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Production Offshoring and the Skill Composition of Italian Manufacturing Firms: A Counterfactual Analysis*

Roberto Antonietti† Davide Antonioli‡

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Abstract

This work explores the effects of cross-border relocation of production on the skill composition of Italian manufacturing firms. Its aim is to assess if the firms' strategy to offshore production activities towards cheap labor countries determines a bias in the relative employment of skilled versus unskilled workers. Using a balanced panel of firm-based data across the period 1995-2003, we test this skill-bias hypothesis by means of a counterfactual experiment in which we employ a difference-in-differences propensity score matching estimator in order to control for selectivity bias without relying on a specific functional form of the relations of interest. In line with the literature, our results point to confirm a general, although weak, skill bias effect of production offshoring on the labor-force composition of Italian manufacturing: in particular, we find that firms farming out production stages in 1998-2000 show an upward shift in the skill ratio with respect to the counterfactual of firms not moving their production abroad. However, when we look at the single components of the skill ratio, we find that the skill bias effect is primarily driven by a fall in the employment of production workers, while a weak or not significant effect is found with respect to the employment of skilled personnel.

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1 Introduction

During the last three decades the way goods are manufactured has dramatically changed. Next to an extensive use of IT capital, imported materials, intermediate services and skilled labor, an increasing replacement of low-skill employment is occurring due to the fact that firms de-locate low-skill intensive activities towards less developed, cheap labor, countries. Trade flows, import competition and foreign direct investments (FDI), thus, result in a reorganization of production through which home firms can specialize on the high-value-added phases of production while economizing on production costs.

The international relocation of production and service activities has received a lot of attention in recent times, and often in relation to the increasing fear of domestic job losses, particularly concerning blue collars and low-skilled personnel. Traditionally, two main explanations have been given to account for the shift in demand away from low-skilled workers in industrialized countries. The first refers to non-neutral technological change that, by fostering the demand for more qualified workers within technologically advanced industries, tends either to increase the wage inequality in relatively flexible labor markets (like in the US and UK) or to increase the relative unemployment of less qualified workers in relatively more rigid ones (as in Germany, France, Denmark and Italy). The second claims for increased international trade and globalization of production, according to which labor is relocated in a way that determines a shift of redundant and routine activities toward less-developed countries, while keeping non-routine,high skill-intensive activities at home, thus increasing the domestic firms' comparative advantage in the production of high-value added goods.

However, recent international evidence (Mann, 2004; Brainard and Litan, 2004; Amiti and Wei, 2005) has also shown that the increasing digitization of production now enables firms not only to offshore pure manufacturing stages, but also service activities like software programming, medical diagnosis, lab research, product development and analytical activities, thus creating the conditions for the transfer of IT, knowledge-intensive, jobs.

Our contribution to the debate moves is twofold. First, differently from the main literature that generally puts the attention on the strategies of large multinational firms, we focus on a sample of small and medium firms located in Italy, i.e. firms that, although not being large multinationals, are

pushed by globalization to act in this way. Second, we test the skill-bias effect of production offshoring by setting up a counterfactual exercise based on difference-in-differences propensity score matching, thanks to which we can compare the skill composition of offshoring firms to a suitable counterfactual of non-offshoring firms, thus controlling for sample selection and unobserved heterogeneity and without relying on specific functional forms of the objective function.

The article is structured as follows. Section 2 briefly sketches the empirical literature developed around the skill-bias effects of international fragmentation, and production offshoring in particular. Section 3 describes data and the empirical methodology adopted. Section 4 presents and discusses the empirical evidence and section 5 concludes.

2 Background literature

Even if it has often been considered a 'hot topic' for both international trade and labor economists, the impact of globalization on the international division of labor and the employment and wage dynamics of workers is still ambiguous.

The question if the international relocation of production determines a change in the skill intensity of jobs is still unanswered, especially in Italy (Piva and Vivarelli, 2004): what seems clear is that such effect depends on the type of offshoring strategy adopted, the unit of analysis considered and the empirical methodology employed.

The literature on the skill composition effects of offshoring can be divided in two main lines of research, according to the theoretical perspective through which offshoring is conceived.

