The Skill Bias Effect of Technological and Organisational Change: Evidence and Policy Implications

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Aim of the Paper

- At the **macroeconomic level**, there has been a shift in the **skill composition** in the **G-7** countries in the last 20 years.

- Potential **explanations** in the literature are:
    - *1) skill-bias technological change (SBTC);*
    - *2) skill-bias organisational change (SBOC);*
    - *3) SBTC + SBOC*.

- What is happening in **Italy**?

Upskilling in the G-7 in the '80s and '90s

Shares (% values) of white-collars in manufacturing employment in the G-7
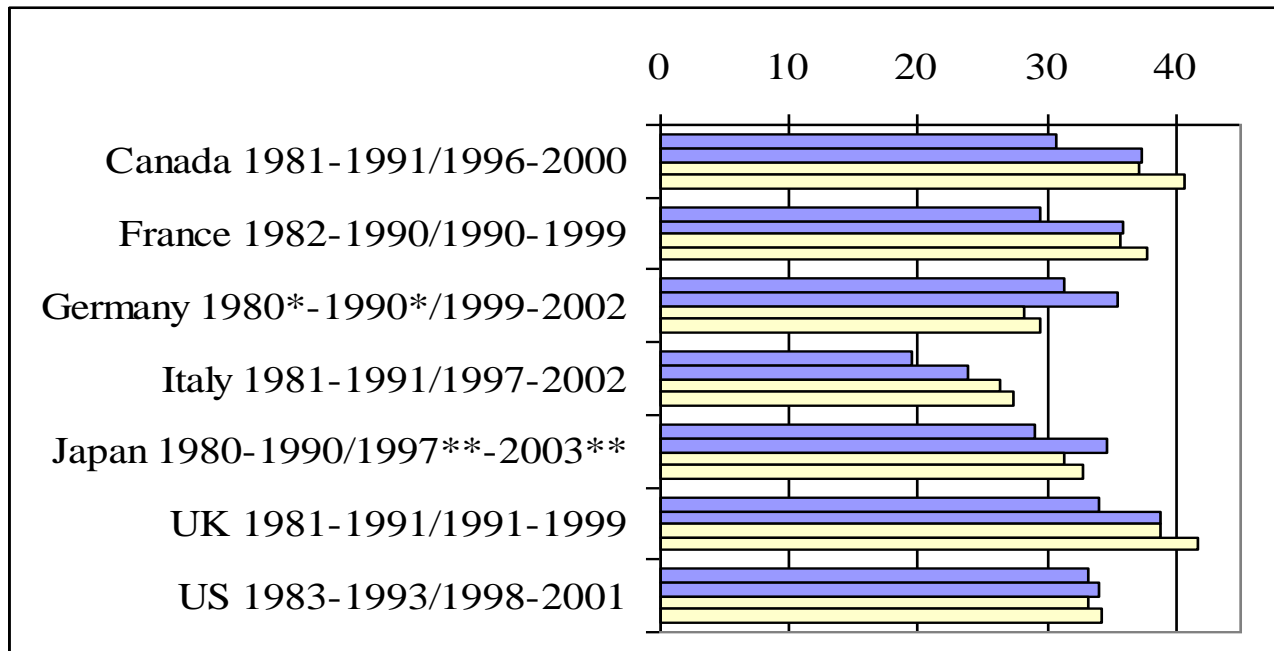
Source: Calculations based on OECD data (1998) for the first two years and on different national sources for the last two years.

The Skill-Biased Technological Change (SBTC) Hypothesis

- The SBTC hypothesis is based on **complementarity** between **new technologies and skilled workers** and **substitutability** between **new technologies and unskilled**.

- **Different proxies** for technology in empirical studies.

- **Empirical evidence supporting SBTC** are found at sectoral and firm-level data analysis especially in *US* (Berman *et al.*, 1994; Doms *et al.*, 1997; Siegel, 1998; Adams, 1999) and *UK* (Machin, 1996).

- **Less robust** results in **European countries** (*France*: Goux-Maurin, 2000; *Spain*: Aguirregabiria-Alonso Borrego, 2001).

The Skill-Biased Organisational Change (SBOC) Hypothesis

- The SBOC hypothesis is based on the idea that **reorganisational processes within firms** play a determinant role in **increasing demand for skilled** (Lindbeck-Snower, 1996).

- Recent *trends* are :
    - *1) decentralization and delayering*
    - *2) collective work*
    - *3) multi tasks*

- Some **empirical analysis support SBOC** at the firm-level especially in **France** (Greenan-Guellec, 1998; Thesmar-Thoenig, 2000; Caroli *et al*., 2001) and **UK** (Caroli-Van Reenen, 2001).

SBTC + SBOC

- A recent strand of the literature tends to emphasize that **technological change**, especially **GPT** (Bresnahan-Trajtenberg, 1995), **and organisational change are complementary** and generate **superadditive effects** (Milgrom-Roberts, 1990 and 1995).

