOODS OF OTHERS

by Virginia Di Nino *

Abstract

Using results collected for the first time through interviews with Italian manufacturing firms, this work shows that around a quarter of aggregate manufacturing sales are not sold by the actual producer. This circumstance, known as carry along trade (CAT), means that the comparative advantage of some manufacturing firms lies in activities other than crafting, with important consequences for the interpretation of productivity measures. CAT firms hold a 3% productivity premium compared with the average firm, which does not disappear controlling for size, export and multinational status, geographical location and sector. This premium increases to 10% when CAT involves mainly packaging and to 20% when goods produced by third parties are sold under the brand or associated with the brand of CAT firms. Furthermore, CAT firms specializing in downstream activities earn higher profit margins on sourced than on in-house production. CAT can thus be conceived as an example of functional upgrading of some firms towards more valuable downstream activities. Usual productivity measures disregard the CAT phenomenon and bundle a firm's ability to combine factors within a physical production process with other sources of profitability, such as proximity to consumers, access to foreign markets through well-established distributional channels, and marketing skills. The existence of CAT calls for a methodological refinement of productivity measurement.

JEL: F12, F14, L11.
Keywords: carry along trade, productivity premia, servicification.

Contents

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Introduction[1]

A recent body of empirical trade literature has identified an interesting characteristic of firms' export behaviour, i.e. the fact that a large share of exports consists of goods not produced by the firm. According to these studies, around 30% of total Belgian export value and 75% of the number of exported products falls into this category. The share appears larger for Italy, with the value of non-produced exports representing almost two thirds of the total; 95% of exporters sell abroad at least one good that they do not produce (Bernard et al., 2012; De Angelis et al., 2011). This phenomenon looks widespread and sizeable, but until recently had been ignored by trade theory and the related empirical literature.

These facts suggest that exporters are sometimes better at selling, distributing or marketing some products than at producing them. This can happen for a number of reasons, namely inefficiencies in certain production phases, lack of necessary skills, synergies that make the joint sale of many products more profitable, and so forth. Conversely, producers might at times find it convenient not to sell their merchandise directly as they face obstacles of various kinds in reaching foreign markets, for instance sunk costs to create a distribution network or legal and cultural barriers. Following the definition in Bernard et al (2012) we name this phenomenon as Carry Along Trade (CAT), in which each firm, given its intrinsic characteristics (productivity) and constraints (market structure and market power), may find it optimal to sell products of other firms or to sell part of its own production through other firms.

An extensive definition of CAT is the following: *CAT refers specifically to situations where a manufacturing firm, which produces in-house its own goods, also sells, at home and/or abroad, final goods similar to or different from those internally crafted that are entirely made by third manufacturing firms.*

Therefore, the analysis is not concerned with distributing service companies, nor does CAT involve intermediate inputs sold by one firm to another; it concerns exclusively sales of final goods by the producing firm that are then marketed by another firm, which we call here the CAT firm. A few examples help to clarify what CAT is about and what it is not. The possibility of buying a kitchen at IKEA that is fully equipped with electrical appliances made by other companies is CAT; the coffee machines branded and sold by Nespresso at its stores, but produced entirely by Delonghi or Krups, are CAT. Similarly, the apparel branded FIAT or Triumph that is evidently not produced by the car and motorbike makers but is indeed sold in their stores is an example of CAT goods. Often, when the object is rebranded and the initial producer is unknown, the final consumer may not perceive that what she is buying is entirely created by a third company. This is very common for apparel and foodstuff.

By contrast, the marketing-sale service supplied by Tannico and Viniespumanti[2] to many wine producers is not considered CAT. These are retailers that buy and re-sell abroad and in Italy foreign and Italian wines but do not produce wine themselves. Similarly, spare parts for cars or

[1] The author thanks Riccardo Cristadoro for supporting this research project from its initial stages, for suggestions along the way and for his comments on earlier versions of the work. I am doubly indebted to Alessandro Borin and Michele Mancini, first because they kindly gave me data on TFP of Italian firms, and second for the discussions we had on the topic. To Massimo Sbracia my thanks for the catchy title. Comments and advice from Giuseppe Parigi and Pietro Catte also considerably improved the final outcome.
Errors are the author's sole responsibility. The views expressed in this paper are those of the author and do not necessarily reflect those of the Bank of Italy

[2] These two companies are in the business of online wine sales.

motorbikes are CAT goods if they are bought by car or motorbike makers and sold to final customers in their mono-brand stores or through their dealers, without any additional transformation, either under their brand or in combination with their own goods. But the same spare parts cannot be considered CAT goods if they are bought to be used as components in car or motorbike assembly.

This is the first work to investigate CAT using the results of a specific set of questions incorporated, only for manufacturing firms, in the 2012 Survey of Industrial and Service Firms (hereafter, the Survey), concerning whether and why the firms in the sample also sold goods produced entirely by other firms (i.e. mediated production) or, symmetrically, turned the final production over to other firms to exploit their distribution channels (i.e. mediated sales) or to exploit sales synergies. Each case of CAT is, at one and the same time, a situation of mediated production for the final seller and of mediated sales for the producer. Here, we focus on the incentives to the selling firms and on their features; we therefore refer only to the final seller as the CAT firm (active CAT firms or mediated production) and CAT goods are those sold by an CAT firm but produced by third companies.[3]

Initially, CAT was mainly associated with exports as its existence was first discovered by matching production and export data, although there is no reason to believe that it concerns only foreign sales. Moreover, focusing on exports can overestimate CAT whenever a firm under-reports or does not report the production of a good that is counted among exports.[4] By putting the question directly to firms, the risk of inflating the phenomenon disappears as both size and diffusion are computed by resorting to survey responses and not to a statistically problematic matching between products sold and products manufactured. Furthermore, employing the outcome of the Survey it is possible to identify separately domestic CAT from export CAT, to gauge the relevance of CAT in the domestic market, and to relate CAT activities to a rich set of firm characteristics provided by the Survey.

Based on Survey data, CAT appears less pervasive than in previous studies: it concerns around 36% of exporters, compared with 95% in De Angelis et. al (2011), and 22% of the total value of exports (66% in De Angelis et al., 2011). Goods exported under the final seller's trademark are found to account for around 60% of exported CAT. The widespread rebranding suggests that these products are comparable with internal production in terms of quality as perceived by customers.

The Survey investigates the main reasons and the prevalent costs associated with CAT activity, thus contributing to the recent debate on what is exactly the competitive advantage of a firm. Mion (2013) finds that the competitive advantage of exporters depends on the experience of sales managers in supplying foreign markets, on their knowledge of specific destination markets, and on their ability to find new distribution channels in these markets. Alfaro and Charlton (2009) and Costinot et al. (2011) argue that firms are reluctant to externalize high value added services that are considered strategic for their competitive advantage, but they are more likely to relocate high volume production requiring low skills and standard technologies.

[3] Firms that sell their production through others' distribution channels are called passive CAT firms.

[4] ProdCom (Production Communitaire) is the database on production of firms harmonized across European member states. Production of marginal goods may go unmentioned by firms or be under-reported; this is allowed in the survey. Statistical imputation is also possible in some cases when the information is missing. For these reasons some goods may appear as non-produced in Prodcom but as sold abroad by a firm according to export records.

According to the analysis, CAT firms have some of the features generally associated with the most efficient firms: they are bigger than average, pay higher salaries, invest more abroad and in R&D, and have fewer financial constraints.

CAT might distort estimates of firm performance and productivity. First, on a technical note, the hypothesis implicitly maintained when estimating productivities with firm level data is that the production process of a good is identical for every firm within an industry; this is clearly not the case with CAT. This issue, which also arises in the broader context of production fragmentation, is even more serious for CAT, where outsourcing concerns the whole production process. Second, CAT firms might be able to charge a higher price for the goods they sell, irrespective of the efficiency and quality of their production, by virtue of the market power derived from their control of distribution in a certain market segment and their particular ability to retain customers.

This paper tries to shed some light on the way standard measures of productivity are related to CAT activity, exploiting the fact that the productivity premium of CAT firms varies with the task accomplished. Estimates show the existence of a productivity premium associated with CAT firms that increases (1) when CAT is the result of a strategic decision by the producing firm to outsource marketing; (2) when it is pursued within the same industrial group; and (3) when packaging is the most important activity (i.e. the largest cost in the balance sheet of CAT firms) relating to CAT goods.

Overall, the productivity premium appears to be related to a firm's knowledge of destination markets and to its proximity to consumers, a feature that CAT shares with the 'buyer driven' chains,[5] suggesting that productivity measures might be capturing, to some extent, abilities of CAT firms other than that of combining production factors to obtain a physical good.

From the analysis of EBITDA, a proxy for profit margins separately computed within each firm for in-house and sourced products, it emerges that profit margins tend to be higher on the latter. This differential is positive in exactly the same specific circumstances when a productivity premium is also detected, that is when CAT involves mainly packaging, rebranding and/or distributing sourced products. Therefore, the higher value and profitability of CAT firms originates in downstream activities.

The remainder of the work is organized as follows. Section 2 contains a statistical overview of the phenomenon, its dimension, diffusion and characteristics. It investigates the aggregate, geographical, industrial and firm level profiles of CAT firms. Section 3 compares the productivity of CAT with that of other groups of firms and provides estimates of the total factor productivity (TFP) premium. Section 4 computes a proxy of cost mark-up for in-house and CAT goods separately, suggesting that a positive differential in favour of CAT goods may be partly at root of the TFP premium identified in Section 3. Section 5 explains the limits of existing firm theories in fully accounting for CAT. Section 6 concludes.

[5] The literature on global value chains (GVC) generally refers to 'producer driven' production processes when the lead firm within the chain specializes in upstream activities such as R&D or design, which are indeed fundamental tasks for that type of good to be sold successfully. By contrast, it refers to 'buyer/consumer driven' chains when the lead firm within the chain is mainly involved in downstream tasks such as marketing and distribution.

2. Aggregate and firm level evidence

2.1 *Economic size and diffusion of CAT*

According to the Survey,[6] 36% of firms sell goods produced by others (CAT firms), one out of seven has its production sold to the final consumer through others (passive CAT firms), and a large share of firms is involved in both active and passive CAT, a fact that reveals the existence of pervasive sales networks.

CAT firms tend to be large. They make up around 50% of total manufacturing sales, of which about half is generated by selling others' production. Exporters are more likely to be CAT firms (the share of exporters among CAT firms is 90%, against 75% in the overall sample, although more than one third of CAT exporters sell sourced goods only domestically). Mediated exports, i.e. sales abroad of CAT goods, account for 22% of exports.[7] Hence CAT, an activity first identified in connection with exports, is done almost exclusively by exporting firms, although these perform the same activity to a very significant extent in the domestic market as well.

