E C O N O M I C S B U L L E T I N

The skill bias in Italy: a first report

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Abstract

In this study three possible determinants of the increased demand for skilled workers are tested using a panel of 412 Italian manufacturing firms over the period 1989−1997. The results suggest the statistical significance of the impact of organisational change, while they tend to exclude the roles of RDspending and foreign direct investment.

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1. Introduction

The debate regarding the skill bias developed fully in the United States in the early '90s. At first, researchers tended to identify the spread of new technologies as the main cause of the increase in the ratio between skilled and unskilled workers. The hypothesis is that R&D expenditure is complementary to the skilled workers, while it tends to make the less skilled redundant. The *skill biased technological change* (SBTC) hypothesis has been supported by many empirical tests regarding the manufacturing sectors in the US and the UK (see Berman *et al*. 1994, Betts 1997, Autor *et al.* 1998, Machin and Van Reenen 1998, and Adams 1999).

In recent years - partly due to less unequivocal empirical results (see Doms *et al*. 1997 and Mairesse *et al*. 2001) - two further possible explanations for the skill bias have been put forward. The first is based on the fact that trade flows and foreign direct investment (FDI) result in a relocating of production which is less intensive in terms of skilled labour to the less developed countries, and a specialisation by industrialised countries in sectors which are more intensive in terms of skilled labour (see Wood 1994, Feenstra and Hanson 1996, and Markusen and Venables 1996). The second tends to underline the importance of firm's organisational change (sometimes, but not always, linked to technological change), which results in a reduction in unskilled labour and an increase in skilled labour (see Aghion *et al.* 1999, Bresnahan *et al.* 2001, and Caroli and Van Reenen 2001).

Our contribution to the understanding of the problem – based on data and methodology presented in Section 2 – is an attempt to answer the following question. In a technologically-intermediate country such as Italy, is the hypothesis which identifies R&D as the main cause for skill upgrading still valid? In Section 3 we shall discuss the results of the empirical analysis carried out, and in the final section we shall attempt to provide some preliminary conclusions.

2. Data and methodology

The data used come from the investment bank Mediocredito Centrale (MCC) and are based on the results of three questionnaire waves (1989-91; 1992-94; 1995-97) carried out over a representative sample of Italian manufacturing firms; the panel comprises 412 firms, which represent approx. 160,000 employees in 1997.

Following Berman *et al*. (1994) and Machin and Van Reenen (1998), the method used is based on the estimation of a restricted function of total variable cost which is given only by the cost of labour (the only variable factors of production are the two categories of workers) while capital and technology are assumed to be quasi fixed factors for firm *i*:

$$LC_i = f\left(Y_i, K_i, w_{ij}, R\,\&\,D_i\right) \tag{1}$$

where: LC = labour cost; f = translog functional form; Y = output; K = capital; w_j = wage for the j_{th} category of workers (in our case j = 2: WC = white collars, i.e. non manuals and BC = blue collars, i.e. manuals); $R\&D$ = research and development.

Taken all the variables in logarithms, we make use of the minimisation of costs and the implementation of Shephard's lemma and at time *t* we obtain:

$$s_i = \frac{\partial \ln LC_i}{\partial \ln w_{i,WC}} = \varphi_i + \alpha \ln(Y_i) + \beta \ln(K_i) + \gamma \ln(w_{i,WC} / w_{i,BC}) + \delta \ln(R\,\&\,D_i) \tag{2}$$

where s_i represents the share of labour cost of white collars.

To eliminate the φ_i, fixed effects, we proceed to differencing (Δ) with a random error term (u) and the following stochastic form is obtained:

$$\Delta s_i = \alpha \Delta ln(Y_i) + \beta \Delta ln(K_i) + \gamma \Delta ln(w_{i,WC} / w_{i,BC}) + \delta \Delta ln(R\,\&\,D_i) + u_i \qquad (3)$$

In this specification, the relative wage variable entails a risk of endogeneity - due to its collinearity with the dependent variable - and it is generally eliminated or instrumented (see Machin and Van Reenen 1998). However, the specification proposed in (3) can be translated in terms of employment and in this case the dependent variable can be measured either as the ratio of white collars (WC) to total workers or the ratio of white collars (WC) to blue collars (BC) (Hamermesh 1993, and Berman *et al*. 1994). One of the advantages of this alternative specification is that it is not necessary to instrument the wage variable.

