TECHNOLOGY, MNEs ACTIVITY AND ITALIAN SKILL UPGRADING

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Abstract

This paper analyses empirically whether skill-biased technological change and foreign direct investment play a role in explaining the skill-upgrading in Italian manufacturing during the 1990s. The author uses, simultaneously, industry level data from two groups of firms operating in each sector: foreign owned firms and Italian multinational firms investing abroad. But while the results do not find evidence of skill upgrading transmitted through technology effort undertaken by Italian parents, they support the hypothesis of a positive role played by the group of foreign owned firms in explaining the skill composition of the workforce in Italy. This result is confirmed especially in low-tech sectors. However, this positive impact may be partially or completely offset if the share of inward FDI activity increases over a certain threshold. The results do not provide support that the R&D effort undertaken in high-tech sectors by each group of firms has influence on Italian skill upgrading.

Keywords: Foreign Direct Investment, Skill Biased Technological Change, Skill Upgrading.
JEL classification: F23, J31, O33

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1. Introduction

Over the last decades, the structure of wages and employment has been widely characterised by a growing share of skilled workers in the labor force showing a skill-upgrading tendency.[1]

A clear result from several decomposition analysis of the change in skill share is that the most increase is driven by within-industry changes. This leads to two possible explanations consistent with within-industry shift: skill-biased technological change and globalisation.

According to the first one, the technical progress reduces the need of unskilled labor. The idea is that there is a complementarity between new technologies and skilled workers. In the literature, many studies have found a significant relationship between indicators of technological change, such as R&D expenditure and computer use, and the shift in the relative demand for skilled workers.[2]

Increased globalisation may affect skill-upgrading through increased competition from other countries. Many studies have analysed this issue focusing on cross-border trade, outsourcing and foreign direct investment (FDI).

This paper investigates the role of SBTC and FDI as possible determinants of the increase in the relative demand for skilled workers in Italian manufacturing industry between 1994 and 1997.

According to the theoretical literature, both inward and outward foreign direct investments are a potential channel for increasing the skilled component of the workforce. Regarding outward FDI, there are two reasons to expect that the skill intensity in the home country is affected by multinational activity. On the one hand, the parents might find it profitable to relocate the most unskilled-labor intensive activities in foreign countries abundantly endowed with unskilled labor at lower cost. In this case, usually, the high skilled activities, such as headquarters and R&D, given their characteristics of indivisibility and their nature of public-good are located at home. These choices increase the relative demand for skilled workers in the home country. On the other hand, when outward investments are located in high-tech countries, we may expect that the high skilled activities are transferred to the foreign countries and the effect on skill upgrading in the home country may be reduced. Regarding inward FDI, it is often argued that affiliates of foreign multinational enterprises are a channel through which technology may be transferred to the local economy accelerating the skill upgrading process.

In the literature, several studies have examined the hypothesis that FDI has led to improvement in the position of more skilled workers. Figini and Gorg (1998), using sector level data on Ireland, find that the new technology introduced by MNEs increases the wage inequality between skilled and

[1] The term skill upgrading refers to a generalised increase in the skill intensity which has led to an increase in the wage of skilled relative to unskilled workers.

[2] See for example: Berman, Bound and Griliches (1994), Machin and Van Reenen (1998), Haskel and Heden (1999), Manasse and Stanca (2002).

unskilled workers in the host country as long as the domestic firms learn the new technology, afterwards the wage inequality decreases following an inverted-U relationship between presence of multinationals and skill upgrading. Blonighen and Slaughter (2001) do not find a correlation between increase in foreign affiliate activity and skill upgrading in the United States manufacturing industry. Slaughter (2000) investigates whether the US multinational transfer generates change in the skilled labour share of the total wage. The results show that US outward FDI are not correlated to the degree of skill upgrading. Using the same framework Head and Ries (2002) develop a model for Japanese manufacturing firms. They are able to identify a positive link between outward FDI and skill upgrading, especially using firm level data rather than industry level data. In their paper the authors also find that this correlation is more evident for FDI located in low-income countries. For Mexico, Feenstra and Hanson (1997) find that an increase in FDI is associated with an increase in wage inequality. They argue that a rise in outsourcing, by multinationals from developed countries, contributes to an increase in the relative demand for skilled workers both in developing and developed countries, such as Mexico and US.

The weak evidence of skill upgrading caused by FDI activity at industry level may suggest that in order to find some relationships with skill upgrading we need to focus on the characteristics of multinationals and foreign affiliates. It might be interesting to investigate if the degree of internationalisation is the more suitable measure to use to analyse the effect of FDI on the relative demand of skilled workers, or, if it would be better to focus also on other variables, such as the R&D undertaken, that characterised the two groups of firms involved in inward and outward FDI.

Recently, another line of research (Lichteberg and van Pottelsberghe (2001) and Braconier, Ekholm and Midelfart Knarvik (2001)) have focused on the existence of R&D spillovers in terms of productivity, transferred through inward and outward FDI.[3] In these works, FDI flows are used as weights when the stock of foreign R&D is considered. Therefore, when we consider, for example, inward FDI, the effect of foreign R&D on host country productivity is a sort of "indirect" effect, because the analysis focuses only on the interaction between R&D performed in foreign countries and inward FDI flows, but we may be interested in the role played on our dependent variable by the R&D effort undertaken directly by foreign owned firms located in the country. At the same time, regarding outward FDI we may be interested in the role played by R&D effort undertaken directly by Italian MNEs that invest abroad.

This paper contributes to the existing literature in a number of ways. First, the paper helps to better understand the relationship between technology and within-industry skill upgrading focusing on the subjects that have undertaken R&D effort in each sector. In other words, we distinguish the effect of

[3] [3] Lichteberg and van Pottelsberghe (2001) conduct a country analysis, while Braconier, Ekholm and Midelfart Knarvik (2001) use Swedish firm level data.