The first bulk of studies looks at offshoring as a foreign investment strategy of the firm, and, in this respect, distinguishes between vertical and horizontal FDI (Markusen, Konan, Venables, and Zhang, 1996; Lipsey, 2002). The former is mainly driven by the will of exploiting the differences in factors endowments and prices and leads to a net decrease in domestic employment (Agarwal, 1997; Braconier and Ekholm, 2000; Mariotti, Mutinelli, and Piscitello, 2003). The latter, instead, is driven by the will to replicate abroad the whole production process of the home country, with the aim of having access to new markets and global opportunities and with the effect of

increasing the skill intensity of domestic jobs and occupations (Markusen, Konan, Venables, and Zhang, 1996; Blömstrom, Fors, and Lipsey, 1997; Mariotti, Mutinelli, and Piscitello, 2003).

However, if the literature generally agrees on the total employment effects of FDI, less explored is the issue of the effect of FDI on the human capital composition of the workforce. The research question thus becomes: does investing in cheap-labor countries lead to a skill upgrading at home?

Head and Ries (2002) try to answer this question by looking at Japanese multinationals in the period 1965-1990: their results point to a positive relationship between offshoring and the demand for skilled labor only if production re-location is directed to developing countries and only when the unit of analysis is the single firm. Similarly, Hansson (2004) finds that production delocalization toward less developed countries contributes to the general increase in the average level of qualification within Swedish multinationals. For Italy, Barba-Navaretti and Castellani (2004) and Castellani, Mariotti, and Piscitello (2006) find a skill upgrading effect of foreign investments by multinationals primarily due to the international relocation of low value-added segments of the production process that leads to a lower demand for low-skill labor at home.

In contrast with these results, Slaughter (2000), looking at 32 US manufacturing industries in the 1980s, does not show clear results in favour of the positive relationship between FDI and the employment of skilled workers at home.

Another group of studies, instead, focuses on the trade dimension of offshoring and consider it as a strategy of international fragmentation of production. According to Jones and Kierzkowski (2001), international fragmentation can be thought as a process of splitting up and spread of previously integrated stages of production over an international network of production sites. More specifically, production offshoring refers to the de-localization of manufacturing activities toward a low-cost country or region[1]. To the extent that this practice determines a reorganization of the production process, it implies a labor recomposition within domestic firms.

The evidence available from international trade literature provides general support for the skill-biased nature of production relocation. Wood

[1]Alternatively, the Oxford English Dictionary defines offshoring as the action or practice of moving or basing a business operation abroad, usually to take advantage of lower costs (http://dictionary.oed.com/).

(1994), for instance, calculates that import competition determines a reduction in the demand for unskilled labor by 30% in 1990. On the same line are Sachs and Shatz (1994), who conclude that production internationalization exerts a double effect on overall labor composition: it is not only the cause of a general decrease in manufacturing but, together with technological change, is a determinant of the decline in the relative demand for low-skilled workers. Moreover, Feenstra and Hanson (1996) give some evidence that, for the period 1972-1990, international outsourcing is responsible of a 30% to 50% rise in the demand for skilled workers, and, thus, for a rise in income inequality.

For the UK, Anderton and Brenton (1999) estimate that, between 1970 and 1986, imports from low-wage countries determine a negative impact of about 40% on the wage-bill share and relative employment of low-skilled workers. This result is further reinforced by Hijzen, Görg, and Hine (2004), who show that, between 1982 and 1996, international outsourcing has a strong negative impact on the demand for semi-skilled and unskilled labor.

For France, Strauss-Khan (2003), using input-output tables and labor data, finds that the highly increasing vertical specialization, i.e. the share of imported inputs in production, is the main determinant of the sharp decline in the share of unskilled workers between 1977 and 1993, passed from -15% in the period 1977-85 to -25% between 1985 and 1993.

For Austria, instead, a positive and significant effect on skills comes out only for proxies of international trade like export openness and outsourcing, while a negative effect arises when considering import penetration (Dell'mour, Egger, Gugler, and Pfaffermeyr, 2000).

For the Italian case, the scanty evidence seems to support the positive relationship between skills demand and offshoring. Helg and Tajoli (2005) compare the effect of international fragmentation of production on the skill ratio in Italy and in Germany and show that a positive and significant impact emerges only for the former, while for the latter a negative effect seems to prevail[2].

Concluding, the most recent literature on skill-bias international frag-

[2]Similar results for the German case emerge also in Fitzenberger (1999) and Falk and Koebel (2000), who find no evidence that international outsourcing of production and services positively affect the skill composition of manufacturing workforce. Rather, Fitzenberger leaves technology the dominant role in shifting away the employment of unskilled workers.

mentation of production seems to generally stress the negative impact of production offshoring on the employment and pay of unskilled relative to skilled workers. However, what also emerges is that country-specific effects, together with different measurement and econometric techniques, matter in explaining these effects. Indeed, whether international delocalization is a sufficiently large phenomenon in order to account for any economically significant skill-bias effects is, therefore, an empirical matter.