A large fraction of CAT exports (60%) concerns products sold under the final seller's brand, suggesting that the origin of the sourced goods is concealed to final customers and that CAT firms rate the quality of sourced products as good as the quality of their own production.

CAT firms can be found in any industry, but they are more frequent in the agro-food sector (milk and flavour products), paper products and plastics industries, and in the production of some electrical appliances (see Figure 1A). In the automotive industry renowned brands operate CAT for spare parts. The distribution of the CAT phenomenon across sectors follows the same pattern characteristic of buyer-driven global value chains (GVCs), where the lead firm within a chain specializes in marketing and distribution.

It may be surprising that so pervasive a phenomenon has been detected only partially in previous studies. An explanation could be that it is bound to go unrecorded unless the statistics bureau requires firms to declare production and sales by product and market. Similarly, it goes unnoticed when a firm specializes exclusively in services for the manufacturing sector and is accordingly assigned to the tertiary sector. On this point, Bernard and Fort (2013) show that in the U.S. a large share of service firms carries out activities such as marketing, design and R&D exclusively for manufacturing firms; from the economic point of view it would therefore be more correct to consider them part of the manufacturing sector. Such a shift in firms' classification would add almost half a million workers to the U.S. manufacturing sector, attenuating the negative employment trend in this industry.[8]

2.2. *Distinguishing features of CAT firms*

CAT firms are on average significantly larger in terms of turnover and employees, are geographically concentrated in the North, especially the North-East, of Italy, and most of them

[6] Some 1445 manufacturing firms were interviewed in the Survey; 1234 answered the section on indirect selling, 447 with an affirmative response; 238 provided a specific reason and further information on the share of turnover derived from indirect selling.
[7] This is equivalent to 8% of total manufacturing sales.
[8] In 'Factoryless goods producers in the US', Bernard and Fort (2013) find that almost half a million workers in the U.S. are employed by a wholesale company but operate manufacturing activity. This suggests that the fall in manufacturing employment is definitely less pronounced than previously documented, with major implications for modelling, interpreting and making predictions on economic facts. Among others things it changes the propagation of shocks from manufacturing to the rest of the economy and the allocation of inputs and outputs (i.e. productivity) across sectors.

specialize in final goods production (obtained via the transformation of either intermediates or raw materials; 68%[9]). Sales per employee are significantly larger for CAT firms, which also pay higher wages. The share of these firms investing abroad is almost twice that of the rest of the sample (18% with respect to 10%; see Table A1), but the share of foreign investment per firm over the past five years is comparable in the two subgroups. They invest more (as a share of total turnover) in R&D of new products than the average firm, but they do not spend more in new physical capital. Even though most of them are exporters, they are less export-oriented than other exporters: the share of exports in total turnover is 38% on average for CAT firms compared with 42% for non-CAT export firms.[10] Finally, CAT firms have less binding external financial constraints than the rest of the sample.[11]

The same analysis repeated on the subsample of multinationals[12] shows that half of them are involved in CAT. Even among them, CAT firms continue to be significantly larger, to sell more output per worker, and to pay higher wages. Once again, they are somewhat less export-oriented; this may be due to the choice of CAT multinational firms to supply each market via local domestic production, externalized to third local firms. Differences in investment as a share of total turnover (either in physical capital or in R&D) between the two subgroups are negligible.

2.3. Why firms operate CAT: cost saving and sales synergies

Is it considerations of convenience that lead the producing firm to have its production sold by a third party (i.e. it is a case of mediated sales) or is it the selling firm that outsources some manufacturing? To understand what drives CAT we must first identify when it is a case of mediated sales and when of mediated production. In the Survey, CAT firms were asked to select up to two out of five reasons for being involved in this activity and were left the option to provide an open answer. They could choose to indicate that for them CAT was a way (1) to produce for less (*'Is it too expensive for your company to produce these goods internally?'*) or (2) to sell more (*'Does selling CAT goods foster sales of your own production?')*. Alternatively, they could indicate that it is a way for producers (3) to distribute or (4) to sell their production through a better organized network (*'Are producing firms advantaged by distributing through your network or associating their good to your brand?'*); or, finally, it could be (5) the result of intra-group strategy (i.e. cases in which each firm within a group specializes in a few specific tasks).

The responses indicate that CAT firms purchase goods from a third party more frequently to curtail internal production costs. This holds true for any type of firm: exporters, multinationals and firms belonging to a group or not. Theoretical models[13] of multi-product firms predict that a firm will begin production starting from the good in which it has the greatest competence (Bernard, 2010) and then expand up to the product for which the market price just makes up for marginal production costs. So we would expect to observe, as we move from core internal products to CAT products, reduced expertise and a shrinking profit margin. The validity of these predictions is empirically checked, with Survey data, in Section 5.

[9] The remaining CAT firms are producers of intermediate goods, from either raw materials or other intermediate goods.
[10] This is confirmed in every single year of the sample period under consideration.
[11] Dissimilarities between CAT and other firms were assessed on the outcome of statistical tests on mean differences.
[12] The sample of multinationals (145 observations) consists of firms that declared they had invested abroad between 2008-2012.
[13] Bernard et al. (2003) assume that the productivity of a multi-product firm depends on its firm level ability and firm product level expertise.

The second most frequent answer shows that CAT goods boost sales of the firm's own products,[14] revealing the existence of sales synergies. Prices and sales of in-house production are related to CAT activity. This may be justified by consumers' preferences being skewed towards multi-product, mono-brand stores (there are plenty of examples to support this view, the classical one being the Apple stores).

In 16% of cases CAT is a strategy pursued by the original producers (to market their production) to overcome the sunk costs of distributing or exporting. In 19% of cases CAT is an intra-group strategy, with the lead firm specializing in sales and distribution.[15]

When firms were asked to list the largest costs associated with CAT activity, choosing among three alternatives, 69% of the respondents pointed to logistics and distribution, 19% selected packaging, and only 12% indicated R&D and product design.

Overall, the concrete comparative advantage of CAT firms appears to be a deep knowledge of markets and distribution channels, as is the case for leading firms in industries where product sales are buyer driven (OECD, 2013).

3. CAT: an open issue for total factor productivity estimates

With respect to the notion of product specialization occurring across firms, which is standard in trade and productivity literature, CAT is an example of incomplete task specialization entailing positive effects on aggregate productivity because it allows firms to focus on tasks in which they have a comparative advantage for some products and to still operate the entire production process for other goods. The positive effect on aggregate productivity counters the potential bias that CAT introduces on firm level productivity estimates. Irrespective of the underlying reasons for adopting CAT, there are at least two possible issues regarding the way TFP is measured when some of the firms in the sample operate CAT: 1) the hypothesis maintained in TFP estimations that the production process is the same for every firm within a sector is invalidated; and 2) a specialization in downstream activities such as packaging, marketing and distribution may reveal a special ability to retain customers that can positively affect the price charged and consequently the ''perceived productivity'' of CAT firms.

Fuss and Warzynski (2012) identify a bias in the TFP estimates of multi-product firms. In their case the bias originates from the impossibility to correctly identify and allocate the production factors across production lines. Analougously the existence of CAT distorts TFP estimates because the production factors cannot be correctly allocated among tasks. As a result, TFP estimated on firms that specialize in high value added tasks is greater, but this reflects the bundle of activities performed rather than a superior skill in organizing the production factors within each task (corresponding to the definition of TFP).

As far as methodology is concerned, the problem arises from the fact that the firm's sales and production factors are not separately identifiable for goods produced within its boundaries (internal production) and for CAT goods. Thus, current procedures for TFP estimation treat CAT and internal products as if they originated from the same production process, whereas factor

[14] Bernard et al. (2011), seeking a novel theoretical explanation, obtain empirical evidence in favour of the existence of demand-scope complementarities.

[15] One out of two parent companies sells goods produced by other firms; 40% of CAT firms belong to a group.

contributions obviously vary substantially between the two categories (see Appendix B for details) because the activities performed are different. This implies that when the estimated coefficients on the factors of production are employed to obtain the TFP of CAT firms, the productivity measure will be biased upwards whenever the CAT activity is concentrated in high value added stages of production (marketing and R&D) and downwards vice versa. To this extent, CAT suggests the need for a refinement of the TFP concept that should encompass complementary activities and be able to distinguish when a firm focuses its activity on specific tasks. The questions contained in the Survey help to better understand the type of CAT activity, and particularly whether it involves high/low value added tasks.

At the same time, specializing in some complementary activities enhances visibility and allows a firm to create a direct contact with final customers, which in the end skews consumers' preferences towards CAT firms' by-products. Productivity measures that fail to take into account this aspect may confuse the ability to exploit the proximity to final consumers with efficiency in production. This potentially concerns any firm with some market power, but the likelihood that it relates to CAT is greater given the tasks performed by CAT firms.

Estimates of TFP, as obtained in Borin and Mancini (2014), and value added per worker are related to the status of CAT firm, to the reasons for operating CAT, to the activity involving CAT, and to the share of CAT sales in total turnover. TFP is a firm specific, price deflated measure of productivity, obtained by applying standard methods à la Levinshon-Petrin (see Appendix C for details). The vast majority of firms operating CAT in 2012 also did so in 2007, proving that this activity is part of a firm's long-term strategy; [16] for this reason the analysis refers to the decade 2001-11, for which firm data on TFP were available and CAT firms could be credibly considered such.[17]

4. CAT firms do it better

The methodological approach consists in verifying the existence of a productivity premium for CAT firms with respect to the average firm, which is then quantified and finally qualified. The empirical investigation assesses whether and to what extent the premium varies according to destination markets (domestic or foreign) and the reasons underlying the CAT choice.

Firms are initially divided into a non-CAT and an CAT group, taking due account of multinationals (MNE), which are over-represented among CAT firms and have been shown to be among the most efficient companies (see Borin and Mancini, 2015, for a quantification of the productivity premium of Italian multinationals). Firms are then allocated to the following subgroups depending on their status: (1) non-MNE non-CAT firms, (2) non-MNE CAT firms, (3) MNE non-CAT, and (4) MNE and CAT.[18] The empirical density distributions of productivities for

[16] Firms' answers to the 2013 poll confirm that CAT activity is a firm strategy for more than a single year. Furthermore, the answers to questions about CAT asked in 2007 to firms declaring they operate CAT in 2012 show that an overwhelming majority did so in 2007 as well (80%). The inertia is unsurprising, as rearranging internal organization and setting up a new production line are strategic decisions for a firm that cannot be easily reversed.

[17] The period analysed was extended and shortened without affecting the main empirical conclusions; results obtained from alternative sample periods are reported in the Appendix or will be provided by the author on request.

[18] A similar exercise was repeated on the four subgroups, dividing firms into non-CAT- non-exporter, CAT non-exporter, CAT-exporter, non-CAT exporters. Results did not differ qualitatively, confirming the existence of an CAT productivity premium beyond the exporter premium.

these four groups is computed to identify the presence of stochastic dominance of one type or another.