R&D effort undertaken by two groups of firms: foreign owned firms located in Italy and Italian multinational firms investing abroad. Secondly, in the analysis, we explicitly address and try to control whether the degree of internationalisation of each sector, in terms of the activity of foreign owned firms and Italian subsidiaries abroad, affects the skill upgrading. Thirdly, the interaction between the R&D effort and the degree of internationalisation of each group of firms in the sector is also considered in the empirical analysis. Finally, in terms of methodology, this is the first attempt, at least for Italy, to consider altogether both data on foreign owned firms and Italian multinationals.
The rest of the paper is organised as follows. Section 2 specifies the analytical framework and suggests the technology indicators used in the empirical estimations. Section 3 describes the dataset and reports some descriptive statistics. Section 4 shows the results and Section 6 concludes.

2. Analytical Framework

Following the literature we derive an econometric specification from a non homothetic translog cost function.[4] Skilled and unskilled labor are the only variable factors of production while capital is a quasi-fixed factor. By differentiating the function with respect to input price and by employing Shephard's Lemma we obtain a cost share equation of the form:

$$SHw= b_0+ b_1\ln(w^s/w^u)+ b_2\ln y + b_3\ln k/y + b_4T \quad (1)$$

Where SHw is the skilled workers wage bill divided by total wage bill ($w^sL^s/w^sL^s+w^uL^u$)[5], w^s and w^u are the average wage rates of skilled and unskilled workers, y is the real output and k is the physical capital, T is the state of technology.
To move on to the regression model for industry i in year t, we append an error term and a set of time dummy variables:

$$SHw_{it} = \beta_0+ \beta_1\ln(w^s/w^u)_{it} +\beta_2\ln(y)_{it} + \beta_3\ln(k/y)_{it} + \beta_4(T)_{it} + \beta_5D_t + \varepsilon_{it} \quad (2)$$

Moreover, we assume that

$$\varepsilon_{it} = c_i + u_{it} \quad (3)$$

where c_i is a time-invariant individual fixed effect and u_{it} is the idiosyncratic errors changing across t as well as across i. c_i measures the effect of all factors that are specific to individual i but constant

[4] A complete derivation is found in , e.g., Berndt (1991)
[5] L^s and L^u are respectively the number of skilled and unskilled workers.

over time. We estimate equation (2) given the assumption (3) using the fixed effects estimators that allows us to eliminate the unobserved effect c_i.[6]

The sign of β_1 depend on the elasticity of substitution between skilled and unskilled workers, a positive estimate for β_1 implies an elasticity of substitution below one. The coefficient of lny controls for industry scale and the coefficient of ln(k/y) indicates if capital is complement ($\beta_3>0$) or substitute ($\beta_3<0$) to skilled labor. Regarding β_4, we expect a positive value of the coefficient because skilled workers should have a comparative advantage in implementing new technology.

One estimation issue related to equation (2) refers to the wage regressor. In this literature it is common practise not to include this term in the estimation equation. The reason is that the cross-sectional relative wage variation might be due to various skill mix differences rather than to exogenous wage differences[7], which means that we confound price changes with quality changes. In a panel analysis we allow the constant term or the coefficients of time dummies to capture change in the wage faced by all industries. We estimate equation (2) both with the wage term and without the wage term and we find similar results.

To consider the potential impact of technology on skill upgrading we consider the technological effort undertaken respectively by foreign owned firms and Italian multinationals. We construct the measure of technology as the ratio of R&D and Patent investments over total assets, physical assets and knowledge assets, of each group of firms in the industry i. In other words, we use the investment in R&D and Patent of the group of foreign owned firms in sector i over its total assets, $R\&D_{inw}$, and the investment in R&D and Patent of the group of Italian MNEs in sector i over its total assets, $R\&D_{MNEs}$.

Differently from similar studies, we do not employ in our regression the R&D expenditure as a share of value added because we use balance sheet data in which the term R&D is not an expenditure term but the investment in R&D (and Patent) are included among the intangible assets, in other words the database contains capitalized R&D.[8]

In addition, in the model we use an alternative measure of technology indicator defined as the ratio of intangible assets to the total assets respectively of foreign owned firms and Italian MNEs, INT_{inw}

[6] The fixed effect (FE) method computes the deviation of each variable with respect to its individual specific mean and then regresses the deviation of the dependent variable on the deviation of the regressors. See, e.g., Wooldridge (2002)

[7] See for example Berman Bound and Griliches (1994), Machin and Van Reenen (1998)

[8] It is worth noting that the Italian firms, drawing up the balance sheet, may state their investment in R&D using two different methods. One of them provides that the investment in R&D is included in the balance sheet among the intangible fixed assets as a precise term: "Research, development and advertising expenses". The other method allows the inclusion of R&D among the intangible fixed assets but using a more general term defined as "Others". Of course, we are not able to have information about the amount of the investment in R&D when the second method is used by the firm.
To reduce this problem of measurement, in the empirical analysis we use as indicator of technology effort a measure that includes R&D and Patent.

and INT_{MNEs}. In fact, it may be of interest to show the correlation between the investment in intangible assets and the shift in the relative demand of skilled workers especially because, according to the theory, the multinational firms have a comparative advantage in knowledge capital which is high-skilled intensive. We would expect a positive impact of the technology variable on skill upgrading, both for foreign owned firms and Italian parents, but the results might show a different impact of the two groups of firms due to different R&D investment decisions and different organisation of labor and task.

To address the hypothesis that the increased relative demand for skilled workers has been caused by foreign direct investment, we add to the basic model a measure of inward and outward FDI activity: the number of employees in the group of foreign owned firms in industry i over the total employment in industry i, FDI_{inw}, and the number of employees of parents' subsidiaries in industry i over the total employment in industry i, FDI_{out}. A positive coefficient of these two variables confirms the hypothesis that FDI, both inward and outward, might increase the relative demand for skilled workers in the country.