- Recent empirical analyses test - positively - the correlation between **ICTs and organisation strategies** and their impact on the **skill demand** and recruitment strategies (Hitt-Brynjolfsson, 1997; Bresnahan *et al.*, 2002).

Data and Model

- Firm-level data come from **Mediocredito Centrale**. A sample of 400 **manufacturing firms** covering the **1989-1997** period has been used.

- Starting from a translog cost function, it is possible to estimate **two functions** for **two categories** of workers (*white-collars* & *blue-collars*) through **SURE**:

$$\Delta \ln WC_{it} = C + \alpha \Delta \ln Y_{it} + \beta \Delta \ln K_{it} + \gamma \Delta \ln w_{WC,it} + \delta SB_{it-1} + u_{it}$$

$$\Delta \ln BC_{it} = \bar{C} + \bar{\alpha} \Delta \ln Y_{it} + \bar{\beta} \Delta \ln K_{it} + \bar{\gamma} \Delta \ln w_{BC,it} + \bar{\delta} SB_{it-1} + \bar{u}_{it}$$

- *i = 1, …, n; t =1991-1997; t-1 = 1989-1991*
- *WC* = white-collars; *BC* = blue-collars
- *Y* = sales; *K* = capital; *w* = wage
- *SB* = Skill Bias; alternatively equal to *R&D*, *ORG* (organisational change) and *R&D*ORG*
- *u* = usual error term

Table 2: Descriptive statistics

	Sample (1991)	Population (1991)
Observations	400	4,169
Employees (average)	351	310
Sales (average, million Italian lira)	93,989	85,478
R&D (%) 1989-1991	48	36.99
ORG (%) 1989-1991	41.75	37.80
ORG and R&D (%) 1989-1991	23.25	20.24

Table 3: SUR estimates of change in demand for WC and BC between 1997-91

	(1) dlWC	(2) dlBC	(3) dlWC	(4) dlBC	(5) dlWC	(6) dlBC
Constant	0.17 (1.34)	0.12 (1.17)	-0.13* (1.83)	-0.05 (0.64)	0.16 (1.33)	-0.05 (0.64)
Sales	0.32*** (5.79)	0.38*** (6.34)	0.31*** (5.64)	0.39*** (6.58)	0.31*** (5.51)	0.40*** (6.60)
Capital	0.04 (1.11)	0.09** (2.49)	0.04 (1.02)	0.10*** (2.62)	0.04 (1.04)	0.10*** (2.57)
Wages	-0.60*** (6.96)	-0.004 (0.04)	-0.59*** (6.91)	-0.01 (0.15)	-0.59*** (6.88)	-0.01 (0.14)
R&D	0.02 (0.36)	-0.01 (0.19)				
ORG			0.06 (1.46)	-0.08* (1.83)		
ORG*R&D					0.09* (1.78)	-0.10* (1.82)
Takeover/Breakup dummies (Wald test)	5.56*	1.21	5.95*	1.18	5.86*	1.23
Size dummies (Wald test)	25.75**	12.53***	26.20***	10.42**	27.29***	11.21**
Sector dummies (Wald test)	0.53	2.35	0.40	2.58	0.78	1.81
R²	0.23	0.19	0.24	0.20	0.24	0.20
Observations	400	400	400	400	400	400

Table 4: SUR estimates of change in demand for WC and BC between 1997-91 (SHOPFLOOR)

	(1) dlWC	(2) dlBC	(3) dlWC	(4) dlBC
Constant	-0.13* (1.76)	0.13 (1.30)	-0.14* (1.90)	0.12 (0.86)
Sales	0.31*** (5.64)	0.39*** (6.60)	0.30*** (5.45)	0.40*** (6.70)
Capital	0.04 (1.05)	0.10*** (2.60)	0.04 (1.05)	0.10*** (2.58)
Wages	-0.59*** (6.94)	-0.01 (0.12)	-0.59*** (6.91)	-0.01 (0.12)
SHOPFLOOR	0.05 (1.22)	-0.09* (1.91)		
SHOPFLOOR*R&D			0.09* (1.83)	-0.12** (2.20)
Takeover/Breakup dummies (Wald test)	6.12*	1.20	6.04**	1.14
Size dummies (Wald test)	26.18***	14.73***	26.95***	11.15**
Sector dummies (Wald test)	0.42	2.66	0.81	1.88
R^2	0.24	0.20	0.24	0.20
Observations	400	400	400	400

Conclusions

- **Persisting upskilling trend** in manufacturing in the **G-7**.

- Using a sample of 400 **Italian manufacturing firms**, the long-difference econometric analysis shows a **superadditive skill-bias** effect of **reorganisation** (driving explanation) **combined with technological change**.

- **Reorganisational strategies** should be coupled with intervention on **HRM** to **avoid redundancy of blue-collars** and **skill shortage** (Freeman-Soete, 1994).

- Moreover, the **increasing demand** for **multi-skilled workers** calls for a **supply** of **general educational/training** at high/intermediate levels, rather than technical education and vocational training (Bresnahan, 1999).