According to the Kolmogorov-Smirnov (K-S) non-parametric test for first order stochastic dominance, CAT firms appear to be more productive (see Figure 1 and Table 1). In particular,[19]

(a) non-MNE CAT firms are significantly more productive than other non-MNEs: the green line in Figure 1 lies to the right of the blue one and the difference between the two distributions is statistically significant (see the first panel in Table 1).[20]

(b) the MNE productivity distribution dominates over the non-MNE one; the red line lies to the right of both the green and the blue line, and

(c) MNE CAT firms outweigh MNE non-CAT firms; the orange line is somewhat to the right of the red line in Figure 1. According to the KS tests the difference is significant (see third panel of Table 1).

The stochastic dominance is ascertained on a measure of total factor productivity corrected a first time for sector and year effect, and then for sector, year and size effects (proxied by logged employment).[21]

Fig. 1: Cumulative density distribution of Total Factor Productivity by firm category.

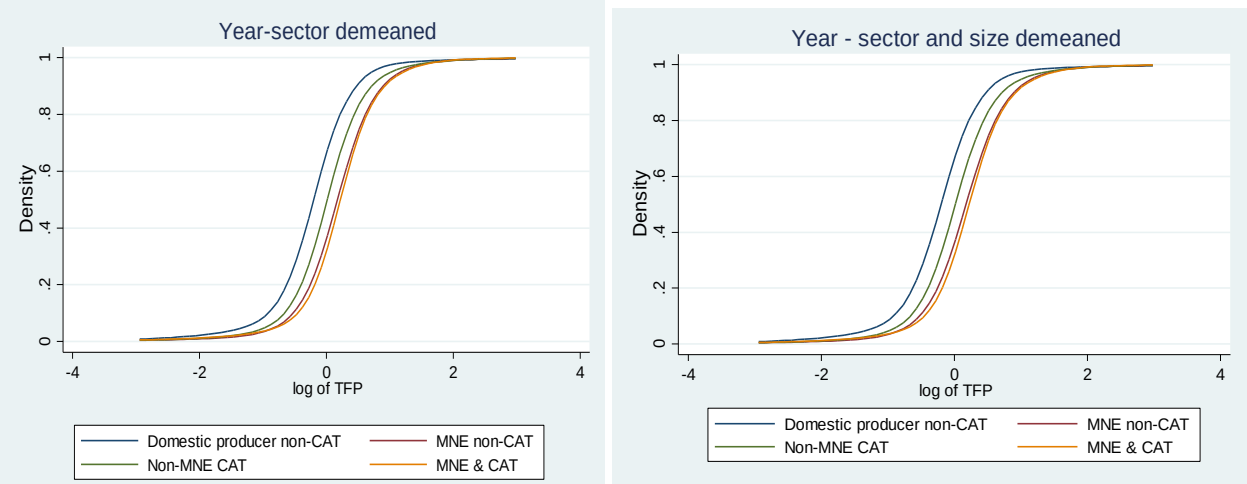


Table 1: Test for equality of productivity distributions between CAT and non-CAT firms[1]

[19] The K-S test on two samples consists of two one-way tests carried out on the maximum difference between the distribution values of the two samples. Large statistics suggest that the two distributions are different, small statistics that there are non-significant differences in the distribution of the two samples.

[20] The first line in the upper panel of Table 1 tests the null hypothesis that CAT non-MNE firms are less productive than non-CAT non-MNE ones; the results reject the null (the p value is equal to 0). The second line tests the null hypothesis that the group of non-CAT non-MNE firms has lower productivity; the test fails to reject the null. The third line shows the results from a combined test and confirms that CAT are on average more productive among non-MNE firms.

[21] More precisely, TFP is demeaned by subtracting year-sector means; the transformed variable is then used in the first set of K-S tests. It is then regressed on the log of employment to control for firm size, and the residuals are used in the second set of tests.

Kolmogorov-Smirnov test for equality of distribution				
Smaller group	D	P-value	D	P-value
	TFP_log (demeaned sector year effect)		TFP_log (demeaned sector year and size effect)	
CAT=0	0.0926	0	0.0542	0
CAT=1	-0.0006	0.997	-0.0011	0.989
K-S:	0.0926	0	0.0542	0
	TFP_log (demeaned sector year effect)		TFP_log (demeaned sector year and size effect)	
CAT=0 & MNE=0	0.2187	0	0.071	0
CAT=1 & MNE=1	-0.0024	0.976	-0.0054	0.889
K-S:	0.2187	0	0.071	0
	TFP_log (demeaned sector year effect)		TFP_log (demeaned sector year and size effect)	
CAT=0 & MNE=1	0.0557	0	0.0774	0
CAT=1 & MNE=1	-0.0092	0.747	-0.0068	0.853
K-S:	0.0557	0	0.0774	0

(1) The 'D column' shows the D statistic (largest difference in frequency distribution of productivity), while the next column reports the P value for the test that the productivity of group (a) is outweighed by (i.e. is smaller than) that of group (b); the first two columns report results controlling for sector and year effect, the last two controlling also for size effects.

To obtain a measure of the productivity premium held by CAT firms, different specifications of the following equation are estimated:

$$TFP_{i,t} = c_{tsp} + d_{CAT}CAT_i + d_{MNE}MNE_{i,t} + d_{EXP}EXP_{i,t} + Z_{i,t} + \varepsilon_{i,t} \quad (1)$$

where *TFP* is the total factor productivity of firm *i* at time *t*. *CAT* is a dummy variable equal to 1 when a firm sells third parties' production; *MNE* is a dummy variable equal to 1 for multinational firms; *EXP* is the dummy variable equal to 1 when a firm exports. The accompanying coefficients capture, respectively, the productivity premium associated with the status of CAT firm, with respect to an average productivity of domestic non-CAT firms; c_{tsp} represents the control variables for the year (c_t), sector (c_s), and province (c_p). Z_{it} is a ''size effect'' variable and assumes the following three alternative specifications:

$$Z_{i,t} = 0;$$
$$Z_{i,t} = \beta_{emp} emp_{it};$$
$$Z_{i,t} = \beta_{emp} emp_{i,t} + \beta_{emp2} emp^2_{i,t}.$$

i.e. Z_{it} controls for the existence of linear or quadratic relationships between TFP and firm size, proxied by the logarithm of employment *(emp)*.[22] The same regressions are computed using as dependent variable value added per worker instead of TFP, with similar results.

The coefficient on CAT is positive and highly significant, hinting at the presence of a productivity premium of around 2-3%, which does not disappear controlling for industry, province and year effect, for firm size, and for the status of exporter and multinational (see Tables 2 and 3A for further robustness checks).

Table 2: The productivity premium of CAT firms concerns export activity.

[22] Interactive terms of indicators EXP with CAT and MNE with CAT are also used in an attempt to capture the additional effect of operating CAT when a firm is already either EXP or MNE. The estimated coefficients are non-significant, in some cases one of the variables is dropped due to collinearity.

	Dependent variable: log of TFP			
Regressors	(1)	(2)	(3)	(4)
MNE	**0.07***		**0.091***	**0.06***
	(0.015)		**(0.017)**	**(0.01)**
EXPORTER	-0.02	-0.0151	-0.04**	0.01
	(0.021)	(0.020)	(0.02)	(0.02)
CAT	**0.022***	**0.029****	0.02	
	(0.012)	**(0.014)**	(0.013)	
Domestic CAT				0.005
				(0.02)
Export CAT				**0.052****
				(0.024)
Share of domestic CAT on total sales				0
				(0)
Share of export CAT on total sales				**0.003*** **
				(0.001)
R2	**0.50**	**0.49**	**0.51**	**0.50**
Observations	10746	7876	7623	12665

The estimation method assumes that errors are uncorrelated with regressors (random effects); ***, ** and * stay respectively for 10 - 5 and 1% level of significance of the estimate coefficient. The estimations control for industry, province, year and size effects. – (2) Excludes multinationals from the sample. – (3) Excludes firms within groups from the sample.

Robustness checks confirm these empirical findings over different periods and for different control groups (see Appendix D).[23] The size of the CAT premium does not change when the sample progressively excludes firms below a turnover threshold. [24] Finally, excluding multinationals does not change the outcome. The exclusion from the sample of firms within groups, on the grounds that the policy of shifting profit through pricing strategies of within-group sales may alter the correct estimation of the TFP, reduces the CAT coefficient to 2 % (see Table 2 and Table 3A).

4.1. Productivity of CAT firms rises with export

With respect to early literature that identified CAT firms only on foreign markets, this paper verifies that CAT also concerns domestic sales (40% of cases). As the answers of manufacturing firms in the Survey of Industrial and Service Firms split CAT sales into domestic (CAT_d) and export sales (CAT_{ex}), it is possible to test whether the TFP premium is positively correlated with the share of domestic and export CAT sales in total $\left(\frac{sales_{d\,CAT}}{sales_{total}}; \frac{sales_{ex\,CAT}}{sales_{total}}\right)$ respectively.

$$Z_{i,t} = emp_{it} + \beta_d \frac{sales_{d\,CAT}}{sales_{total}} + \beta_e \frac{sales_{ex\,CAT}}{sales_{total}} + d_d CAT_d + d_{ex} CAT_{ex}$$

Results show that the productivity premium disappears for domestic CAT (see Table 2, column (4), and Tables 7A and 8A for additional specifications) as β_d and d_d are never significant,

[23] To test for the presence of a differential CAT effect on productivity the sample was reduced to larger and larger firms (by dropping first small then medium-sized enterprises).

[24] Because CAT firms are over-represented among big firms, the analysis was repeated by excluding relatively small firms from the sample, which modifies the control group in the estimation of the CAT productivity premium, and by estimating a separate premium for different firm size categories. This is obtained by separating the CAT dummy into four new binary variables, one for each quartile of the firm size distribution (see Appendix C).

while it is specifically associated with export activity (d_{ex}) and positively correlated to the share of CAT exports in total sales (β_e).

4.2. The TFP premium changes with reasons and tasks associated with CAT

The reasons why a firm turns to CAT activity are expected to influence its productivity measure and might help discern the roots of the premium.

Exploiting the results of the survey, five binary variables are created, one for each possible justification for CAT among those listed in Section 2.c.[25] Similarly, three binary indicators identify, respectively, cases when the main activities, in terms of costs, performed on CAT products by the seller are (i) R&D or design, (ii) packaging, and (iii) distribution and logistics. These indicators are by construction orthogonal to each other. Equation (1) is re-estimated with Z_{it} specified as follows:

$$Z_{i,t} = emp_{it} + \sum_{k=1}^{5} d_k REAS_k$$

$$Z_{i,t} = emp_{it} + \sum_{k=R\&D,\, packaging,\, distribution,\, other} d_k Task_k$$

where $REAS_k$ represents the five binary indicators explained above and $Task_k$ represents three binary indicators, one for each of the three aforementioned tasks.