Furthermore, we allow the technology term to interact with the FDI term. In this way, our specification is able to capture pattern of R&D effort that reflect the degree of internationalisation of Italian economy. In fact, the interaction term is designed to capture the relationship between R&D effort and degree of internationalisation of sector i. If both the coefficients of R&D effort and interaction term are positive, this means that the direct effect of R&D on skill upgrading is strengthened; in other words, the R&D effort encourages the relative demand of skilled workers when the degree of internationalisation of the sector is high. If the coefficient of R&D effort is positive but the interaction term is negative, then the R&D effort encourages the skill upgrading only if the FDI are small, suggesting that a large degree of internationalisation fosters the unskilled labor force.

3. Data

Data sources

To analyse the relation between skill upgrading and R&D effort performed by the two groups of firms, foreign owned firms and Italian multinational firms, in each sector i, we combine data from two datasets: the ISTAT survey and the "Centro Studi Luca D'Agliano – Reprint" dataset. The first, refers to Italian firms with 20 or more employees and contains information for each manufacturing sector on wages, employment, value added and capital including tangible fixed assets (both new and old) and land. The wage variable includes wage and salary payments to employees as well as the

contributions to Government funds. The survey allows us to collect information separately for blue-collar and white-collar workers. The definition of blue-collar refers to manual workers and that of white collar refers to managers and clerical workers and in our empirical analysis we use this classification as a proxy of unskilled and skilled workers. The adoption of this classification is in line with the existing empirical works, even if we acknowledge that skill upgrading might occur both for white collar and blue collar workers but, unfortunately, this kind of data are not available. From ISTAT dataset we collect data at 3-digit level following the NACE classification from 1994 to 1997.

The second dataset, named "Centro Studi Luca D'Agliano – Reprint", is the merging of Reprint database of the Politecnico of Milan, which contains information on foreign owned firms in Italy and Italian multinational firms investing abroad, and the AIDA database of Bureau Van Dijck, which contains information on balance sheet data and other economic data of Italian firm[9]. From this database with collect data on R&D, Patent[10], Tangible fixed assets, Intangible fixed assets, the number of employees in foreign owned firms and the number of employees in foreign subsidiaries of Italian multinational firms. Unfortunately it is not possible with this kind of data to have information separately on skilled and unskilled workers in each firm, forcing us to conduct and industry level analysis.

Regarding the data on foreign subsidiaries of Italian multinational firms, we have data on employment only every two years (1993-1995-1997). Thus, for the missing years we assume that the level of employment in subsidiaries is the mean between the previous and the follow year.

To construct the panel used in this paper we aggregate separately the data of foreign owned firms and Italian multinational firms at industry level[11] and combine them with the 3-digit level data of the ISTAT survey obtaining for the empirical estimation a panel of 80 manufacturing industries from 1994 to 1997[12].

Descriptive Statistics

An important point to evaluate is the presence of skilled upgrading in Italian manufacturing sectors.

[9] The Reprint database covers approximately 70% of the Italian multinational firms. The underestimation is likely to be due to the presence of many small firms which are difficult to identify. While, on the side of inward FDI, the database contains the population of all the foreign owned firms.

[10] The R&D variable is defined as "Research, development and advertising expenses" and the Patent variable is defined as "Industrial patents and intellectual property right".

[11] We know that the more disaggregated the data the more the probability of capturing the within industry shifts in labor demand towards skilled workers, but we are not able to aggregate the firm level data at a more disaggregated industry level than 3-digit, because in the "Centro Studi Luca D'Agliano – Reprint" database the firms are classified with a 3-digit code or less. In fact, during the aggregating process we are not able to take into account 114 firms, among foreign owned and parents, that are classified with a 2-digit code.

[12] Foreign owned firms are present in 90 3-digit sectors and Italian parents in 85 3-digit sectors, but using both data the dataset reduces to 80.

Table 1 shows the evolution of the wage share, the employment share and the relative wage between 1994 and 1997 for each manufacturing sector.[13]

With regard to the wage share, Table 1 shows that 17 of the 23 2-digit sectors exhibit a positive variation in wage share between 1994 and 1997, revealing the presence of skill upgrading. Less evidence of skill upgrading is noted when we use the employment share, where only 12 of 23 sectors have a positive variation.

Considering low and high technology sectors[14], the results show that the wage share and the employment share has risen especially in low-tech sectors which we would expect to be less skilled. Moreover the skill upgrading seems stronger in low-tech sectors such as Tobacco (16), Apparel products (18), Wood & cork (20) and Recycling (37). Taking into account the 80 3-digit sectors we find the same pattern. The skill upgrading is more evident if we consider the wage share and the low-tech sectors.

The higher presence of skill upgrading in the wage rather than in the employment is somehow counterintuitive for a country such as Italy, for which we would expect an adjustment of the labour market throughout the employment and not throughout the wages. However, Manasse, Stanca and Turrini (2003), using data from 1995 to 1997, cast some doubts on the Italian labour market rigidity. Admittedly, the Italian pattern seems more stable in the 1990s compared to the 1980s, when the skilled worker wages increased more significantly than those of the unskilled (Faini et al. 1999).

The relative wage increases in each sector except two, Rubber and plastic products (25) and Other Transport (35), where the decrease is, however, very low. The most relevant increase in relative wage is shown in sectors such as Apparel products (18), Luggage, leatherwear and footwear (19), Paper and pulp (21), Coke and petroleum (23), Metal products (27), Office machinery and computers (30) and Recycling (37), which are all low-tech sectors with the exception of two. This result seems to confirm the rise in Italian wage inequality during the period considered in our analysis.

Table 2 reports means (and standard deviation) for the main variables involved in the estimation equation. We report the means both for low-tech sectors and for high-tech sectors. The descriptive statistics show that wage share, employment share and relative wage, are higher in high tech sectors than in low tech sectors and this is in line with the theory according to which the high tech sectors employ more skilled labour force and pay higher wages.

