Innovation and Employment: Evidence from Italian Microdata

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Technology and employment: theory

- At the macroeconomic level, concern about **negative employment impact of technology** is not new (Hobsbawm, 1968).

- The fear comes especially from the **labour-saving** effect of **process innovation** (Ricardo, 1951).

- Some **“compensation mechanisms”** can counterbalance the employment negative impact of technology (Marx, 1961; Vivarelli, 1995).

Technology and employment: empirical evidence (1)

- Empirical literature is developed at **three levels** depending on the **disaggregation of data** (macroeconomic, sectoral and firm level analysis) and using **different proxies** for **technology**.

- Focusing on **firm level analysis**, empirical evidence **cannot capture all** the sectoral and macroeconomic **effects of innovation** (*business stealing*), but fully captures the **direct** labour-saving effect of innovation.

Technology and employment: empirical evidence (2)

- **Previous empirical evidence** at the **firm level** shows a generalised **positive impact** of technology on employment both in *cross-section and panel data* analysis in Germany (Entorf-Pohlmeier, 1990; Smolny, 1998), UK (Blanchflower *et al*. 1991; Van Reenen, 1997), France (Greenan-Guellec, 1996), US (Doms *et al*., 1997), Australia (Blanchflower-Burgess, 1998).

- **Negative** employment **impact** of technology just in the Netherlands (Brouwer *et al*., 1993) and Norway (Klette-Førre, 1998).

Microeconometric analysis on Italian firm level data

- The aim of this analysis is to assess the **microeconometric employment impact of innovation** in **Italy** mainly characterised by **capital-embodied intermediate technologies**.

- Firm level data come from **Mediocredito Centrale**. A **balanced panel** dataset of **575 manufacturing firms** (with no less than 11 employees) covering the **1992-1997** period has been used.

The model (1)

- Starting from a **perfectly competitive firm** maximising profits under a **CES function**:

$$Y = A\left[(\alpha L)^{\rho} + (\beta K)^{\rho}\right]^{1/\rho}$$

- The **stochastic version of labour demand augmented by innovation** (*inn*) can be derived for a panel of firms (*i*) over time (*t*):

$$l_{i,t} = \beta_1 y_{i,t} + \beta_2 w_{i,t} + \beta_3 inn_{i,t} + (\varepsilon_i + \nu_{i,t})$$

where $i = 1, \ldots, n$ and $t = 1, \ldots, T$.

The model (2)

- In order to **introduce dynamic regressors (employment and innovation)** and to **avoid biased and inconsistent estimators**, the **first difference** specification is adopted:

$$\Delta l_{i,t} = \alpha \Delta l_{i,t-1} + \beta_1 \Delta y_{i,t} + \beta_2 \Delta w_{i,t} + \beta_{3,1} \Delta inn_{i,t} + \beta_{3,2} \Delta inn_{i,t-1} + \Delta v_{i,t}$$

- *l* = number of employees
- *y* = sales
- *w* = average wage per employee
- *inn* = value of innovative investments (peculiarities of Italian manufacturing)
- *v* = usual error term

Estimation method

• In order to overcome common problems concerning the **endogeneity of the lagged depend variable** (correlation $\Delta l_{i,t-1}$ and $\Delta v_{i,t}$) and **other potentially endogenous** variables, it is necessary to rely on **instrumental** variables **techniques**: ***GMM-DIF*** and ***GMM-SYS*** (Arellano-Bond, 1991; Blundell-Bond, 1998).