The largest productivity premium (almost 20% in the most complete specification; see Table 3 and Table 5A for further specifications) occurs when CAT is triggered by the fact that producers find it convenient to associate their products with the brand of the final seller. The premium is still very sizeable (around 11%) when CAT is justified by an intra-group strategy, and positive, although not always significant, when the producer exploits the distribution network of the CAT firms. It is non-significant when CAT is a strategy followed by selling firms to outsource costly production activities or to foster sales of its own products by associating them with CAT products. In other words, the premium of the CAT final seller is positive if the initial producer asks for a *sale service* and it is not significant if the final seller requires a *production service*.

Regarding the activity most closely associated with the productivity premium, the results indicate that it is packaging and distribution. CAT firms have the highest productivity premium when their main costs are in the downstream phases of production; the premium disappears when the main cost is R&D and design (see Tables 3, 5A and 6A for alternative specifications). This closely recalls once again the literature on outsourcing-offshoring, which divides GVCs into 'buyer driven' and 'producer driven'. According to this literature, producer driven products are defined as those goods for which R&D and design (upstream activities) are performed by the lead firm in the GVC because of the high value added generated and because they turn out to be particularly important for selling the finished product. On the contrary, in buyer driven chains marketing,

[25] The five alternatives that CAT firms could choose from are as follows: (1) 'Is it more expensive for your company to produce CAT goods in-house?'; (2) 'Does selling CAT goods foster the sales of your own production?'; (3) 'Is there an advantage for producers of CAT goods in distributing through your network?' ; (4) 'Is there an advantage for producers in associating their production with your brand?'; and (5) 'Is CAT an intra-group sales strategy?' Since firms could choose up to two of the five alternatives, the dichotomy indicators, equal to 1 when a reason is selected and 0 otherwise, are not orthogonal to each other. Every case of blank answer is attributed to CAT NES (i.e.e Not Elsewhere Specified).

branding and distribution assume special importance. Accordingly, CAT can be thought of as a case of extreme production fragmentation occurring for buyer driven chains.

Excluding firms within groups from the sample on the grounds that the policy of profit shifting through within-group sales may alter the correct estimation of TFP, only those operating packaging still have a positive and highly significant (over 12%) productivity premium. When multinationals are excluded from the sample, packaging and distribution are still associated with a significant productivity premium, the largest being related to packaging (around 16%).

According to this set of results, CAT firms providing a sales service and incurring a high share of total costs in packaging and distribution are more productive. If the productivity premium is generated only by downstream activities, and consequently the hypothesis that CAT concerns buyer driven goods is true, then firms crafting the good but outsourcing the sales service (passive CAT firm) should not gain any premium. [26]

Table 3: The productivity premium is large for CAT firms that specialize in downstream tasks

		Dependent variable: log of TFP		
	Regressors	(5)	(6)	(7)
	MNE	**0.065*** (0.014)**	**0.073*** (0.015)**	**0.165*** (0.014)**
	EXPORTER	-0.01 (0.02)	-0.02 (0.02)	0.018 (0.021)
	CAT	-0.03 (0.027)	0.004 (0.009)	**0.025** (0.012)**
	passive CAT			-0.001 (0.02)
Main reasons for operating CAT	Outsourcing to more efficient producer	0.03 (0.021)		
	Outsourcing to more efficient seller	-0.012 (0.026)		
	Renown of CAT brand is a valuable asset for goods of third parties	**0.191*** (0.034)**		
	Sales sinergies between CAT and in-house production	-0.001 (0.021)		
	Within group strategy	**0.11*** (0.025)**		
	Other reasons.	0.08 (0.036)		
Main balancesheet entry concerning CAT goods	R&D & design		-0.012 (0.035)	
	Packaging / Rebranding		**0.10*** (0.025)**	
	Logistic and distribution		**0.03** (0.015)**	
	R2	**0.50**	**0.50**	**0.49**
	Observations	10746	10746	9849

The estimation method assumes that errors are uncorrelated with regressors (random effects); ***, ** and * stay respectively for 10-5 and 1% level of significance of the estimated coefficient. The estimations control for industry, district, year and size effects.

[26] In the survey, firms were also asked whether they operated mediated sales, in other words whether they outsourced the marketing of their products (i.e. cases of passive CAT). Some firms operate active and passive CAT at the same time, revealing the existence of sales networks, others either the former or the latter.

A way to test this hypothesis is to estimate again equation (1), isolating in a separate binary indicator companies that outsource the sales service. The coefficient on this dummy variable would capture any premium over the average non-CAT firm that is earned by passive CAT firms. In this case Z_{it} is specified as follows:

$$Z_{i,t} = emp_{it} + d_a CAT + d_p CAT_{only\ passive}$$

Recall that some CAT firms perform at the same time passive and active CAT; hence, to disentangle the effect of only passive CAT the $CAT_{only\ passive}$ dummy variable identifies firms that rely on others to sell their own production but excludes those that also sell products of third companies. The *CAT* dummy variable takes the value 1 any time the firm sells the production of others.

As expected, the results in Table 3, column (7), show that the group of passive CAT does not have a productivity premium, while this is confirmed for active CAT firms (see also Table 8A for further specifications). Most likely, passive CAT firms outsource sales services because they do not have access to proprietary distributional channels, encounter greater difficulties in penetrating markets, and are less well-known by final consumers.

To conclude, the empirical analysis carried out at the firm level shows that the productivity premium for CAT firms

1. is not driven simply by firm size,
2. is detected when firms perform active CAT and the main costs borne by the selling firms concern downstream activities (packaging and distribution), and
3. is positive and significant for firms selling third party products on foreign markets.

5. Profit margins on CAT goods

In this section, proxies for firms' profits are employed to further support the early evidence on CAT firms' productivity premium and the tasks originating it.

Ideally, to discern which task generates the premium, one should know how factors are allocated along the different production stages to obtain final in-house and CAT goods. It is evident, though, that some tasks are performed for both types of goods and others only for in-house production. Productivity measures also come from two different compounds of task level efficiencies for in-house and CAT goods. Although the dataset lacks a proper 'product dimension', i.e. 'the ideal situation', it nonetheless contains information to compute firms' profitability measures separately for in-house and CAT sales.

If the degree of buyer bargaining power (upstream) and market power (downstream) of CAT firms is the same for the two types of goods, profitability is uniquely determined by productivity.[27] Any profitability differential between in-house and CAT products should be generated by an underlying productivity differential that stems from a different task composition. For example, a higher profitability of CAT goods would suggest greater efficiency of their production process.

[27] With the information available, there is no possibility of having even a rough measure of buyer power and market power separately. Nonetheless, it is unlikely that market power systematically differs for CAT and non-CAT goods; on the contrary, it is less unlikely that the CAT firms exercise some buyer power on the initial producers of CAT goods.

Given the information available, profitability is measured by the cost-price mark-up, defined as the wedge between price and average cost of production.[28] Exploiting information on the cost and sales share of CAT goods in the total,[29] it is possible to compute an indicator that is related to the mark-up differential between internal and CAT production for a subset of CAT firms.[30]

$$\frac{CAT_{sales}}{Total_{sales}} - \frac{CAT_{costs}}{Total_{costs}} = \frac{p_{CAT}Q_{CAT}}{p_{CAT}Q_{CAT} + p_iQ_i} - \frac{c_{CAT}Q_{CAT}}{c_{CAT}Q_{CAT} + c_iQ_i}$$

$$= \frac{c_{CAT}Q_{CAT}c_iQ_i}{(p_{CAT}Q_{CAT} + p_iQ_i)(c_{CAT}Q_{CAT} + c_iQ)}(\mu_{CAT} - \mu_i) = \gamma(\mu_{CAT} - \mu_i) \quad (2)$$

where Q_{CAT} and Q_i are the quantity of CAT and internal production sold; c_{CAT} and c_i, the average costs of producing CAT and internal production; p_{CAT} and p_i the prices charged by the final seller for CAT and internal sales. Finally μ_{CAT} and μ_i are the cost mark-up on CAT and internal production respectively. As γ is obviously always positive, the left-hand side of equation (2) is greater than zero if the mark-up differential is positive. Moreover, as γ is smaller than 1, unless a firm originates very large losses on both internal and CAT sales, [31] (2) implies that the proxy for the mark-up differential is smaller than the actual one by a factor that differs across firms. A positive differential implies that a firm earns larger profit margins on CAT goods. Figure 4 shows the frequency distribution of the mark-up-differential, computed as in equation (2).

This differential is positive for the majority of firms (negative in less than 30% of cases), suggesting that a firm operating CAT is in general able to earn a larger margin on CAT goods than on its own production. This result is not surprising as CAT is a way of redistributing tasks among firms in order to maximize the value produced, but it is also additional indirect evidence that CAT firms have an advantage in those stages of production specifically performed for CAT goods.

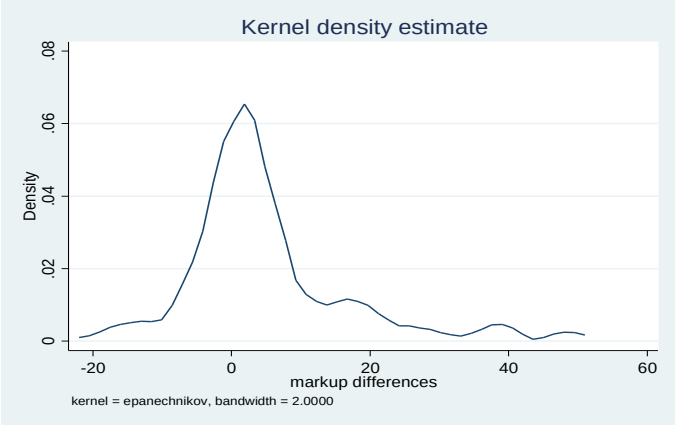
Fig. 4: Kernel density of the mark-up differential between CAT and internal sales

[28] This measure is a function of any factor affecting firm profitability. For instance, market competition tends to compress profit margins, efficient firms are expected to earn greater margins, and consumers' preferences for a specific product increase its market price, irrespective of its production cost and intrinsic quality.

[29] Firms were asked to provide information about the shares of CAT in total costs in the (Business Outlook Survey of 2013).

[30] The survey provides data on the share of CAT sales in total sales in 2012 and the share of CAT costs in total costs in 2013. Assuming the latter to have been constant between 2012 and 2013, we obtain an expression for the mark-up differential between internal and CAT products in 2012.