The share of workers employed in the group of foreign owned firms, FDI_{inw}, is higher in high-tech sectors than in low-tech sectors, indicating that the Italian economy is characterised by a high

[13] For simplicity in the table we report the variation and the mean of each 2-digit sectors.
[14] The distinction between low and high technology sectors follows WIFO and OECD classifications.

degree of inward FDI in terms of employment especially in those sectors where Italy is not specialized. This result may suffer from the classification of the industries chosen, however it is worth noting, that among the high tech sectors we have also included some high scale intensive industries where Italy is likely to have a comparative advantage.

The same pattern is shown by the share of workers of Italian foreign subsidiaries, FDI_{out}, suggesting that the foreign activity, in terms of number of employees, is higher if the parent belongs to high tech sectors than to low-tech sectors.

Moreover the descriptive statistics reported show approximately the same amount of the investment in technology for the two groups of firms. But, looking at low and high-tech sectors, we find that in the former the foreign owned firms undertake higher R&D effort than Italian MNEs while in the latter the investment in R&D is higher for Italian MNEs. However, performing a t-test we cannot refuse the null hypothesis that in both sectors, the mean of the R&D effort undertaken by the group of foreign owned firms equals the mean of R&D effort undertaken by the group of Italian parents. We would expect a higher amount of R&D effort performed by the group of Italian MNEs in respect to the group of foreign owned firms because, following the theory, the parents should have a higher level of R&D, advertising, patents and intangible assets relative to total assets than affiliates. However this finding seems not to be corroborated for the group of Italian parents as pointed out above confirming the weak investment in technology by Italy.

We find a different pattern looking at the investment in intangible assets. In fact, the descriptive statistics show that the amount of intangible assets is higher for the group of foreign owned firms than for that of Italian MNEs and this happens to be the case both for low and high tech sectors. In that case the t-test performed shows that the difference between the two means is statistically different from zero.[15]

The descriptive statistics reported show that the difference between the two groups of firms is not a question of less R&D effort performed but is related to the different amount of investment in intangible assets undertaken. However, we have to take into account that the intangible assets include not only R&D and patents but also brand, concessions, goodwill and some of these variables do not depend directly on the choice of foreign affiliates to invest in technology.

4. Estimation results

[15] We are able to refuse the null at 10% level of confidence for low tech sectors and at 1% for high tech sectors.

In our econometric analysis we focus on the relationship between skill upgrading and R&D effort performed by the two groups of firms, foreign owned firms and Italian multinational firms, in each 3-digit industry.
More specifically, we estimate the following equation:

$$SHw_{it} = \beta_0 + \beta_1 \ln(w^s/w^u)_{it} + \beta_2 \ln(Y)_{it} + \beta_3 \ln(K/Y)_{it} + \beta_4 (R\&D_{inw})_{it} + \beta_5 (R\&D_{MNEs})_{it} + \beta_6 (R\&D_{inw} * FDI_{inw})_{it} + \beta_7 (R\&D_{MNEs} * FDI_{out})_{it} + \beta_8 (FDI_{inw})_{it} + \beta_9 (FDI_{out})_{it} + \beta_{10} D_t + u_{it} \quad (4)$$

We estimate equation (4) using the fixed effect method allowing the intercept term to differ across sectors capturing sector specific time invariant effects.
Results are shown in Table 3. We include among the regressors the relative wage term, however we find similar results also excluding it. The first column, specification (1), contains the results using the R&D effort as measure of technology, while in the second column, specification (2), we perform the same analysis using the investment in intangible assets as measure of technology.
We obtain the most interesting results using the intangible assets, specification (2). The coefficient on INT_{inw} is positive and highly significant pointing out that the investment in intangible assets by foreign owned firms contributes to increase the Italian skill upgrading. The same result seems confirmed also using the R&D effort as measure of technology, specification (1). Moreover, the coefficient of $R\&D_{inw}$ is higher than that of INT_{inw} suggesting a stronger impact of R&D effort over the dependent variable.
The interaction term, $INT_{inw} * FDI_{inw}$, is significant but negative. This means that high intangible assets associated with high inward FDI activity is likely to decrease the skilled-labor component of the workforce. If we consider the magnitude of the coefficient, the effect of the investment in intangible assets by the group of foreign owned firms on skill upgrading is approximatevely given by:

$$\partial SH / \partial INT_{inw} = 0.0712 - 0.3289 * FDI_{inw}$$

The effect on the wage bill share is positive only if the derivative is positive and that is true for FDIinw<0.2165. This means that if the relative number of workers in foreign owned firms is high, given the average investment in intangible, there will be an increase in the demand for unskilled workers and the positive impact of the relative amount of intangible assets on skill upgrading will be offset. The idea is that an increase in the volume of inward FDI activity makes the sector less skilled-labor intensive as skilled-labor knowledge-intensive activities are spread over a large share

of foreign owned firms in the industry[16]. However, taking the mean of FDI_{inw} we may conclude that the relative amount of investment in intangible assets by the group of foreign owned firms contributes to increase the skill upgrading.[17]

The interaction term is not significant when we use the R&D effort, specification (1); however, the sign and magnitude of the coefficient confirms the existence of a threshold above which the overall impact of R&D effort on skill upgrading became negative.

No evidence emerges of a relationship between R&D effort and investment in intangible assets undertaken by the group of Italian parents and the skilled labor share of the total wage bill. This result is somehow in line with other studies on Italy like Piva and Vivarelli (2002), Brenton and Pinna (2001) and Helg and Tajoli (2003), even if the effect of technology effort on skill upgrading is not the main objective of these works, and even if they do not distinguish between the two groups of firms as we do in this work, they find a weak role of R&D in explaining the skill composition of the labor force.