3 Methodology and data

3.1 Empirical methodology

Empirical studies testing for the skill-biased international trade are generally based on the estimation of labour demand equations, typically in a transcendental logarithmic form (Christensen, Jorgenson, and Lau, 1973; Berman, Bound, and Griliches, 1994).

However useful, this approach suffers a major limitation. It relies on a "simple" cost function framework, which is subject to a set of *ad hoc* restrictions in order to assure its tractability: optimization restriction, homogeneity assumptions and the specific functional form that constraints the parameters to assume specific values. Furthermore, limited information is usually provided on labour composition and firms characteristics, these latter being particularly important if one believes that firms endogenously choose to invest abroad by looking, for instance, at previous experience and at the composition of its internal assets. Thus, a possible problem of sample selection may arise, according to which the set of firms which decide to transfer production abroad cannot be thought as randomly drawn from the whole population.

In the following analysis, we employ a semi-parametric approach based on the Propensity Score Matching (PSM henceforth)(Rosenbaum and Rubin, 1983), developed within the evaluation literature in a context of observational data (Angrist, Imbens, and Rubin, 1996; Heckman, 1990, 1997; Heckman, Ichimura, and Todd, 1997; Heckman, Lalonde, and Smith, 1999; Sianesi, 2004; Wooldridge, 2001; Smith and Todd, 2005). The PSM is a more flexible technique with respect to standard labour demand estimation, because it does not force the imposition of a parametric specification and it

allows to handle the selection bias along with the problem of (time-invariant) unobserved heterogeneity. This can be achieved by exploiting the longitudinal structure of our data and by coupling the PSM with a difference-in-differences (DID) approach.

Operationally, the Difference-In-Differences-Propensity Score Matching (DID-PSM henceforth) method consists in a two step procedure. For our purpose, we estimate, at first, the probability of being an offshoring firm (the propensity score) conditional on the vector of characteristics X[3], through a logit regression. The Xs are supposed not only to affect the firm's decision to offshore production, but also to have an influence on the dependent variable, i.e. the skill composition of the labor force.

After having tested the balancing property by employing the algorithm developed by Becker and Ichino (2002)(see Table A2 in the Appendix), at the second stage, we use the propensity score to estimate the average treatment effect on the treated (ATT). In our case the outcome variables are the DID, in levels, of the skill ratio of the workforce and the DID, in levels, of each occupational category over total employment. The algorithm adopted in the PSM procedure is the Epanechnikov kernel (KPSM). The implementation of the KPSM allows us to use the weighted averages of all the counterfactual firms (on the common support) to construct the counterfactual outcome (Smith and Todd, 2005; Caliendo and Kopeinig, 2005; Caliendo, Hujer, and Thomsen, 2005).

The ATT is then computed in the following way:

$$\hat{ATT} = \frac{1}{N_t} \sum_{i=1}^{N_t} (\Delta Y_i^t - \sum_{j=1}^{N_t} W(i,j) \Delta Y_i^c) \tag{1}$$

where N_t is the number of delocalizing firms and ΔY is the difference between the outcome variables (i.e. the skill ratios or the single occupational categories) before and after the treatment period, and W is the weight assigned to each counterfactual unit in the construction of the counterfactual outcome.

The main aim of the DID-PSM method is to generate a set of non-offshoring (not treated) firms as much similar as possible to the offshoring (treated) ones in order to get a proxy of what would have happened to domestic skill composition within offshoring firms if they had not chosen to

[3]For a description of the variables used in the analysis see Table A1 in the Appendix

displace activities outside national borders, and then testing whether the outcome of the offshoring firms significantly differ from that of the counterfactual set[4].

3.2 The dataset

The dataset consists in a sample of Italian manufacturing firms drawn from the VII, VIII and IX waves of the Survey on Manufacturing Firms (*Indagine sulle Imprese Manifatturiere*) provided by Capitalia (ex Mediocredito Centrale) and covering the period 1995-2003. Interviews have been conducted respectively in 1998, 2001 and 2004 for the three surveys over all firms with more than 500 employees and over a representative sample of firms with more than 11 and less than 500 employees, stratified by geographical area, sector of economic activity and size. The three waves, 1995-1997, 1998-2000 and 2001-2003 gather information on 4.497, 4.680 and 4.289 units respectively.