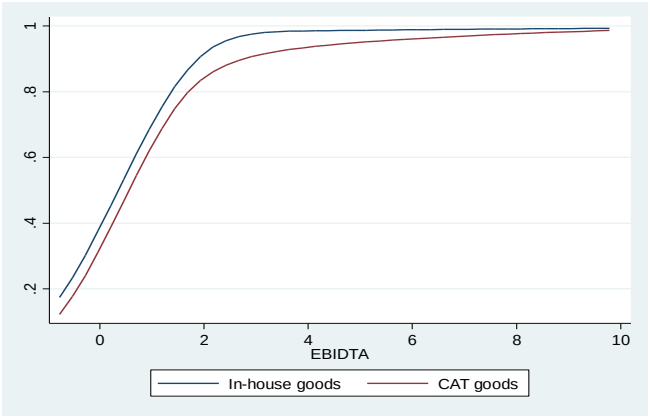
[31] γ is greater than 1 when $\mu_{CAT}(1+\alpha)+\mu_i(1+1/\alpha)<1$, where $\alpha=Q_{CAT}c_{CAT}/Q_ic_i$. Numerical solutions show that this condition is fulfilled when the price charged is roughly less than a quarter of the production cost for both CAT and internal goods. A firm therefore needs to make very large losses for γ to be greater than 1. We can exclude these cases as unrealistic as such large losses would soon push a firm out of the market.

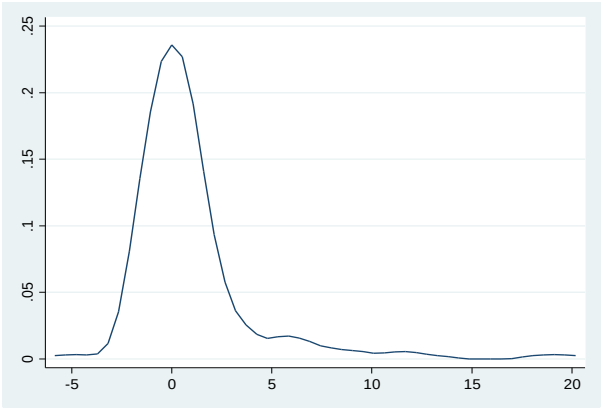


It cannot be ruled out, however, that surveyed firms constantly underestimate the share of total costs associated with their CAT activity. To address this case, an alternative measure of firms' profitability has been used as a proxy of mark-up: earnings before interest, taxes, depreciation and amortization (EBITDA). EBITDA can be separately computed for internal goods and CAT (even if only for 196 companies), allocating white collar salaries to CAT and internal production in proportion to the share of CAT in total sales.[32] The cumulative distribution function of EBITDA for CAT and internal goods is reported in Figure 5a; the probability distribution of the EBITDA differential between CAT and internal production, computed at firm level, is in Figure 5b. Again, empirical evidence points to a greater profitability of CAT goods.

Figure 5a Cumulative density distribution of EBITDA on in-house and CAT goods

Figure 5b Density distribution of EBIDTA differential between in-house and CAT goods, computed at firm level.





[32] This measure might underestimate EBITDA for CAT as a fraction of white collar duties are likely to be performed exclusively for in-house production; at the same time it may somewhat overestimate EBITDA for CAT because few blue collars (warehouse workers and drivers) are needed to sell both internal and CAT goods.

With firm heterogeneity, the mark-up (proxied in this case by EBITDA) on the cost of production is either assumed constant (this is the case with a constant elasticity of substitution utility function) or decreasing in the marginal cost of production (this is the case of a quasi-linear demand schedule à la Melitz-Ottaviano, 2008); in the latter situation the more efficient firms earn pure profits.[33] Finally it may also reflect product quality, with higher quality corresponding to higher mark-ups (Borin, 2011; Antoniades, 2012).[34] In the light of these considerations, the positive mark-up differential for CAT goods may be a signal of better quality, but this interpretation would be somewhat at odds with the fact that often internal and CAT goods are sold under the same brand. Alternatively, and most likely, it reveals that CAT is a way of splitting the production-sale process and allocating tasks across firms according to each firm's special skill/ability, which assigns complementary activities to CAT firms. Which activities exactly?

Indirect evidence that downstream phases are the key advantage for CAT firms are obtained with the empirical analysis of firms' TFP; here it is carried out a by group investigation of EBITDA, the conclusions of which can potentially validate or refute the deductions based on TFP.

When separating firms into groups according to the reasons motivating CAT, the mark-up differential remains generally positive, with the sole exception of firms selling CAT goods to promote their internal production. In particular, the differential is largest when the motivation for CAT is to associate sourced goods with the brand of the CAT firm, when it is an intra-group strategy, and when the distribution network of CAT firms is an advantage.[35] Similarly, distinguishing firms according to the main costs of selling CAT products, a positive differential in EBITDA is found when packaging and distribution are the main costs, while no significant differential is detected when the largest cost is associated with R&D.

Results derived with profitability indicators are therefore consistent with the empirical analysis of TFP: profit margins as well as the productivity premium for CAT firms are greater when packaging and distribution are the activities characterizing CAT.

6. CAT and the existing theoretical literature

CAT straddles three distinct strands of the economic literature: theories of outsourcing, theories of multi-product heterogeneous firms, and theories of industrial and exporting services. None of them is able to fully accommodate the set of novel stylized facts discovered about this phenomenon.

Following the outsourcing literature, CAT can be thought of as a case of radical vertical fragmentation, in which the entire production process is outsourced to third companies. Helpman and Antras (2004) maintain two assumptions that are essential in explaining CAT: firm heterogeneity and a production function that is a combination of intermediate inputs and organization activity. They also assume that only firms in rich northern countries specialize in organization tasks (headquarter services), while firms in the south can only produce intermediate goods; this is necessary to explain north-south trade. Nonetheless, a satisfactory theoretical foundation for CAT must account for the evidence that, within the same country and within a

[33] Trade literature defines pure profits as the operating profits exceeding sunk and fixed costs.

[34] As long as a downward sloping demand curve (less is asked for higher prices) is assumed, the hypothesis of a mark-up increasing in the cost of production, for comparable quality level, can safely be excluded.

[35] Despite the small number of observations (159), the presence of a significant differential of EBIDTA between in-house and CAT goods was validated by a formal statistical test.

single firm, the crafting of some goods is fully internalized, while that of some other products is carried out through CAT, that is, the model must assume that in a northern country some firms do organization and intermediates, while others specialize in intermediates and some others in organizational tasks.

Other theories of vertical fragmentation (see Grossman & Rossi-Hansberg, 2008) were mainly conceived to explain north-south trade in parts and components, a trade motivated foremost by differences in relative factor abundance and in remuneration across countries. Accordingly, a country specializes in tasks for which it holds a comparative advantage, while CAT implies a coexistence of firms that specialize in different tasks within the same country; factor rewards are an unlikely driving force of the process.

Models of multi-product firms predict that the range of goods produced within a company expands from the high-expertise core products (characterized by larger production and higher mark-ups) to the low-expertise variety (Bernard et al., 2010). More productive firms produce a larger variety of goods internally. These models predict a high correlation between internal production and productivity; on the contrary, this paper shows that CAT firms have a productivity premium and earn a larger mark-up on CAT goods.[36]

Economic models concerned with industrial services generally assume that firms resort to wholesalers when obstacles encountered in domestic and foreign trade are too great. In these cases, the wholesalers exploit economies of scale and offer export services to many firms simultaneously, redistributing across firms the costs associated with trade barriers (Akerman, 2010; Bernard, Grazzi & Tomasi, 2011). In this literature, CAT firms are both a service and a manufacturing enterprise and might earn extra profit for the distribution service they perform. Nonetheless, these models cannot explain why the CAT premium is largest when rebranding is involved and when packaging is the main activity performed by the final seller in order to market CAT products.

7. Conclusions

Based on the Italian Survey of Industrial and Service Firms, this paper provides a direct measurement of the diffusion of CAT that confirms the importance of the phenomenon. The empirical investigation shows that CAT concerns a quarter of all manufacturing sales and is not limited to sales on foreign markets, whereas previous research investigated only export related CAT.

CAT is a clear example of what the literature calls functional upgrading of production processes, usually within international GVCs. It is a strategy undertaken by firms, mostly in advanced countries, to concentrate on a few key stages of the production process in which most of the value added is created.

CAT firms are generally more productive than others, even controlling for their size and exposure to foreign markets. The productivity premium is larger when the main cost CAT firms incur for this specific activity is connected with packaging or distribution. No premium arises

[36] A corollary of this is that while the number of exported CAT products increases significantly in a firm's sales per worker, the number of goods produced in-house increases only slightly in sales per worker, and that CAT exports increase at the same rate as regular exports with a firm's productivity (Bernard et al., 2012).

when CAT firms mainly carry out R&D or design on CAT goods and when CAT concerns solely domestic sales. These results suggest that the knowledge of the destination markets and the ability to penetrate them through existing distribution channels may be the crucial comparative advantages of CAT firms.

An alternative interpretation of these results, albeit difficult to confirm through empirical evidence, is that the proximity of CAT firms to final consumers grants them some degree of market power, which shifts rightward the demand schedule for their products and makes it less elastic; in this case, the extra productivity may be capturing the ability to charge higher prices. This interpretation is indirectly confirmed by the absence of a premium when design and R&D are indicated as the major costs of CAT activity.

The existing theories of outsourcing and firm heterogeneity are unable to accommodate all the stylized facts that have emerged from studying CAT. According to prevailing theories, outsourcing is determined by factor cost differentials across countries; this hypothesis, which well describes trade in parts and components between developed and developing countries, is unsuited to explain a specialization process occurring among firms within the same country and within a firm across products. Mainstream theories of firm heterogeneity would predict that the crafting firm is better at producing the CAT product but cannot explain why the same firm is less good at placing it on the market.

CAT requires an adequate theoretical framework that can accommodate a two-fold selection dimension: which tasks should be outsourced and for which products. On empirical grounds, the pervasiveness of CAT suggests that a refined concept of TFP is needed to isolate and measure a firm's ability to combine factors within each stage of the production process, including firm performance in complementary activities positioned upstream or downstream, such as R&D, design, advertising and distribution.

References:

AKERMAN A. (2010), 'A Theory on the Role of Wholesalers in International Trade based on Economies of Scope', *Research Papers in Economics*, Stockholm University.

ALFARO L. and A. CHARLTON (2009), 'Intra-industry Foreign Direct Investment', *American Economic Review*, vol. 99(5), 2096-2119, December.

ANTONIADES A. (2012), 'Heterogeneous Firms, Quality, and Trade', Working Paper, Georgetown University.

ANTRAS P. and E. HELPMAN (2004), 'Global Sourcing', *Journal of Political Economy*, vol. 112(3), pp. 552-580.

BERNARD A., J. BRADFORD JENSEN, S.J. REDDING and P. K. SCHOTT (2007), 'Firms in international trade', *Journal of Economic Perspectives*, vol. 21(3), 105–130.