Regarding the coefficient on FDI, the specification (2) shows a significant and positive link between inward FDI and skill upgrading but the result does not seem very robust suggesting a weak role of foreign affiliates activity in explaining Italian skill upgrading. In both the specification, the share of employees in foreign subsidiaries, FDI_{out}, is significant and negative indicating that outward FDI contribute to reduce the skill upgrading. Given this result, we may argue that the Italian parents are likely to localize abroad not only the stages of production which are intensive in unskilled labor but also those activities which require skilled labor force and this decision might reduce the demand of skilled workers at home. It is also true that at the end of 1997 53% of Italian subsidiaries were located in developed countries with a percentage of employees of 47.6%[18]; in addition, the descriptive statistics reported show that the relative employment in foreign subsidiaries is higher in high tech sectors than in low tech sectors. This piece of evidence suggests that the Italian parents might delocalise abroad even their skilled intensive activities taking advantage of the major technological effort performed in other developed countries.

Finally, turning to other variables, the wage regressor is always significant and positive; the coefficient on capital term is significant and negative suggesting that an increase of the capital per

[16] Another possible explanation of the result, consistent with the Italian economy, refers to the existence of an inverted – U relationship between inward FDI and skill upgrading. The skill upgrading first increases, as foreign owned firms employ more skilled labor force, then the skill upgrading decreases as a high share of FDI activity is associated with an increase in the demand of unskilled workers given the Italian comparative advantages in unskilled-intensive activities. If that is true a high degree of inward FDI will completely offset the positive impact of intangible assets on skill upgrading. Unfortunately, given the short period of observation (1994-1997) we cannot prove this hypothesis including the square of FDI_{inw} to allow for the inverted-U relationship.

[17] Multiplying the regression coefficients in column (2) by the mean of FDI_{inw} we can see that the investment in intangible assets explain almost 1.62% of the mean of our dependent variable.

[18] Our elaboration on data of: Italia Multinazionale 2000, CNEL

unit of output tends to reduce the skill component of the workforce. This result contrasts with the common result in US data, where capital and skills appear to be complementary, but it is in line with other studies on Italy (Brenton and Pinna 2001; Helg and Tajoli 2003) and on Japan (Head and Ries 2002). The production variable is negative and significant indicating that, as the production scale increases, the wage share decreases fostering unskilled workers.

So far, we have observed how the R&D effort of the two groups of firms considered may affect the relative demand for skills in the overall 3-digit manufacturing sectors. At this point, we are interested in evaluating to what extent the effects of technology effort on skill upgrading are similar across industry. To point out this issue we perform the same econometric approach for low-tech sectors and for high-tech sectors which foreign owned firms and Italian multinationals belong to.
From Table 4 it appears that only the technology effort undertaken in low-tech sectors contributes to increase the skilled labor wage bill share. The results confirm the role of foreign owned firms in explaining Italian skill upgrading. The coefficient on $R\&D_{inw}$, specification (1), is positive and significant and the interaction term is negative and significant. Hence, considering the derivative:

$$\partial SH / \partial R\&D_{inw} = 0.2843-1.9655*FDI_{inw}$$

we obtain a positive value if $FDI_{inw}<0.1446$ and, looking at the mean of this variable in low-tech sectors, we obtain that the R&D effort affects the skill upgrading positively.[19]
From specification (2) we find significant results about the groups of Italian multinationals. The coefficient on the relative amount of investment in intangible assets, INT_{MNEs}, is significant and positive, but the interaction term between this measure of technology and the degree of internationalisation of Italian economy in terms of outward FDI is negative. In addition, if we consider the magnitudes of these coefficients the positive impact of the investment in intangible assets is actually completely offset by outward FDI and the effect turned out to be even negative.[20] This indicates that technological activity performed by multinational firms is biased towards unskilled workers. Once more the results confirm the weak propensity of Italy in investing in technology and support the hypothesis that Italian parents might also localise their skill-intensive activities abroad.

[19] More specifically, the contribution of R&D effort undertaken by foreign owned firms on skill upgrading is almost 6.5%.
[20] The related derivative shows a positive value only if $FDI_{out}<0.0656$.

Regarding the group of foreign owned firms, the coefficient on intangible assets, INT_{inw}, is positive and significant but the interaction term is not significant, therefore we cannot compute the total impact of this technology measure on skill upgrading.

The results for high-tech sectors are presented in specifications (3) and (4). As can be seen, there is no evidence of skill upgrading transmitted through technology effort undertaken both by foreign owned firms and Italian parents.

5. Concluding remarks

In this study we have used industry-level data for Italy to study whether the R&D effort undertaken by two particular groups of firms is a possible explanation of skill upgrading. We argue that foreign owned firms and Italian multinational firms might contribute to increase the wage bill share through the technology effort performed.

Based on data from 1994 to 1997, we are able to draw some conclusions. Firstly, we find evidence of a positive relationship between R&D and skill composition of Italian labor force but only for the group of foreign owned firms. This result is also confirmed using the investment in intangible assets as alternative measure of technology. However, the empirical evidence shows that the positive impact might be offset if the share of inward FDI increases over a certain threshold.

Secondly, the same analysis conducted for low and high-tech sectors reveals significant results but only in low-tech sectors and for the technology effort undertaken by foreign owned firms. We do not find evidence of a role played by each of the two groups of firms in explaining skill upgrading in high-tech sectors.

One possible explanation for this difference in results is that Italian economy is not characterised by high investment in technology. Thus, the Italian MNEs might be more boosted to delocalise their skilled-intensive activities abroad to take advantage of the higher technological effort undertaken in other developed counties. On the other hand, the R&D effort performed by the group of foreign owned firms seems biased towards skilled labor force especially in low-tech sectors where Italy is likely to have comparative advantages and in which probably it is worth investing in R&D.