In order to have a balanced panel, we first merge the three waves, so to get a sample of 414 firms always present in each time span (Table 1). Sixteen (3.8%) out of 414 are offshoring firms in 1998-2000, which represents a slightly overrepresented sample with respect to the percentage (1.9%) that emerges from the VIII Survey on Manufacturing Firms (Capitalia, 2001). In order to avoid bad matches in the construction of the counterfactual, we further dropped the firms classified into Scale intensive and Science based Pavitt sectors(Pavitt, 1984), because, in our sample, such sectors lack of offshoring firms[5]. For the same reason, we also excluded other groups of firms potentially conducive to misleading results. Specifically, we dropped those firms having systematic missing values in balance sheets data, those having undergone takeovers or break-ups (the jump/fall in employment could heavily affect our skill ratio outcome variable) and, finally, those which have (likely) delocalized production phases before and after 1998-2000. After this procedure we end up with a panel of 184 firms suitable for the analysis.

As it can be noted in the Table 1, the major part of the firms in our final sample is of small and medium size (93.5%): this is in line with the neat

[4]The works of Caliendo and Kopeinig (2005) and Smith and Todd (2005), among others, provide useful details about the matching procedure and its specific implementations.

[5]This is in line with Capitalia (2001) and Fortis (2005), who find that the sectors most involved in offshoring practices are textile and clothing, leather and shoes and machinery.

prevalence of such a typology of enterprises in the Italian manufacturing context. In Table 2 we note that only 7 out of the 184 firms (about 4%) have chosen to offshore production. Once again, despite the appearance, such a figure overestimates the percentage of offshoring firms within our final sample, when compared with the VIII Survey on Manufacturing Firms (Capitalia, 2001). However, an important aspect that should be stressed is that, as in the original 1998-2000 cross-section (in which the share of offshoring firms progresses along with their employment size), also in our final sample large firms show a higher propensity to shift production abroad than small and medium ones.

The limited number of offshoring firms does not represent a crucial issue when the matching procedure is applied[6]. What is more important is the dimension of the set of untreated units, which needs to be large enough in order to draw an appropriate counterfactual set. However, given the limited number of treated units, we cannot consider our sample as to be fully representative of the whole Italian manufacturing industry: rather, we consider it as a sort of "case study".

Table 1: Sample structure by economic sector and employment size

		Pavitt Sectors			
Size	Supplier Dominated	Specialized Suppliers	Scale Intensive	Science Based	Total
Small (10-49)	105	68	36	4	213
Medium (50-249)	66	50	18	3	137
Large (>250)	23	18	11	3	55
Total	194	136	65	10	405*

	Pavitt Sectors		
Size	Supplier Dominated	Specialized Suppliers	Total
Small (10-49)	79	38	117
Medium (50-249)	36	19	55
Large (>250)	8	4	12
Total	123	61	184

*Note: The 9 missing values are due to the lack of observations reporting the Pavitt classification

[6]If the treated units in the sample were a representative set of the treated in the population it would be possible to generalize the results, if they are not representative as in the present case it is still possible to consistently verify the impact of the treatment on the treated without generalizing the results on a national level.

Table 2: Production offshoring by Pavitt sectors and employment size

Offshoring	**Num. Obs.**	**Frequency**		
No	177	96.2		
Yes	7	3.8		
Total	184	100.0		
Offshoring	**Supplier Dominated**	**Specialized Suppliers**	**Total**	
No	119	58	177	
Yes	4	3	11	
Total	125	63	184	
Offshoring	**Small (10-49)**	**Medium (50-249)**	**Large (>250)**	**Total**
No	113	54	10	177
Yes	4	1	2	7
Total	117	55	12	184

3.3 Empirical evidence

A preliminary look at the evidence provided by the trends in the workforce composition for non-offshoring and offshoring firms, before and after the years (1998-2000) in which delocalization takes place (Figure 1), seems to support the rationale behind our analysis. In fact, it is possible to recognize an almost parallel dynamics of the workforce occupational categories and of the skill ratio variable for offshoring and non-offshoring firms before 1998-2000. This finding supports the validity of the identification assumption[7] at the basis of the DID implementation stating that in the absence of the treatment the outcome of the treated and untreated units would have followed parallel paths over time. On the contrary, the different behaviour of the two sets of firms in terms of workforce trend, after 1998-2000, is pretty clear.