BERNARD, A., E. BLANCHARD, I. VAN BEVEREN, and H. VANDENBUSSCHE (2012), 'Carry-along Trade,' Working Paper 18246, NBER.

BERNARD, A., T. FORT (2013), 'Factoryless Goods Producers in the US', Working Paper 19396, NBER.

BERNARD, A., M. GRAZZI and C. TOMASI (2011), 'Intermediaries in International Trade: Direct versus indirect modes of export', Working Paper 17711, NBER.

BHATTARAI S. and R. SCHOENLE (2010), 'Multiproduct Firms and Price-Setting: Theory and Evidence from U.S. Producer Prices.' Working paper, Princeton University.

BORIN A. (2011), 'Trade and Quality Differentiation among Heterogeneous Firms', Working Paper, Università degli Studi di Roma Tor Vergata.

BORIN A. and M. MANCINI (2015), 'Foreign Direct Investment and Firm Performance: An empirical analysis of Italian firms', Temi di Discussione 1011, Bank of Italy.

COSTINOT A., L. OLDENSKI and J. RAUCH (2011), 'Adaptation and the Boundary of Multinational Firms,' *The Review of Economics and Statistics*, MIT Press, vol. 93(1), pages 298-308, February.

DE ANGELIS, E., S. DE NARDIS and C. PAPPALARDO (2011), 'Produttori ed esportatori multiprodotto' in Italy in the World Economy. ICE-ISTAT Report 2010-2011, ed. by ISTAT, 307 – 316.

De LOECKER J. (2007), 'Product Differentiation, Multi-product Firms and Estimating the Impact of Trade Liberalization on Productivity' Working Paper 13155, NBER.

De LOECKER J. and F. WARZINSKY (2011), 'Markups and Firm-*Level* Export Status,' *American Economic Review*, vol. 102(6), 2437-71.

ECKEL, C., L. IACOVONE, B. JAVORCIK, and J. P. NEARY (2011), 'Multi-Product Firms at Home and Away: Cost- versus Quality-based Competence,' CEPR Discussion Papers 8186, C.E.P.R. Discussion Papers.

FUSS, C. and F. WARZINSKY (2012), 'The Determinants of Markups on Export Markets: A firm-product-market Analysis', mimeo.

GARCIA, A. and N.VOIGTLANDER (2013), 'Exporting and Plant Level Efficiency Gains: Its' in the Measure', Working Paper 19033, NBER.

GROSSMAN, G. M. and E. ROSSI-HANSBERG (2008), 'Trading Tasks: A Simple Theory of Offshoring', *American Economic Review* , vol.98(5), 1978–1997.

LEVINSHON., J. and A. PETRIN (2003), 'Estimating Production Functions Using Intermediate Inputs to control for Unobservables', *Review of Economic Studies*,vol. 70 (2), 317-341.

MELITZ, M.J. (2003), 'The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,' *Econometrica*, vol. 71(6), 1695-1725.

MELITZ, M.J. and G.I.P. OTTAVIANO (2008), 'Market Size, Trade, and Productivity,' *Review of Economic Studies*, vol. 75(1), 295-316.

MION, G. and L.C. OPROMOLLA (2013), 'Managers' mobility, trade performance, and wages,' Working Paper Series 1596, European Central Bank.

OLLEY, S. and A. PAKES (1996), 'The Dynamics of Productivity in the Telecommunications Industry', *Econometrica*, vol. 64(6), 1263-1297

OECD (2013), 'Interconnected Economies: Benefiting from Global Value Chains'.

PASADILLA, G.O and C.M.M. LIAO,(2007), 'Has liberalization Strengthened the Link between Services and Manufacturing?', Discussion Paper 2007-13, Philippine Institute for Development Studies.

SMEETS V. and F. WARZINSKY (2013), 'Estimating productivity with multi-product firms, pricing heterogeneity and the role of international trade' *Journal of International Economics*, vol. 90(2), 237-244.

Appendix A - Figures and Tables

Table 1A: CAT and non-CAT firms: a comparison along different dimensions

	All firms	Statistics	Sales (1000€)	Employment (#)	Sales per employee (1000€)	Export sales (1000€)	Share of export sales in total sales	Blue collar salary (€)	White collar salary (€)	Fixed investments (1000€)	Fixed investments in total turnover (%)	R& D investments (1000€)	R&D investment in total turnover (%)
All firms	Non - CAT	mean	48222	157	308	24261	33	24426	34783	1335	3.83	926	0.78
		median	12490	59	183	2087	21	24000	33786	210	1.43	0	0.00
	CAT	mean	99699	266	377	48031	38	25854	36668	3168	3.98	1688	1.00
		median	24061	96	240	6382	36	25000	35913	439	1.59	1	0.00
	CAT / non - CAT	mean	2.07	1.69	1.22	1.98	1.14	1.06	1.05	2.37	1.04	1.82	1.28
		median	1.93	1.63	1.31	3.06	1.71	1.04	1.06	2.09	1.12		
Multinationals (1)	Non- CAT	mean	90553.72	331	267	59093	56	25604	36790	2107	3	1214	1.50
		median	57000	229	224	27566	67	25000	36000	1532	2	272	0.47
	CAT	mean	205326.3	540	334	117110	49	26077	37968	6690	3	3399	1.42
		median	75859	257	286	32692	52	25604	36729	1550	2	120	0.13
	CAT / non - CAT	mean	2.27	1.63	1.25	1.98	0.88	1.02	1.03	3.18	1.14	2.80	0.94
		median	1.33	1.12	1.28	1.19	0.77	1.02	1.02	1.01	1.41	0.44	0.26

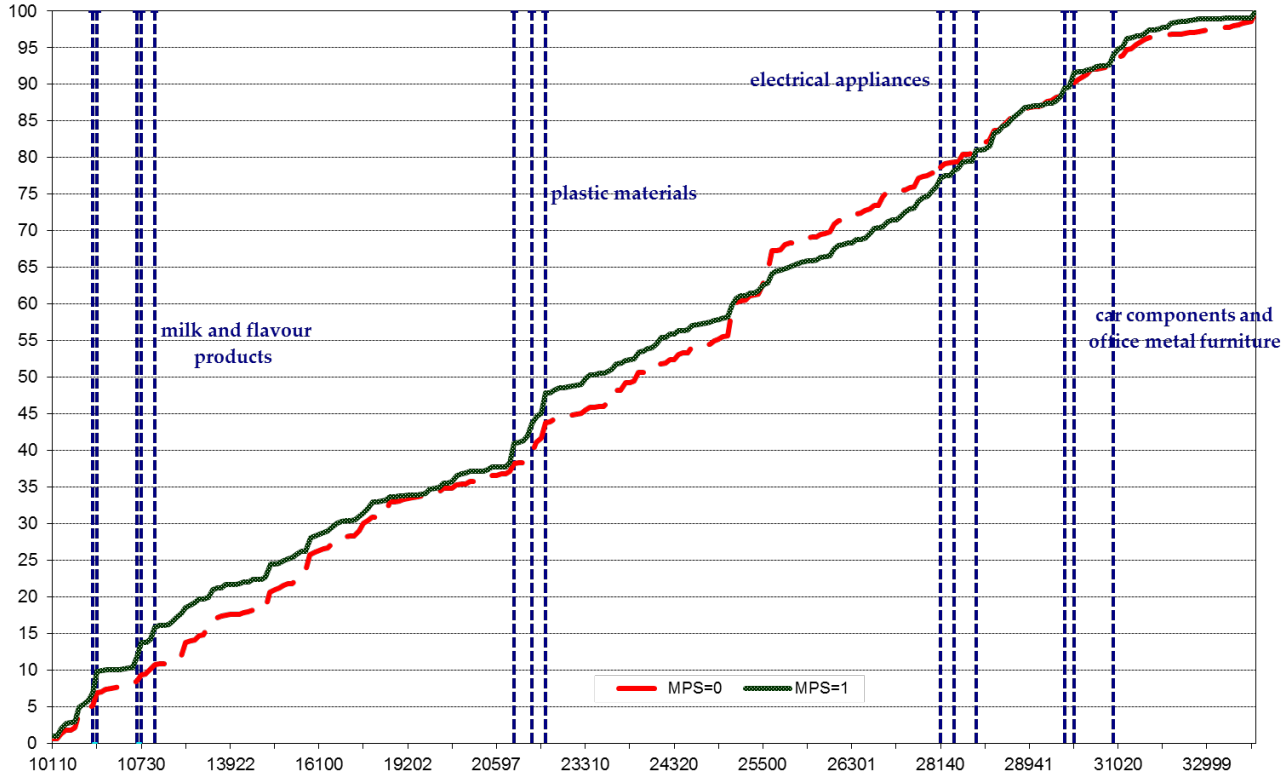
Source: Survey of Industrial and Service Firms (2012) covering Italian manufacturing firms with more than 20 employees.
(1) Multinationals are firms that declared they had invested abroad between 2008 and 2012.

Table 2A: Why do firms operate CAT?

	Cost advantage of producer in crafting the good with respect to the selling firm	Convenience of producer to have its production distributed by the selling firms	Convenience of producer in associating its goods to the brand of selling firm	Sales sinergies between product of producer and selling firm	Intra-group strategy	Other
Firms within a group	44.8	15.5	5.3	32.2	42.6	9.4
Independent firms	62	15.8	13.4	51.1	0	5.5
Exporters	54.6	16.3	10.8	43.7	19	5.7
Non-exporters	52.8	9.6	1.7	39	1.6	23.4
MNE(2)	52.8	34.8	18.1	38.8	13.3	4.9
Non-MNE	53.9	14.1	9.7	44	19.4	6.6
Total	**53.8**	**16**	**10.4**	**43.5**	**18.9**	**6.5**

(1) Rows do not necessarily sum to 100 as each firm could provide up to two explanations for CAT. – (2) Multinationals are firms that declared they had invested abroad between 2008 and 2012.

Figure 1A: Cumulative density distribution of CAT and non-CAT firms according to the ATECO classification(1)



Source: Survey of Industrial and Service Firms (2012)

(1) The ATECO codes for industrial activities are reported in increasing order on the horizontal axis. The cumulative frequency (0 - 100) is on the vertical axis. The blue vertical dashed lines indicate the sectors in which CAT firms are more concentrated than non-CAT firms. This occurs in the food industry (milk and flavour products), pharmaceutical radioactive substances, plastic products, electrical domestic equipment, car components and metal office furniture.