The results, therefore, seem to give some support to the belief that a different organisation of the labor force exist, e.g. in terms of need of new tasks, within the two group of firms considered, and this finding confirms the need of further analyses in this direction.

References

- Autor D.H., Katz L.F., 1999. Changes in the Wage Structure and Earnings Inequality. *Handbook of Labor Economics* 3, 1463-1555.
- Autor D.H., Katz L.F., Krueger A.B., 1998. Computing Inequality: Have Computers Changed the Labor Market? *The Quarterly Journal of Economics*, 1169-1213.
- Aitken B., Harrison A., Lipsey R.E., 1996. Wages and Foreign Ownership. A Comparative Study of Mexico, Venezuela, and the United States. *Journal of International Economics* 40, 345-371.
- Barba Navaretti G., Bruno G., Castellani D., Falzoni A.M., 2002. Does Investing Abroad Create or Destroy Jobs at Home? The Case Of Italian Outward FDI. mimeo
- Bartel A.P., Sicherman N., 1999. Technological Change and Wages: An Interindustry Analyses. *The Journal of Political Economy* 107(2), 285-325.
- Berman E., Bound J., Griliches S., 1994. Changes in the Demand for Skilled Labor Within U.S. Manufacturing: Evidence from the Annual Survey of Manufacturers. *Quarterly Journal of Economics* 109(2), 367-397
- Berman E., Bound J., Machin S., 1998. Implication of Skill-Biased Technological Change: International Evidence. *The Quarterly Journal of Economics*, 1245-1279.
- Berman E., Machin S., 2000. Evidence of Factor Biased Technological Change in Developing Countries.
- Bernard A.B., Bradford Jensen J., 1997. Exporters, Skill Upgrading, and the Wage Gap. *Journal of International Economics* 42, 3-31.
- Berndt E.R., 1991. *The Practice of Econometrics: Classic and Contemporary*. Addison-Wesley Publishing Company.
- Blomstrom M., Fors G., Lipsey R.E., 1997. Foreign Direct Investment and Employment: Home Country Experience in the United States and Sweden. *The Economic Journal* 107, 1787-1797.
- Blomstrom M., Kokko A., 1994. Home Country Effects of Foreign Direct Investment: Evidence from Sweden. *NBER Working Paper* No.4639.
- Blomstrom M., Kokko A., 2000. Outward Investment, Employment, and Wages in Swedish Multinationals. *Oxford Review of Economic Policy* 16(3), 76-89
- Blonighen B.A., Slaughter M.J., 2001. Foreign-Affiliate Activity and U.S. Skill Upgrading. *The Review of Economics and Statistics* 83(2), 362-376.
- Brainard S.L., Riker D.A., 1997. Are U.S. Multinationals Exporting U.S. Jobs? *NBER Working Paper* No.5958.
- Brenton P., Pinna A.M., 2001. The Decline Use of Unskilled Labour in Italian Manufacturing: Is Trade to Blame? *CEPS Working Document* No.178.
- Butler A., Dueker M.,1999. Does Foreign Innovation Affect Domestic Wage Inequality?. *Journal of International Economics* 47, 61-89.
- Channells L., Van Reenen J. 1999. Has Technology Hurt Less Skilled Workers? *IFS Working Paper* No.27.
- CNEL, 2000. Italia Multinazionale 2000
- Coe D.T., Helpman E., 1995. International R&D Spillovers. *European Economic Review* 39, 859-887.
- Driffield N., Taylor K., 2000. FDI and the Labour Market: A Review of the Evidence and Policy Implications. *Oxford Review of Economic Policy* 16(3), 90-103.
- Faini R., Falzoni A.M., Galeotti M., Helg R., Turrini A., 1999. Importing Jobs and Exporting Firms? On the Wage and Employment Implications of Italian Trade and Foreign Direct Investment Flows. *Giornale degli Economisti e Annali di Economia* 58(1) 95-135.
- Feenstra R.C., Hanson G.H., 1996. Globalization, Outsourcing and Wage Inequality. *The American Economic Review* 86(2), 240-245.
- Feenstra R.C., Hanson G.H., 1997. Foreign Direct Investment and Relative Wages: Evidence From Mexico's Maquiladoras. *Journal of International Economics* 42, 3371-393.
- Feenstra R.C., Hanson G.H., 2001. Global Production Sharing and Rising Inequality: A Survey of Trade and Wages. *NBER Working Paper* No. 8372
- Figini P., Gorg H., 1999. Multinational Companies and Wage Inequality in the Host Country: The Case of Ireland. *Weltwirtschafliches Archiv* 135(4), 594-612
- Goldin C., Katz L.F., 1996.Technology, Skill and the Wage Structure: Insight from the Past. *The American Economic Review* 82(2) 252-257.
- Gorg H., Strobl E., Relative Wages, Openness and Skill-Biased Technological Change in Ghana. *CREDIT Research Paper* , University of Nottingham, No.18
- Gorg H., Greenaway D., 2002. Much Ado About Nothing? Do Domestic Firms Really Benefit from Foreign Direct Investment. Mimeo.
- Hansson Par, 2000. Relative Demand for Skills in Swedish Manufacturing: Technology of Trade?. *Review of International Economics*, 8(3), 533-555
- Haskel J., Heden Y., 1999. Computers and the Demand for Skilled Labour: Industry- And Establishment-Level Panel Evidence For The UK. *The Economic Journal* 109, C68-C79.