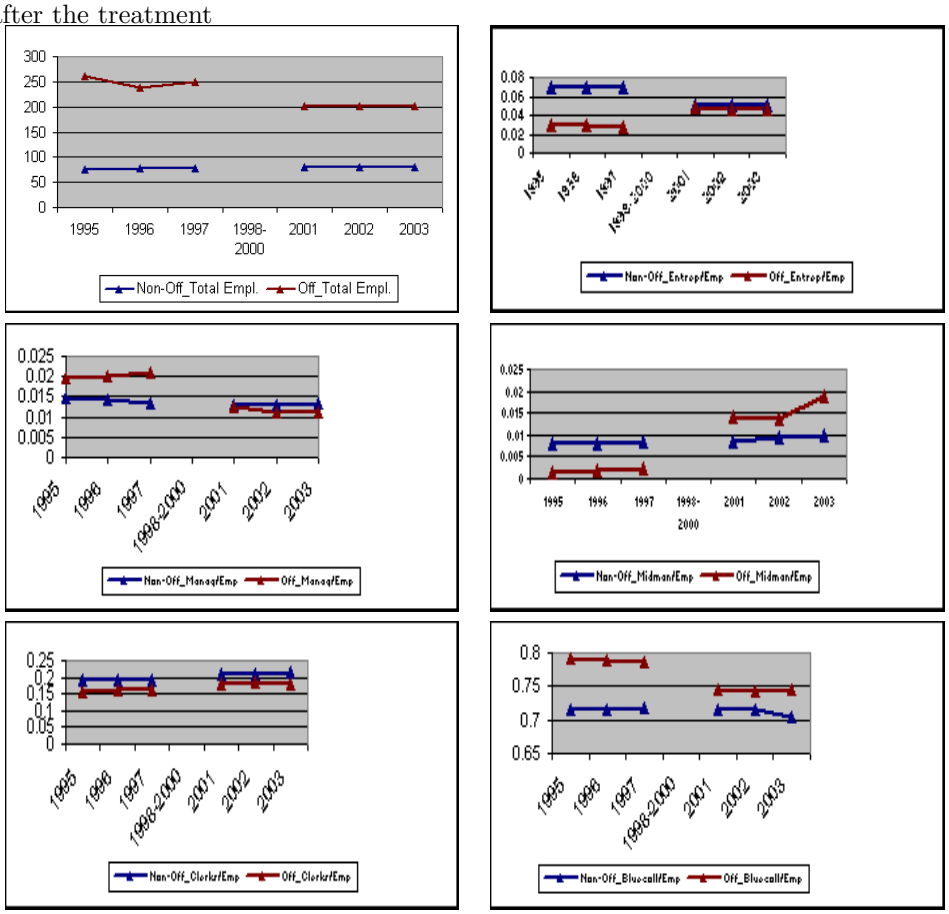
Total employment jumped down for offshoring firms after 1998-2000, while it remains steady for non-offshoring ones. The further decomposition of employment by occupational categories also reveals interesting dynamics. Specifically, for offshoring firms, the share of blue collars on total employment shifts down from the period before to the period after the treatment. On the contrary, the shares of the other occupational categories, which can

[7]The identification assumption which needs to hold for a consistent estimation of the ATT through the implementation of the DID-PSM may be expressed as: $E[Y^0(t=1) - Y^0(t=0)|X, D=1] = E[Y^0(t=1) - Y^0(t=0)|X, D=0]$ where Y_0 is the outcome of the untreated units, D is the binary variable that indicates the treatment, t represents the time ($t=0$ before the treatment period and $t=1$ after the treatment period), X is a vector of conditioning variables. If this assumption holds, it means that the average outcome for treated and untreated would have followed parallel paths in the absence of treatment conditional on the vector of observable characteristics X.

be put under the heading of non production workers, shift prevalently up after the treatment period for the offshoring firms. For non-offshoring firms we can note the almost unchanged average levels and trends of the occupational shares.

Such a graphical analysis may thus induce to assume that offshoring has a detrimental impact on production (unskilled) workers and a positive or null impact on the other occupational categories.