Starting from the general specification (3) with WC/BC as dependent variable, we used a Seemingly Unrelated Regression (SUR) method testing jointly two equations: one for the white collars and one for the blue collars. This method is based on the assumption that the right-hand part of the equation is independent of the error term, that the errors are crossed and that the method therefore guarantees greater efficiency compared with an OLS estimation of the single equations (see Betts 1997 and Adams 1999). Both the equations are expressed in long differences, in order to avoid any further problem of endogeneity (a possible problem of endogeneity is based on the consideration that only the firms which already have skilled workers see the potential for innovative investment). The SUR estimate is thus based on the following system (4):

$$\begin{cases} \Delta ln WC_{it} = C + \alpha \Delta ln(Y_{it}) + \beta \Delta ln(K_{it}) + \gamma \Delta ln(w_{WC})_{it} + \delta R\,\&\,D_{i,t-1} + \lambda FDI_{i,t-1} + \vartheta ORG_{i,t-1} + u_{it} \\ \Delta ln\, BC_{it} = \overline{C} + \overline{\alpha} \Delta ln(Y_{it}) + \overline{\beta} \Delta ln(K_{it}) + \overline{\gamma} \Delta ln(w_{BC})_{it} + \overline{\delta} R\,\&\,D_{i,t-1} + \overline{\lambda} FDI_{i,t-1} + \overline{\vartheta} ORG_{i,t-1} + v_{it} \end{cases} \qquad (4)$$

where: C = constant; t = 1991-97 interval; t-1= 1989-91 interval; Δ represents the long difference (1991-97) for the dependent variables *WC* (white collar employees) and *BC* (blue collar employees), for turnover *Y*, for capital *K* and for wages *w*, while *R&D*, *FDI* and *ORG* represent respectively the dummies of technological innovation, foreign direct investment and reorganisation during the period 1989-91[1].

Once the adopted specification has been defined, we can now return to the empirical definition of the variables used. *WC* and *BC* are the number of non manual and manual employees respectively. All the variables in values have been deflated and expressed according to 1990 prices. Capital, *K*, has been derived from the balance sheet item "net technical assets",

[1] The choice of 1991 as the first year of the second period is due to increased amount and reliability of data compared with corresponding data for 1992; in fact, the first survey was carried out in 1991, while 1992 is retrospective in the second survey - carried out in 1994 - and thus there is more data missing and the available data are less reliable (however, the presence of a year's overlap in long differences estimates is fairly common, see Caroli and Van Reenen 2001).

Note that the lack of quantitative data for the main determinants R&D, FDI and ORG preclude the possibility to carry out different kinds of panel analysis such as GMM estimates.

while production, *Y*, has been quantified in terms of turnover. The average annual wages for WC and BC workers, not being provided by the MCC database, have been proxied by using the INPS (Italian National Institute for Social Security) database[2]. The three possible determinants of the skill bias are represented in the estimates by three dummies which indicate the presence or absence – during the first three years of the examined period – of *R&D* expenditure, firm's organisational changes (*ORG*), and *FDI*.

3. Results

In all the proposed estimates three sector fixed effects have been included (sectors with high, medium and low technology, according to OECD 1998), as have 5 size fixed effects (11-20; 21-50; 51-250; 251-500; >500 employees) and 2 fixed effects related to the declared takeovers or breakups (TB) in the period 1991-97[3].

Table 1 gives the results of three SUR estimates in which first all the three possible determinants of skill bias are given, and then the less-statistically significant ones are dropped. The third column of each estimate shows the tests for significance of the difference in the two estimated coefficients, while the last row gives the result of the independence test for the two equations which make up the system (in all cases the test rejects the independence hypothesis, confirming the benefits of using the SUR method).

Not surprisingly, turnover, capital and wages have the expected signs and are statistically significant (note the greater disincentive effect of wage increases on the labour demand for skilled workers). However, what is more interesting for our aims is the confirmation of the fundamental role of the organisational variable, while the supposed roles of *R&D* and *FDI* in determining the skill bias do not seem to be confirmed.

More precisely, the *ORG* variable has a positive (but not significant) impact on the use of skilled labour, and a higher, very significant negative impact on the use of unskilled labour. As further proof of the robust nature of this result, the test of the difference of the two coefficients is statistically significant in all the three cases.