- Head K., Ries J., 2002. Offshore Production and Skill Upgrading by Japanese Manufacturing Firms. *Journal of International Economics* 58, 81-105.
- Ichino A., 2001. Topics in Micro-Econometrics. Mimeo, European University Institute.
- Johnson G.E., 1997. Change in Earnings Inequality: the Role of Demand Shifts. *Journal of Economic Perspective* 11(2), 41-54.
- Machin S., Van Reenen J., 1998. Technology and Changes in Skill Structure: Evidence From Seven OECD Countries. *The Quarterly Journal of Economics*, 1215-1244.
- Manasse P., Stanca L., Turrini A., 2003. Wage Premia and Skill Upgrading in Italy: Why didn't the Hound Bark? Mimeo.
- Manasse P., Stanca L., 2003. Working on the Train: Technology, Trade, and Wages in Italian Manufacturing. Mimeo.
- Mariotti S., Mutinelli M., Piscitello L., 2003. Home Country Employment and Foreign Direct Investment: Evidence form the Italian Case. *Cambridge Journal of Economics* 27, 419-431
- Markusen J.R., 1995. The Boundaries of Multinational Enterprises and the Theory of International Trade. *Journal of Economic Perspective* 9(2), 169-189.
- Markusen J.R., 1998. Multinational Firms, Location and Trade. *The World Economy* 21(6), 733-757.
- Markusen J. R. 2002 *Multinational Firms and the Theory of International Trade*. MIT Press.
- Parisi M.L., Schiantarelli F., Sembenelli A., 2002. Productivity, Innovation Creation and Absorption, and R&D: Micro Evidence for Italy. Mimeo.
- Peneder Michael, 1999, Intangible investment and human resources. The new WIFO taxonomy of manufacturing industries. *WIFO Working Paper* No. 114.
- Piva M., Vivarelli M., 2002. The Skill Bias: Comparative Evidence and an Econometric Test. *International Review of Applied Economics* 16(3).
- Piva M., Vivarelli M., 2003. Innovation and Employment: Evidence from Italian Microdata. *IZA DiscussionPaper* No. 730.
- Slaughter, M.J., 2000. Production Transfer Within Multinational Enterprises and American Wages. *Journal of International Economics* 50, 449-471.
- Van Pottelsberghe de la Potterie B., Lichtenberg F., 2001. Does Foreign Direct Investment Transfer Technology Across Borders? *The Review of Economics and Statistics* 83(3), 490-497

Table 1 *Wage Share and Employment Share in 2-digit Sector - Descriptive Statistics*

	Low-high tech sector	Wage share 1994	Wage share 1997	Variation (wage share 97 - wage share 94) / wage share 94	Empl. share 1994	Empl. share 1997	Variation (empl. share 97 - empl.share94) / empl. share 94	Relative wage 1994	Relative wage 1997	Variation (relative wage 97-relative wage94) / relative wage 94
15 Food & Drink	0	0.3927	0.3857	-0.0177	0.2898	0.2813	-0.0292	1.5849	1.6043	0.0122
16 Tobacco	0	0.3047	0.3448	0.1315	0.2624	0.2918	0.1117	1.2317	1.2775	0.0372
17 Textile	0	0.2864	0.3054	0.0666	0.1963	0.2089	0.0644	1.6430	1.6648	0.0133
18 Apparel products	0	0.2788	0.3192	0.1449	0.1683	0.1822	0.0824	1.9103	2.1046	0.1017
19 Luggage, leatherwear & Footwear	0	0.2032	0.2168	0.0666	0.1336	0.1312	-0.0186	1.6535	1.8335	0.1088
20 Wood & cork	0	0.2236	0.2624	0.1737	0.1663	0.1904	0.1447	1.4435	1.5130	0.0482
21 Paper & pulp	0	0.3108	0.3331	0.0720	0.2299	0.2292	-0.0029	1.5107	1.6799	0.1120
22 Printing & Publishing	0	0.5781	0.5887	0.0183	0.4569	0.4572	0.0007	1.6285	1.6990	0.0433
23 Coke & Petroleum	1	0.6083	0.6681	0.0985	0.5712	0.5857	0.0253	1.1657	1.4246	0.2221
24 Basic & other chemicals	1	0.6622	0.6658	0.0054	0.5519	0.5551	0.0058	1.5918	1.5970	0.0033
25 Rubber & plastic product	0	0.3375	0.3144	-0.0682	0.2350	0.2183	-0.0710	1.6570	1.6414	-0.0094
26 Non metallic mineral products	0	0.3076	0.3274	0.0646	0.2322	0. 2393	0.0303	1.4685	1.5479	0.0540
27 Metal production	0	0.2811	0.3017	0.0734	0.2286	0.2260	-0.0112	1.3194	1.4796	0.1214
28 Metal products	0	0.2843	0.2854	0.0040	0.2124	0.2079	-0.0208	1.4731	1.5213	0.0327
29 Non electrical machinery	1	0.4449	0.4375	-0.0167	0.3446	0.3369	-0.0224	1.5248	1.5311	0.0041
30 Office machinery & computers	1	0.7550	0.7781	0.0306	0.6582	0.6618	0.0055	1.6007	1.7925	0.1198
31 Electrical machines	1	0.4313	0.4372	0.0137	0.3226	0.3240	0.0043	1.5926	1.6210	0.0178
32 Radio, TV & communication equipment	1	0.6244	0.6287	0.0069	0.5067	0.5009	-0.0113	1.6185	1.6870	0.0423
33 Precision instruments	1	0.6335	0.6295	-0.0062	0.5008	0.4851	-0.0313	1.7230	1.8037	0.0468
34 Motor vehicles	1	0.3321	0.3301	-0.0060	0.2274	0.2205	-0.0301	1.6895	1.7418	0.0309
35 Other transport	1	0.4550	0.4492	-0.0128	0.3494	0.3490	-0.0012	1.5546	1.5213	-0.0214
36 Other manufacturing	0	0.2886	0.3109	0.0772	0.2173	0.2271	0.0452	1.4614	1.5354	0.0507
37 Recycling	0	0.2981	0.4130	0.3855	0.2163	0.2688	0.2425	1.5388	1.9145	0.2442

Low-high tech sector = 0 means low tech sector; Low-high tech sector = 1 means high tech sector
Wage Share = skilled workers wage bill over total wage bill of the sector
Employment Share = skilled workers over total workers of the sector
Relative Wage = average wage of skilled workers over average wage of unskilled workers