Figure 1: Occupational trends for offshoring and non-offshoring firms, before and after the treatment

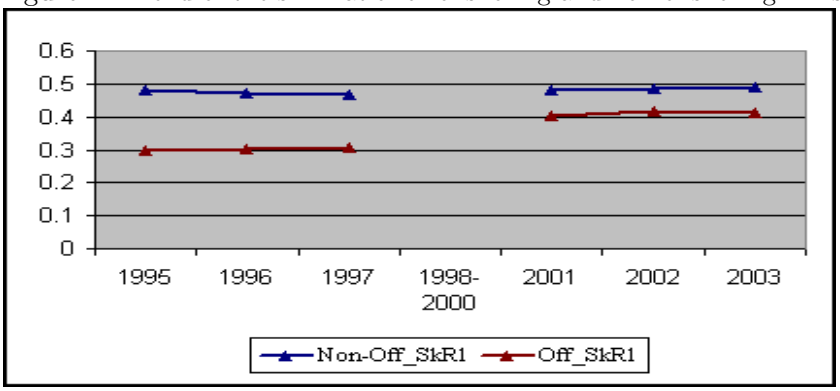


The evidence provided by the dynamic of the skill ratio also suggests a different behaviour in terms of the workforce composition between offshoring and non-offshoring firms in the period 1998-2000 (Figure 2).

In this case, it is clear how the skill ratio for the offshoring firms is higher in the period after 1998-2000 with respect to the skill ratio before the same period. For non-offshoring firms, on the opposite, the skill ratio remains sta-

ble around the same value for both the periods before and after 1998-2000[8]. Therefore, we can argue that the offshoring strategy may play some role in the occurrence of a process of convergence in the workforce composition between treated and untreated firms.

Figure 2: Trend of the skill ratio for offshoring and non offshoring firms



Turning now the attention to the estimation results, we investigate the impact, if any, of production offshoring on the skill composition within our sample of Italian manufacturing firms. As already mentioned, we look not only at the average treatment effect on the firms shifting production abroad, but we also control for the pre-treatment dynamics of the workforce skill composition by computing a difference-in-differences estimator.

In line with recent literature (Berman, Bound, and Griliches, 1994; Slaughter, 2000; Piva and Vivarelli, 2004; Bratti and Matteucci, 2005; Helg and Tajoli, 2005), we define skilled and unskilled workers in terms of non production and production workers respectively, and we compute our indicator as the ratio between the former and the latter. In addition, we look at the dynamics of each single occupational component of the skill ratio: in particular, we decompose the numerator of the skill ratio in three sub-components: the share of top managers, the share of middle managers and the share of clerks with respect to total employment, while, for the denominator, we look at the share of blue-collars on total employment.

Tables 3, 4, 5, 6 and 7 show the outcome of the estimations. The main result of the analysis is that we do find a slight skill-bias effect of production

[8]This also suggests that no major exogenous unobserved shocks potentially influencing the workforce skill composition occurred during the period 1998-2000.

offshoring: this is clear when we look at Table 3, in which the coefficients of the ATT are almost always positive and significant at 10%. The first row of the Table, in particular, shows that, on average, firms relocating part of their activities to cheap labor countries employ, in the post-treatment period, a higher relative share of skilled workers with respect to the counterfactual of firms that do not relocate production abroad. The other rows of the Table show, instead, the decomposition of this average effect into the difference between the skill ratio in each single year namely SR_{2001}, SR_{2002} and SR_{2003} with respect to the average skill ratio of the period before the treatment (1995-97). In this case, it is easy to see that the skill bias effect tends to increase over time, it reaches a maximum in year 2002 and tends to decline, or to become not significantly different form zero, when going through year 2003.

Tables from 4 to 7, instead, show the dynamics of each single component of the skill ratio: top managers, middle managers, clerks and blue collars. What emerges from the estimates is that the general skill bias effect previously described seems to be primarily driven by the fall in the relative employment of production workers, i.e. blue collars. In other words, the skill-bias is due to a decrease in the denominator rather than to an increase of the numerator. In fact, we do not find any statistically significant effect of offshoring on the employment of skilled personnel, even if the sign of the coefficient is positive and the magnitude of the effect is in line with the trend of the general skill ratio.

Table 3: The skill composition effect of production offshoring: nonproduction/production workers

Variable	**Coefficient**	**Bootstrapped s.e.**
$SR_{2001-03} - SR_{1995-97}$	0.139*	0.075
$SR_{2001} - SR_{1995-97}$	0.134*	0.082
$SR_{2002} - SR_{1995-97}$	0.145*	0.086
$SR_{2003} - SR_{1995-97}$	0.138*	0.099

* significant at 10%. All standard errors are bootstrapped (100 repetitions).