Table 3A: Productivity and CAT

	Log of total factor productivity						
	(1)	(2)	(3)	(4)	(5)	Excluding groups	Excluding MNE
CAT	**0.0912*** (0.0117)**	**0.0515*** (0.0116)**	**0.0291** (0.0120)**	**0.0219* (0.0118)**	**0.0371*** (0.0141)**	**0.0223* (0.0133)**	**0.0320** (0.0140)**
MNE			**0.161*** (0.0134)**	**0.0706*** (0.0145)**	**0.0942*** (0.0187)**	**0.0937*** (0.0173)**	
EXPORTER			0.0205 (0.0205)	-0.0169 (0.0205)	-0.0175 (0.0205)	-0.0440** (0.0204)	-0.0235 (0.0204)
Log of employment				**0.142*** (0.0298)**	**0.140*** (0.0298)**	**0.103*** (0.00731)**	**0.128*** (0.00728)**
[Log of employment]^2				-0.00547* (0.00296)	-0.00530* (0.00296)		
MNE*CAT					-0.0500** (0.0250)		
R^2	0.407	0.476	0.487	0.498	0.498	0.510	0.494
Observations	11081	11081	10746	10746	10746	7623	7876

Sample period 2001-2011. The logarithm of total factor productivity is the dependent variable. The estimation method assumes that errors are uncorrelated with regressors (random effects). Specifications include period, province and sector controls. ***, ** and * stay respectively for 10 - 5 and 1% significance.

Table 4A: Productivity premia of MNE and CAT over time

	Log of total factor productivity				
	1988-1992	1993-1997	1998-2002	2003-2007	2008-2011
MNE	**0.17*** (0.061)**	**0.196*** (0.037)**	**0.072** (0.032)**	**0.011 (0.029)**	-0.069 (0.039)
CAT	**-0.172*** (0.056)**	**0.113*** (0.042)**	**0.155*** (0.033)**	**0.118*** (0.028)**	0.1 (0.035)
EXPORTER	**0.023 (0.028)**	**0.08*** (0.021)**	**0.054*** (0.021)**	**0.046** (0.02)**	0.009 (0.028)
MNE=1 & CAT=1	**0.452*** (0.073)**	0.024 (0.055)	-0.007 (0.044)	-0.041 (0.037)	-0.055 (0.047)
Passive CAT	-0.027 (0.061)	-0.006 (0.044)	-0.006 (0.042)	-0.021 (0.038)	-0.013 (0.05)
Log of employment	**0.108*** (0.013)**	**0.066*** (0.009)**	**0.072*** (0.009)**	**0.08*** (0.009)**	**0.073*** (0.012)**
R^2	0.45	0.43	0.47	0.53	0.48
Observations	1986	3518	4099	4571	3595

The estimation method assumes that errors are uncorrelated with regressors (random effects). Specifications include period, province and sector controls. ***, ** and * stay respectively for 10 - 5 and 1% significance.

Table 5A: Productivity premia and the reasons for operating CAT

Sample period	2001-2011						1988-1992	1993-1997	1998-2002	2003-2007	2008-2011
	(1)	(2)	(3)	(4)	Excluding MNE	Excluding Groups					
MNE		**0.0516*** **	**0.0597*** **	**0.0648*** **		**0.0858*** **	0.027	**0.101*** **	**0.139*** **	**0.081*** **	0.039
		(0.0187)	**(0.0145)**	**(0.0146)**		**(0.0174)**	(0.038)	**(0.028)**	**(0.023)**	**(0.02)**	(0.026)
CAT NES	0.0597*	0.0125	-0.0319	-0.0314	0.0148	-0.0509*	-0.034	0.143***	0.061	-0.029	-0.022
	(0.0357)	(0.0350)	(0.0270)	(0.0269)	(0.0327)	(0.0304)	(0.057)	(0.042)	(0.04)	(0.037)	(0.049)
CAT firms externalizes expensive production	-0.0644**	-0.0431	0.0290	0.0285	-0.00730	0.0726***	0.024	-0.104***	-0.029	0.035	0.01
	(0.0290)	(0.0284)	(0.0218)	(0.0218)	(0.0278)	(0.0253)	(0.046)	(0.035)	(0.033)	(0.03)	(0.039)
Advantage of the producer in outsourcing the distribution process	0.128***	0.0847**	-0.0164	-0.0176	0.0130	0.00452	0.112**	0.033	0.016	0.013	-0.101**
	(0.0347)	(0.0341)	(0.0262)	(0.0262)	(0.0362)	(0.0316)	(0.053)	(0.042)	(0.039)	(0.036)	(0.048)
Advantage for the producer inassociating their production to the CAT brand	**0.234*** **	**0.199*** **	**0.193*** **	**0.191*** **	**0.186*** **	**0.124*** **	**0.274*** **	-0.007	**0.148*** **	**0.196*** **	**0.223*** **
	(0.0455)	**(0.0447)**	**(0.0344)**	**(0.0343)**	**(0.0498)**	**(0.0390)**	**(0.067)**	(0.056)	**(0.052)**	**(0.047)**	**(0.063)**
Sales sinergies between CAT and internal production	**-0.0634** **	-0.0369	-0.00921	-0.00959	-0.0742***	-0.0148	0.016	-0.047	-0.043	0.005	-0.043
	(0.0283)	(0.0278)	(0.0218)	(0.0217)	(0.0267)	(0.0248)	(0.042)	(0.033)	(0.032)	(0.03)	(0.04)
Within group strategy	**0.266*** **	**0.151*** **	**0.110*** **	**0.109*** **	**0.205*** **	**0.158*** **	**0.151*** **	0.051	0.061	**0.132*** **	**0.09*** **
	(0.0331)	**(0.0328)**	**(0.0255)**	**(0.0254)**	**(0.0350)**	**(0.0354)**	**(0.051)**	(0.04)	(0.038)	**(0.035)**	**(0.046)**
Other reasons	**0.0843***	**0.104** **	**0.0800** **	**0.0786** **	0.0275	**0.109*** **	0.058	-0.088	-0.066	0.065	0.082
	(0.0487)	**(0.0476)**	**(0.0367)**	**(0.0367)**	(0.0444)	**(0.0402)**	(0.074)	(0.06)	(0.055)	(0.05)	(0.068)
Log of employment		**0.132*** **	**0.0860*** **	**0.0849*** **	**0.115*** **	**0.0975*** **	**0.106*** **	**0.074*** **	**0.083*** **	**0.087*** **	**0.078*** **
		(0.0073)	**(0.0059)**	**(0.0059)**	**(0.0074)**	**(0.0074)**	**(0.012)**	**(0.009)**	**(0.008)**	**(0.008)**	**(0.011)**
R^2	0.0206	0.0632	0.497	0.500	0.498	0.512	0.47	0.44	0.48	0.54	0.49
Observations	10746	10746	10746	10746	7876	7623	2231	3856	4487	4983	3920

The logarithm of TFP is the dependent variable. The estimation method assumes that errors are uncorrelated with regressors (random effects). Specifications include period, province and sector controls. ***, ** and * stay respectively for 10 - 5 and 1% significance.

Table 6A: Productivity premia and the main tasks characterizing CAT activity

	Sample period	2001-2011					1988-1992	1993-1997	1998-2002	2003-2007	2008-2011
		(1)	(2)	(3)	Excluding MNE	Excluding Groups					
	MNE	**0.243*** **	**0.0662*** **	**0.0727*** **		**0.0956*** **	0.049	**0.1*** **	**0.142*** **	**0.092*** **	**0.045***
		(0.0167)	**(0.0186)**	**(0.0146)**		**(0.0174)**	(0.038)	**(0.028)**	**(0.023)**	**(0.02)**	**(0.026)**
CAT main activity	**not specified**	0.0240	0.00867	0.00441	0.0126	0.00545	0.041	0.042	0.028	0.017	-0.015
		(0.0169)	(0.0166)	(0.0129)	(0.0152)	(0.0144)	(0.027)	(0.02)	(0.019)	(0.018)	(0.024)
	R&D & design	-0.0673	-0.0607	-0.0115	-0.0405	0.00252	0.08	0.062	0.086*	-0.009	-0.043
		(0.0455)	(0.0447)	(0.0345)	(0.0501)	(0.0408)	(0.066)	(0.053)	(0.05)	(0.047)	(0.065)
	Packaging	**0.263*** **	**0.275*** **	**0.101*** **	**0.125*** **	**0.121*** **	**0.154*** **	**0.19*** **	**0.09** **	**0.127*** **	0.064
		(0.0334)	**(0.0328)**	**(0.0255)**	**(0.0301)**	**(0.0290)**	**(0.055)**	**(0.04)**	**(0.038)**	**(0.035)**	(0.047)
	Logistic and distribution	**0.0743*** **	**0.0486** **	**0.0295***	**0.0303***	0.0209	**0.069** **	**0.077*** **	**0.049** **	**0.05** **	0.01
		(0.0203)	**(0.0200)**	**(0.0156)**	**(0.0182)**	(0.0178)	**(0.032)**	**(0.024)**	**(0.023)**	**(0.021)**	(0.029)
	Log of employment		0.141***	0.0880***	0.128***	0.101***	0.11***	0.079***	0.086***	0.091***	0.08***
			(0.00711)	(0.00581)	(0.00723)	(0.00727)	(0.012)	(0.009)	(0.008)	(0.008)	(0.011)
	R^2	0.0291	0.0633	0.498	0.495	0.510	0.46	0.44	0.48	0.54	0.48
	Observations	10746	10746	10746	7876	7623	2231	3856	4487	4983	3920

The logarithm of TFP is the dependent variable. The estimation method assumes that errors are uncorrelated with regressors (random effects) Specifications include period, province and sector controls; ***, ** and * stay respectively for 10 - 5 and 1% significance.

Table 7A: Domestic versus foreign CAT

	(1)	(2)	(3)	(4)	(5)	Excluding MNE	Excluding groups
MNE	**0.0718*** (0.0145)**	**0.0643*** (0.0145)**	**0.0683*** (0.0145)**	**0.0693*** (0.0145)**	**0.0594*** (0.0131)**		**0.0901*** (0.0155)**
Domestic CAT		0.0200 (0.0215)			0.00539 (0.0209)	**0.0581** (0.0250)**	-0.0170 (0.0233)
Export CAT		**0.0967*** (0.0226)**			**0.0524** (0.0247)**	0.0516 (0.0331)	**0.100*** (0.0299)**
EXP					0.0100 (0.0193)	-0.00759 (0.0194)	-0.0197 (0.0195)
Share of CAT export on total sales			**0.00360*** (0.000643)**	**0.00339*** (0.000657)**	**0.00251*** (0.000737)**	**0.00211** (0.000994)**	**0.00185** (0.000821)**
Share of domestic CAT on total sales				0.000748 (0.000474)	0.000259 (0.000512)	-0.000586 (0.000600)	0.000171 (0.000544)
Log of employment	**0.0879*** (0.00580)**	**0.0871*** (0.00580)**	**0.0873*** (0.00580)**	**0.0874*** (0.00580)**	**0.0937*** (0.00516)**	**0.125*** (0.00661)**	**0.105*** (0.00654)**
R^2	0.499	0.500	0.499	0.499	0.502	0.492	0.512
Observations	10746	10735	10746	10746	12665	9216	8988

The logarithm of TFP is the dependent variable. The estimation method assumes that errors are uncorrelated with regressors (random effects). It includes sector, district and period controls; ***, ** and * stay respectively for 10 - 5 and 1% significance.