Table 2 *Descriptive Statistics*

		Low-tech sectors	High-tech sectors
	Mean (standard deviation)	Mean (Standard deviation)	Mean (Standard deviation)
Wage Share	0.3908 (0.1492)	0.3379 (0.1140)	0.4774 (0.1595)
Employment Share	0.3000 (0.1411)	0.2531 (0.1078)	0.3768 (0.1554)
Relative Wage	1.6077 (0.2660)	1.5983 (0.3167)	1.6229 (0.1495)
FDI_{inw}	0.1672 (0.1756)	0.1113 (0.1273)	0.2511 (0.2031)
FDI_{out}	0.1391 (0.3487)	0.0948 (0.2088)	0.2034 (0.4777)
$R\&D_{inw}$	0.0099 (0.0324)	0.0100 (0.0401)	0.0098 (0.0153)
$R\&D_{MNEs}$	0.0100 (0.0184)	0.0080 (0.0150)	0.0130 (0.0222)
INT_{inw}	0.1461 (0.1695)	0.1314 (0.1793)	0.1678 (0.1520)
INT_{MNEs}	0.1097 (0.1410)	0.1028 (0.1442)	0.1197 (0.1360)

FDI_{inw} = Employment of the group of foreign owned firms in the sector over Total Employment of the sector
FDI_{MNEs} = Employment of foreign subsidiaries of the group of Italian multinational firms in the sector over Total Employment of the sector
$R\&D_{inw}$ = R&D+Patent over Total Assets of the group of foreign owned firms in the sector
$R\&D_{MNEs}$ = R&D+Patent over Total Assets of the group of Italian multinational firms in the sector
INT_{inw} = Intangible Assets over Total Assets of the group of foreign owned firms in the sector
INT_{MNEs} = Intangible Assets over Total Assets of the group of Italian multinational firms in the sector

Table 3

Skill upgrading in Italian manufacturing sectors, 1994-1997
Foreign Owned Firms and Italian Multinational Firms
Dependent Variable: Wage Share

Method	Fixed Effects	Fixed Effects
Specifications	(1)	(2)
Constant	0.5998***	0.5988***
	(0.1548)	(0.1564)
$\ln(W^s/W^{us})$	0.0659***	0.0661***
	(0.0127)	(0.0128)
lnY	-0.0179*	-0.0183*
	(0.0109)	(0.011)
lnK/Y	-0.0126**	-0.0131**
	(0.0054)	(0.0054)
$R\&D_{inw}$	0.2295***	
	(0.0702)	
$R\&D_{inw}*FDI_{inw}$	-0.5957	
	(0.4157)	
$R\&D_{MNEs}$	-0.1753	
	(0.1091)	
$R\&D_{MNEs}*FDI_{out}$	0.1941	
	(0.869)	
INT_{nw}		0.0712***
		(0.0217)
$INT_{inw}*FDI_{inw}$		-0.3289***
		(0.111)
INT_{MNE}		-0.0004
		(0.0198)
$INT_{MNEs}*FDI_{out}$		-0.0243
		(0.1808)
FDI_{inw}	0.0128	0.0527**
	(0.0236)	(0.0267)
FDI_{out}	-0.0507**	-0.0463**
	(0.0257)	(0.0234)
Time dummies	Yes	Yes
N.obs	312	312
R^2	0.24	0.24

Standard errors in brackets. ***,** and * denote significance at 1%, 5% and 10% level.

Table 4

Skill upgrading in Italian manufacturing sectors, 1994-1997
Foreign Owned Firms and Italian Multinational Firms
Dependent Variable: Wage Share

	LOW SECTOR		*HIGH SECTOR*	
Method Specifications	Fixed Effects (1)	Fixed Effects (2)	Fixed Effects (3)	Fixed Effects (4)
Constant	0.5363**	0.3712	0.5586***	0.5180**
	(0.2390)	(0.2364)	(0.1961)	(0.1987)
$\ln(W^s/W^{us})$	0.0358***	0.0352***	0.2166***	0.2298***
	(0.0125)	(0.0123)	(0.0332)	(0.0338)
LnY	-0.0162	-0.0059	-0.0134	-0.0115
	(0.0168)	(0.0164)	(0.0135)	(0.0137)
LnK/Y	-0.0091	-0.0099	-0.0141**	-0.0116*
	(0.0097)	(0.0095)	(0.0065)	(0.0065)
$Tech_{inw}$	0.2843**		-0.5755	
	(0.1156)		(0.4077)	
$Tech_{inw}*FDI_{inw}$	-1.9655*		1.016	
	(1.0533)		(0.7403)	
$Tech_{MNEs}$	0.2627		-0.1621	
	(0.2008)		(0.144)	
$Tech_{MNEs}*FDI_{out}$	-0.3187		0.2892	
	(1.2983)		(1.2439)	
$Intangible_{nw}$		0.0994***		-0.0036
		(0.0312)		(0.0347)
$Intangible_{inw}*FDI_{inw}$		-0.4132		-0.1369
		(0.3146)		(0.1379)
$Intangible_{MNE}$		0.0514*		-0.0368
		(0.0300)		(0.0274)
$Intangible_{MNEs}*FDI_{out}$		-0.7840**		0.3752
		(0.3301)		(0.2796)
FDI_{inw}	0.0541	0.071**	-0.0181	0.0267
	(0.0342)	(0.0345)	(0.0305)	(0.0365)
FDI_{out}	-0.0375	0.082	-0.0465	-0.0477*
	(0.0582)	(0.0673)	(0.0293)	(0.0267)
Time dummies	Yes	Yes	Yes	Yes
N.obs	175	175	137	137
R^2	0.33	0.35	0.42	0.42

Standard errors in brackets. ***,** and * denote significance at 1%, 5% and 10% level.