Table 4: The skill composition effect of production offshoring: blue-collars

Variable	**Coefficient**	**Bootstrapped s.e.**
$\%BC_{2001-03} - \%BC_{1995-97}$	-0.062*	0.033
$\%BC_{2001} - \%BC_{1995-97}$	-0.064*	0.033
$\%BC_{2002} - \%BC_{1995-97}$	-0.064*	0.033
$\%BC_{2003} - \%BC_{1995-97}$	-0.059	0.038

* significant at 10%. All standard errors are bootstrapped (100 repetitions).

Table 5: The skill composition effect of production offshoring: top managers

Variable	**Coefficient**	**Bootstrapped s.e.**
$\%TM_{2001-03} - \%TM_{1995-97}$	0.005	0.004
$\%TM_{2001} - \%TM_{1995-97}$	0.006	0.004
$\%TM_{2002} - \%TM_{1995-97}$	0.004	0.004
$\%TM_{2003} - \%TM_{1995-97}$	0.004	0.003

* significant at 10%. All standard errors are bootstrapped (100 repetitions).

Table 6: The skill composition effect of production offshoring: middle managers

Variable	**Coefficient**	**Bootstrapped s.e.**
$\%MM_{2001-03} - \%MM_{1995-97}$	0.015	0.028
$\%MM_{2001} - \%MM_{1995-97}$	0.013	0.018
$\%MM_{2002} - \%MM_{1995-97}$	0.012	0.017
$\%MM_{2003} - \%MM_{1995-97}$	0.020	0.028

* significant at 10%. All standard errors are bootstrapped (100 repetitions).

Table 7: The skill composition effect of production offshoring: clerks

Variable	**Coefficient**	**Bootstrapped s.e.**
$\%CL_{2001-03} - \%CL_{1995-97}$	0.003	0.030
$\%CL_{2001} - \%CL_{1995-97}$	0.003	0.035
$\%CL_{2002} - \%CL_{1995-97}$	0.008	0.033
$\%CL_{2003} - \%CL_{1995-97}$	-0.003	0.032

* significant at 10%. All standard errors are bootstrapped (100 repetitions).

4 Conclusions

In this paper we investigate the effect of the choice to offshore production activities toward cheap labor countries on the skill composition of Italian manufacturing firms over the period 1995-2003. We compare the employment of skilled relative to unskilled workers within a sample of firms that, in the period 1998-2000, farmed out part of their production activities across the national borders to the one of a counterfatual sample of firms that, although having similar characteristics, did not choose to move production abroad.

In order to control for possible selection effects and for the presence of unobserved factors that possibly affect the firm's decision to offshore, we employ a difference-in-differences estimation together with propensity score matching. This allows us to compare the outcomes in the post-treatment period with the average outcome in the pre-treatment period.

Our results point to a positive, even if not strongly significant, skill-bias effect of production offshoring. More precisely, we observe that offshoring firms tend to employ a higher relative share of non-production workers with respect to their counterfactuals. However, when we look at the dynamics of each single components of the skill ratio, we find that this general skill-bias is mainly determined by a fall in the relative employment of blue collars.

Our results, thus, seem to support those contributions that do not find a strong skill upgrading effect of globalization on Italian manufacturing firms (Piva and Vivarelli, 2004). In addition, we also support the idea that, in the short run, the vertical fragmentation of production, i.e. the seek to exploit factors cost differentials between countries, contributes to worsen the employment conditions of manual workers (Sachs and Shatz, 1994; Anderton and Brenton, 1999; Strauss-Khan, 2003; Hijzen, Görg, and Hine, 2004).

Put it another way, the offshoring decision seems to be driven by a cost reduction strategy that aims at substituting away "home" production workers with "abroad" and relatively cheaper labour force: the relatively short period of time considered after the treatment, in fact, does not allow to control for the skill upgrading effect that can possibly emerge once the firm reaches sufficient economies of scale in the production of high value-added goods. However, the nature of the data and the limited number of treated units claim for further research on the field.