• **GMM-SYS estimate** turns out to be the most **efficient** due to**:**

1) persistence of the dependent variable

2) $(\sigma_\varepsilon)^2 / (\sigma_v)^2$ **large** in short panels

3) Differenced Sargan test

Table 1: Descriptive statistics: 575 Italian manufacturing firms (1992-1997)

	All firms		**Innovators**		**Occasional innovators**		**Non innovators**	
	Mean	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**	**Mean**	**S.D.**
Output	96196	339341	86381	144344	124147	528650	34010	60875
Average output growth (1992-1997)	5.12%	10.21	4.54%	8.23	6.42%	12.87	3.12%	8.35
Employment	271	550	291	567	270	567	132	254
Average employment growth (1992-1997)	2.34%	8.62	2.25%	8.54	2.67%	9.44	1.41%	3.89
Real wage	54.13	18.74	55.22	19.32	53.42	18.65	49.47	13.47
Innovative investments	2351	7755	2989	6628	1892	9762	0	0
Number of firms	575		318		212		45	
Observations	3450		1908		1272		270	

Table 2: Dependent variable: **employment**

	(1) OLS	(2) WITHIN	(3) GMM-SYS
Employment (-1)	0.93*** (0.005)	0.52*** (0.016)	0.86*** (0.040)
Sales	0.06*** (0.004)	0.14*** (0.009)	0.13*** (0.031)
Wages	-0.12*** (0.009)	-0.35*** (0.016)	-0.20*** (0.034)
Innovative investments	0.007*** (0.001)	0.004*** (0.001	0.005** (0.002)
Innovative investments (-1)	-0.003** (0.001)	-0.002* (0.001)	-0.003 (0.002)
Constant	0.11*** (0.035)		0.13 (0.147)
Time dummies	Yes	Yes	Yes
AR(1)			-5.76***
AR(2)			0.28
Sargan test			53.28
Observations	2875	2875	2875

Notes:

In brackets: White robust standard errors;*=10% significant, **=5%significant, ***= 1% significant.

In column (3) lagged employment and sales are considered as endogenous, innovative investments as predetermined, and wages as exogenous.

AR(1) and AR(2) are tests - with distribution N(0,1) - on the serial correlation of residuals.

The Sargan-test has a $\chi^2(43)$ distribution under the null of validity of the instruments.

Overall long-run employment-innovation elasticity turns out to be 0.0143.

Table 3: robustness checks; dependent variable: **employment**

	(1) GMM-SYS	(2) GMM-SYS	(3) GMM-SYS	(4) GMM-SYS
Employment (-1)	0.87*** (0.037)	0.86*** (0.037)	0.86*** (0.039)	0.85*** (0.043)
Sales	0.11** (0.027)	0.12** (0.029)	0.12*** (0.030)	0.13*** (0.032)
Wages	-0.20*** (0.034)	-0.20*** (0.034)	-0.20*** (0.033)	-0.21*** (0.042)
Innovative investments	0.005* (0.002)	0.005* (0.002)	0.005** (0.002)	0.005** (0.002)
Innovative investments (-1)	-0.003 (0.002)	-0.003 (0.002)	-0.003 (0.002)	-0.003 (0.002)
Constant	0.16 (0.159)	0.14 (0.168)	0.19 (0.15)	0.16 (0.166)
Sectoral dummies (13 ATECO sectors)	Yes			
Sectoral dummies (21 ATECO sectors)		Yes		
Area dummies (4 macro-regions)			Yes	
Size dummies (5 classes)				Yes
Time dummies	Yes	Yes	Yes	Yes
AR(1)	-5.67***	-5.70***	-5.75***	-5.91***
AR(2)	0.32	0.32	0.29	0.25
Sargan test	54.59	55.23	55.89*	54.55
Observations	2875	2875	2875	2875

Conclusions

- Using a panal dataset of 575 Italian manufacturing firms, the microeconometric analysis shows a **significant, although small in size, positive** relationship between innovation - measured through **innovative investments - and employment**.
- Innovative investments are not just a proxy of process innovation, but rather a **mark of innovativeness** (complementarity between process and product innovations).
- The job-creating impact of innovation proves **robust** after checking for time, industry, size of firm and geographical fixed effects.
- Results are **consistent with previous studies**, but **cannot** be easily **generalised**.