Table 8A: Active versus passive CAT

	(1)	(2)	(3)	(4)	(5)
CAT	**0.0427*** (0.0128)**	**0.0244* (0.0130)**	**0.0244* (0.0127)**	**0.0340** (0.0150)**	**0.0312** (0.0141)**
MNE		**0.165*** (0.0141)**	**0.165*** (0.0141)**		**0.192*** (0.0169)**
EXPORTER	0.0594*** (0.0210)	0.0172 (0.0212)	0.0180 (0.0212)	0.0203 (0.0212)	-0.00533 (0.0207)
Passive CAT	0.00311 (0.0163)	0.00433 (0.0164)			
Passive only CAT			-0.0105 (0.0276)	-0.0348 (0.0331)	-0.0284 (0.0301)
R^2	0.478	0.487	0.487	0.474	0.504
Observations	10164	9849	9849	7271	7040

The logarithm of TFP is the dependent variable. Sample period 2001-2011. The estimation method assumes that errors are uncorrelated with regressors (random effects). It includes sector, district and period controls; ***, ** and * stay respectively for 10 - 5 and 1% significance. Column (4) excludes multinationals and column (5) excludes firms belonging to a group.

Appendix B: Production function of CAT firms

There are a number of issues in the literature on the empirical estimation of firm productivity that are still unsolved, mostly because of lack of data. A good review of them is in Garcia Voigtlander (2013). For instance, concerning revenue based measures of productivity, it is well known that as more productive firms charge lower prices and revenues are generally deflated using aggregate price indices (firm/product specific prices are often unavailable), physical production and productivity estimates of the most efficient firms are downward biased and in general the estimated productivity distribution is less dispersed than it should be. Smeets and Warzinsky (2013) point out that estimating the productivity of multi-product firms without correctly allocating production factors across goods will also lead to distorted measurements.

This appendix shows that a similar issue arises when production is fragmented into tasks, namely, strict manufacturing tasks and complementary activities (i.e. services), as in the case of CAT. The set-up streamlines reality but results remain valid removing simplifying hypotheses. Let us assume that:

1. A firm produces a good through two distinct manufacturing processes: in-house (Q_i^H) or outsourcing the service tasks (Q_i^{CAT}) and the production process consists of two stages: manufacturing and services. Complementary services enter the production function symmetrically for the two types of manufactures.

$$Q_i = \left(Q_i^H + Q_i^{MPS}\right) = F(H_i, CAT_i, S_i, A_i)$$

Another firm produces the same good entirely through an internal process.

$$Q_j = F(H_j, S_j, A_j)$$

Q is the quantity produced, H and CAT are the manufacturing activities respectively performed in-house and outsourced, S stays for services and represents the complementary activity necessary to market the good. A is a firm specific overall productivity.

2. The production is a two tier function of tasks and factors. Each firm has an overall productivity (A), which is the ability to combine tasks in order to obtain the final good, and one activity specific productivity (T_H, T_{CAT}, T_S) for each task it realizes, which reflects its skills in combining factors to accomplish a given task. In the first tier the production function is a compound Cobb Douglas with constant return to scale of three main tasks: i) in-house crafting (H), ii) outsourced crafting (CAT), and iii) complementary services (S).

$$Q_i = \frac{1}{\alpha(1-\alpha)}(H_i + CAT_i)^{\alpha} S_i^{(1-\alpha)} A_i \varepsilon_i \quad (1b)$$

$$Q_j = \frac{1}{\alpha(1-\alpha)} H_j{}^{\alpha} S_j^{(1-\alpha)} A_j \varepsilon_j \quad (2b)$$

In the second tier each task is a bundle (Cobb Douglas with constant return to scale) of labour (L) and capital (K).

$$H = \frac{1}{\gamma(1-\gamma)} L_H^{\gamma} K_H^{(1-\gamma)} T_H \quad (3b)$$

$$CAT = \frac{1}{\theta(1-\theta)} L_{CAT}^{\theta} K_{CAT}^{(1-\theta)} T_{CAT} \quad (4b)$$

$$S = \frac{1}{\mu(1-\mu)} L_{S}^{\mu} K_{S}^{(1-\mu)} T_{SH}$$

Replacing (3b) , (4b) in (1b):

$$Q_i = \frac{1}{\alpha(1-\alpha)} \left[\frac{1}{\gamma(1-\gamma)} L_{i,H}^{\gamma} K_{i,H}^{(1-\gamma)} T_{i,H} + \frac{1}{\theta(1-\theta)} L_{i,MPS}^{\theta} K_{i,CAT}^{(1-\theta)} T_{i,CAT} \right]^{\alpha} S_i^{(1-\alpha)} A_i \varepsilon_i$$

For firm i and firm j to share the same production function (same elasticity and then unbiased estimate of productivities) γ must be equal to θ, that is K and L must be allocated identically within the manufacturing task in firm i and j and T_H must be the same as T_{CAT}. The latter assumption implies equal efficiency of firm i and j in the ''manufacturing task'', but this last condition contrasts, for instance, with the survey results that CAT firms outsource the crafting of goods that would be too expensive to produce internally. Therefore, the standard assumption of a common production function for any firm operating within the same industrial sector, which is maintained to estimate firms' TFP, is invalidated.

Appendix C: TFP in Borin- Mancini (2015)

An old branch of industrial organization literature deals with the estimation of the production function; within this literature the works of Olley and Pakes (1996) and, later, of Levinsohn-Petrin (2003) employ what is known as the ''structural approach'', which proved a useful tool to control for firm heterogeneity (i.e. productivity) when estimating the production function, solving for the presence of simultaneity and selection biases.[37] The methodology has been employed in the trade and industrial organization literature to relate TFP to firms' choice to export, to invest abroad, and to start new production lines. De Loecker and Warzynski (2011) study the relationship between mark-ups and export behaviour[38] and show that *'exporters charge higher markups and that markups of firms entering the export market rise significantly'*. Borin and Mancini (2013) obtain structural estimates of TFP for almost 10,000 Italian firms between 1988 and 2011 and investigate the productivity premium associated with multinational status. They identify the presence of an enormous premium on MNE and show how the decision to internationalize production boosts the growth rate of sales, value added and TFP five years later.

The measure for TFP employed in this work is that of Borin-Mancini (2013), with a sample restricted to firms for which information on CAT activity is available. Borin-Mancini (2014) obtain it as the residual of a regression of value added (deflated with firm level production prices) on the Cobb-Douglas production function in which labour (total employment) and physical capital at constant prices are the production factors. Following Smeets and Warzynski (2013), Borin Mancini (2014) built a firm level price index using data on production values and quantity to deflate the value added. Physical capital was reconstructed with the permanent inventory methodology; starting from the initial capital, annual financial statements on investments and the rate of depreciation of machinery, vehicles and buildings were used to update the value of the initial capital. They obtained a much more reliable measure of capital than the standard proxy used in the literature.

[37] It controls for the correlation between production factors and productivity.

[38] Based on Slovenian firm level data on exports and production from 1994 to 2000 they find that, controlling for unobserved heterogeneity, average mark-ups are significantly higher than those estimated in the previous literature. Their approach is promising as an indirect test of the main trade theory on firm heterogeneity. The Melitz model assumes constant mark-ups over the marginal cost, so that trade liberalizing policies do not affect them; on the contrary, the Melitz Ottaviano (2008) model predicts larger mark-ups for more productive firms and a decrease in the average mark-up following trade liberalization.

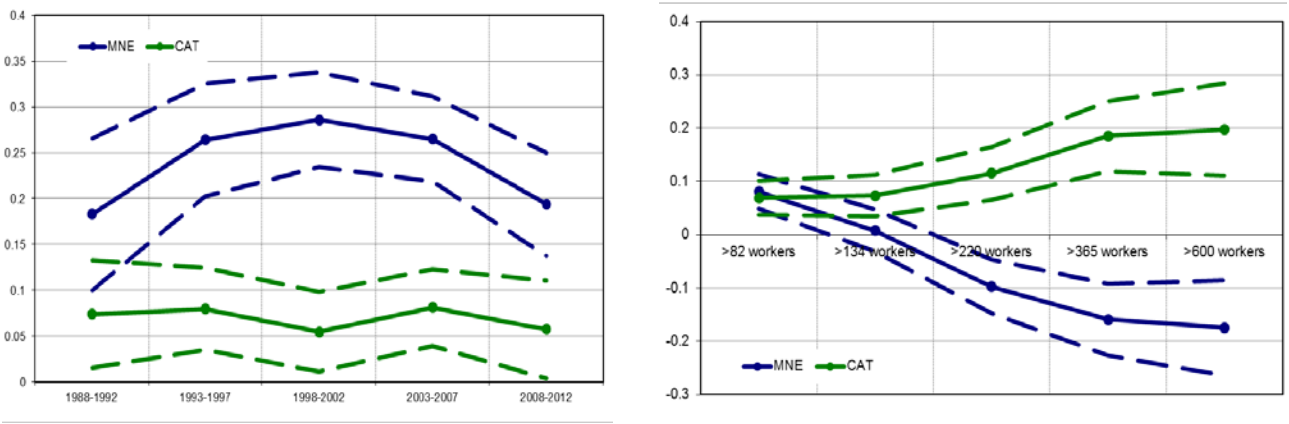
Appendix D: Non-linearity of productivity premium and CAT and MNE status

The CAT premium increases when the sample excludes small firms and the MNE premium tends to disappear (Figure 1C, panel b). The evidence shows a non-linear relation, as a function of a firm's size, between productivity and MNE and productivity and CAT status. The productivity premium on MNE gradually shrinks when the sample is restricted to bigger firms and is unaffected for CAT, suggesting that the two premiums might have different roots.

When firms are divided in two subgroups, depending on their size being below or above the median, the MNE premium for the very large ones is just 3% (which compares with the 20% estimated on the overall sample); on the contrary, the CAT premium, which is equal to 4.4% (when obtained from the whole sample), does not vary significantly. Furthermore, when grouping firms into quartiles according to size, a gradual reduction of the MNE premium emerges but no distinct pattern is present for the CAT premium.

Figure 1C: Evolution of productivity premiums of MNE and CAT[1]

(a) Over time (b) By firm size



(1) MNE and CAT coefficients are estimated as in equation (1) on different samples, as indicated on the horizontal axis. The dashed lines around the green and blue lines define the interval of significance at the 1% level.