If with reference to the *R&D* variable no indication of its possible role in determining skill bias emerges, the case is different for the *FDI* variable. The relative coefficient for this latter determinant is positive (and barely significant) in the equations regarding white collar

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[2] The calculation of wages was rather complex, because it was impossible to find a common firm-identifying code in the two databases. The INPS database was used to single out two categories of workers (WC and BC), the average wage for each category and the wage dispersion index; this index has been applied to the MCC firms in the same time/size/area/sector cells.

[3] Takeovers and breakups may imply obvious discontinuities in employment trends; in order to get rid of unreliable data, the following procedure has been applied. Firms subject to breakup and characterised by the following employment trend: $occu_T < \frac{\sum_{t=1989}^{T} occu_t}{T-1989} - Std.Dev.$ and firms subject to takeover and characterised by the following trend: $occu_T > \frac{\sum_{t=1989}^{T} occu_t}{T-1989} + Std.Dev.$ were dropped from the original MCC database; *occu* indicates employment, while *T* indicates the final year of the three years during which the takeover or breakup was declared.

workers and negative (but not significant) in the equations regarding blue collar workers. This result– though of limited statistical significance – encourages further research in this area.

4. Conclusions

From the evidence gathered, the supposed link between *R&D* expenditure and the skill bias does not seem to be confirmed. This result does not mean that Italian manufacturing is immune to the SBTC; however, this probably does not take place mainly through internal channels – i.e. in-house innovation resulting from *R&D* expenditure – but through organisational changes connected with the purchase and use of new technology. It is interesting to note how this link is based not so much on the complementary nature of reorganisation and skilled labour, but rather on savings in unskilled labour obtained through firm's reorganisation.

To summarise, an interpretative hypothesis could be proposed that distinguishes between the leader countries committed to internal innovation (especially product innovation) with intensive use of skilled labour, and the technologically-intermediate countries more committed to embodied technical change (especially process innovation) linked with organisational changes aimed at saving on unskilled labour.

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Table 1: SUR estimates of the variation in the two employment components (WC and BC) between 1997 and 1991

	(1) dlWC	(2) dlBC	$\chi^2(1)$ coef. dif.	(3) dlWC	(4) dlBC	$\chi^2(1)$ coef. dif.	(5) dlWC	(6) dlBC	$\chi^2(1)$ coef. dif.
Constant	-0.17	0.20		-0.11	0.21		-0.09	0.21	
	(1.64)	(2.18)**		(1.19)	(2.21)**		(1.13)	(2.20)**	
Turnover	0.40	0.42	0.04	0.40	0.42	0.03	0.40	0.42	0.04
	(6.32)***	(6.66)***		(6.29)***	(6.67)***		(6.31)***	(6.67)***	
Capital	0.08	0.11	0.14	0.08	0.11	0.15	0.08	0.11	0.13
	(2.13)**	(2.74)***		(2.14)**	(2.74)***		(2.16)**	(2.74)***	
Wages	-0.67	-0.31	7.46***	-0.67	-0.31	7.52***	-0.69	-0.31	8.41***
	(8.69)***	(3.89)***		(8.71)***	(3.89)***		(8.94)***	(3.88)***	
R&D	-0.03	-0.002	0.13						
	(0.64)	(0.03)							
FDI	0.14	-0.03	1.76	0.136	-0.03	1.67			
	(1.84)*	(0.42)		(1.78)*	(0.43)				
ORG	0.05	-0.12	4.55**	0.05	-0.12	4.44**	0.06	-0.12	4.97**
	(1.10)	(2.52)**		(1.03)	(2.54)**		(1.19)	(2.59)***	
Fixed effects:									
TB (test F)	5.63*	0.38		5.31*	0.39		5.23*	0.39	
Sector (test F)	0.36	0.71		0.69	0.71		0.82	0.67	
Size (test F)	13.38***	8.00**		14.84***	8.03**		13.14***	8.29**	
R^2	0.28	0.18		0.28	0.18		0.27	0.18	
Observations	412	412		412	412		412	412	
Breusch-Pagan's independence test			$\chi^2(1) = 81.6$***			$\chi^2(1) = 81.2$***			$\chi^2(1) = 81.3$***

Notes: 1) Absolute t-statistics in brackets; 2)* significant at 10%; ** significant at 5%; *** significant at 1%; 3) R&D, FDI and ORG refer to the three-year period 1989-91; WC, BC, turnover, capital and wages are all expressed as difference of the logarithm (1997-91) 4) With reference to the fixed effects (TB = takeovers and breakups; Sector = 3 technological categories; Size = 5 size categories) the result of test F is given, regarding the joint significance of the relative dummies.