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Appendix: definition of variables and summary statistics

Variable	**Type and Definition**
Geographical location	*Dummy*
North	Liguria, Lombardia, Piemonte, Valle d'Aosta, Emilia-Romagna, Veneto, Friuli Venezia-Giulia, Trentino Alto Adige, Marche, Abruzzo, Umbria, Toscana, Lazio, Molise
South	Basilicata, Calabria, Campania, Puglia, Sardegna, Sicilia
Employment size	*Dummy*
Small	10-49 employees
Medium	50-250 employees
Large	>250 employees
Sector of economic activity (Pavitt)	*Dummy*
Supplier dominated	Textiles, footwear, food and beverage, paper and printing, wood
Specialized supplier	Machinery and equipment, office accounting and computer machinery, medical optical and precision instruments
Business Groups	*Dummy*
Group	1 if the firms belongs to a business group, 0 otherwise
Technology	*Dummy*
ICT	1 if the firm has invested in informatics and ICT in the period 1995-97, 0 otherwise
Export activity	*Dummy*
EXP	1 if the firm has exported goods in 1995-97, 0 otherwise
Firm's age	*Continuous*
AGE	Age at year 1997
Capital intensity	*Continuous*
$K/Y_{1995-97}$	Net capital stock over sales 1995-97
Productivity	*Continuous*
$Y/L_{1995-97}$	Average sales over average employment 1995-97
Unit labor costs	*Continuous*
$ULC_{1995-97}$	Average labor cost over average employment 1995-97
Financial performance	*Continuous*
$ROI_{1995-97}$	Return on investments
Average skill ratio 1995-97	*Continuous*
$SR_{1995-97}$	Non-production workers: entrepreneurs, top managers, middle managers, clerks

Non-offshoring firms*	**Obs**	**Mean**	**Std.Dev**	**Min.**	**Max.**
North	177	.7627119	.4266272	0	1
South	177	.2372881	.4266272	0	1
Small	177	.6610169	.4747069	0	1
Medium	177	.2881356	.4541794	0	1
Large	177	.0508475	.2203093	0	1
SupplDom	177	.6723164	.4707003	0	1
SpecSupp	177	.3276836	.4707003	0	1
Group	177	.1468927	.3550031	0	1
ICT	177	.6949153	.4617495	0	1
EXP	177	.7062147	.456787	0	1
AGE	177	33.14124	16.56281	7	96
K/Y_{95-97}	177	62.19342	78.68751	.6933796	339.0949
Y/L_{95-97}	177	303.6329	355.6194	34.34141	1628.083
ULC_{95-97}	177	48.01859	59.10143	6.509797	275.3257
ROI_{95-97}	177	23.89585	35.01768	-72.33707	322.285
SR_{95-97}	177	.4732996	.4240047	.0153846	2.563889
WC/L_{95-97}	177	.2830085	.140808	.0151515	.7190977
BC/L_{95-97}	177	.7169915	.140808	.2809023	.9848485
Offshoring firms*	**Obs**	**Mean**	Std.Dev	**Min.**	**Max.**
North	7	.7142857	.48795	0	1
South	7	.2857143	.48795	0	1
Small	7	.5714286	.5345225	0	1
Medium	7	.1428571	.3779645	0	1
Large	7	.2857143	.48795	0	1
SupplDom	7	.5714286	.5345225	0	1
SpecSupp	7	.4285714	.5345225	0	1
Group	7	.1428571	.3779645	0	1
ICT	7	.8571429	.3779645	0	1
EXP	7	.8571429	.3779645	0	1
AGE	7	27.14286	9.352871	16	40
K/Y_{95-97}	7	91.67216	102.9942	15.06065	270.996
Y/L_{95-97}	7	443.961	486.119	90.06921	1301.123
ULC_{95-97}	7	76.67837	78.98095	21.12281	220.0333
ROI_{95-97}	7	32.72583	40.29681	-2.627105	109.2727
SR_{95-97}	7	.3023826	.2620984	.0759734	.875
WC/L_{95-97}	7	.2110251	.1233832	.0706076	.4666667
BC/L_{95-97}	7	.7889749	.1233832	.5333334	.9293925

*Simple t-tests did not reject the hypothesis of the equality of means between treated and control units. The results of the t-test are not reported here but they are available on request.

Testing the balancing property*

Inferior of block of ps	Non offshoring firms	Offshoring firms	Total
0.0062927	123	4	127
0.2	1	2	3
0.4	1	0	1
0.6	0	1	1
Total	125	7	132

*The balancing property is satisfied according to the algorythm developed by Becker and Ichino (2002).

Definition of production offshoring from the Questionnaire

Has the firm delocalized its production activities to Centre-East Europe countries [...] in the period 1998-2000?

i Yes

ii No