

# **INNOVATION AND EMPLOYMENT: Recent insights**

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**Innovation and inclusive growth**

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# OLD, CLASSICAL AND CONTROVERSIAL ISSUE (1)

## •NED LUDD AND CAPTAIN SWING

•*“Machines cannot be constructed without considerable labour, which gives occupation to the hands they throw out of employ.”* (Say, 1967, p. 87; first ed. 1803);

### HOWEVER:

*“...the machine can only be employed profitably, if it...is the (annual) product of fewer men than it replaces.”* (Marx, 1969, p. 552; first ed. 1905-1910);

•*“The introduction of machines is found to reduce prices in a surprising manner. And if they have the effect of taking bread from hundreds, formerly employed in performing their simple operations, they have that also of giving bread to thousands.”* (Steuart, 1966, vol. II, p. 256; first ed. 1767);

### HOWEVER:

*“..the increased demand for commodities by some consumers, will be balanced by a cessation of demand on the part of others, namely, the labourers who were superseded by the improvement.”* (Mill, 1976, p.97; first ed. 1848)

## OLD, CLASSICAL AND CONTROVERSIAL ISSUE (2)

•“I have before observed, too, that the increase of net incomes, estimated in commodities, which is always the consequence of improved machinery, will lead to new saving and accumulation” (Ricardo, 1951, vol 1, p. 396; third edition, 1821) ;

### HOWEVER:

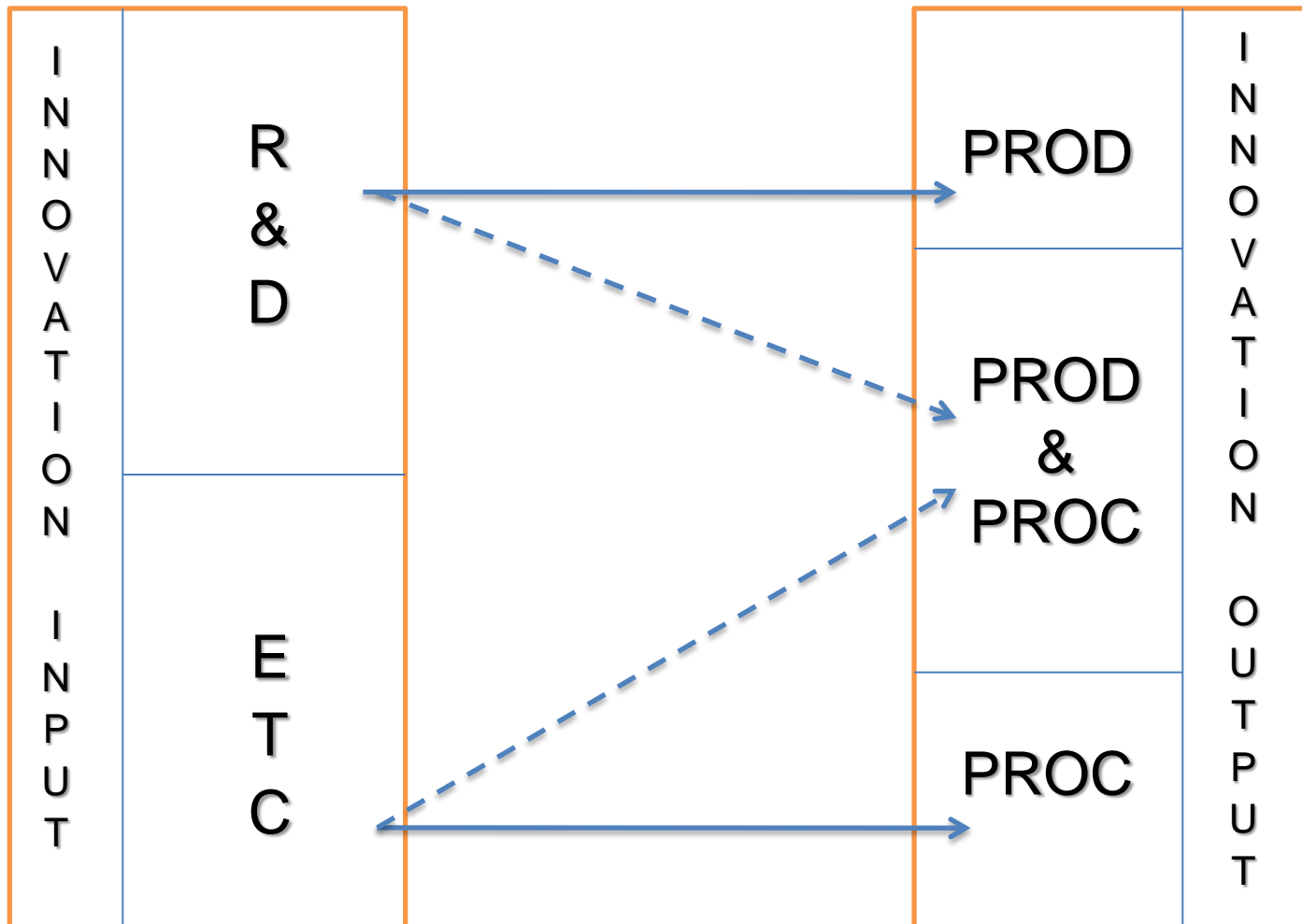
“The accumulation of capital, though originally appearing as its quantitative extension only, is effected, as we have seen, under a progressive qualitative change in its composition, under a constant increase of its constant, at the expense of its variable constituent.” (Marx, 1961, vol. 1; p. 628; first ed. 1867).

•“ Entirely new branches of production, creating new fields of labour, are also formed, as the direct result either of machinery or of the general industrial changes brought about by it.” (Marx, 1961, vol. 1; p. 445 first ed. 1867);

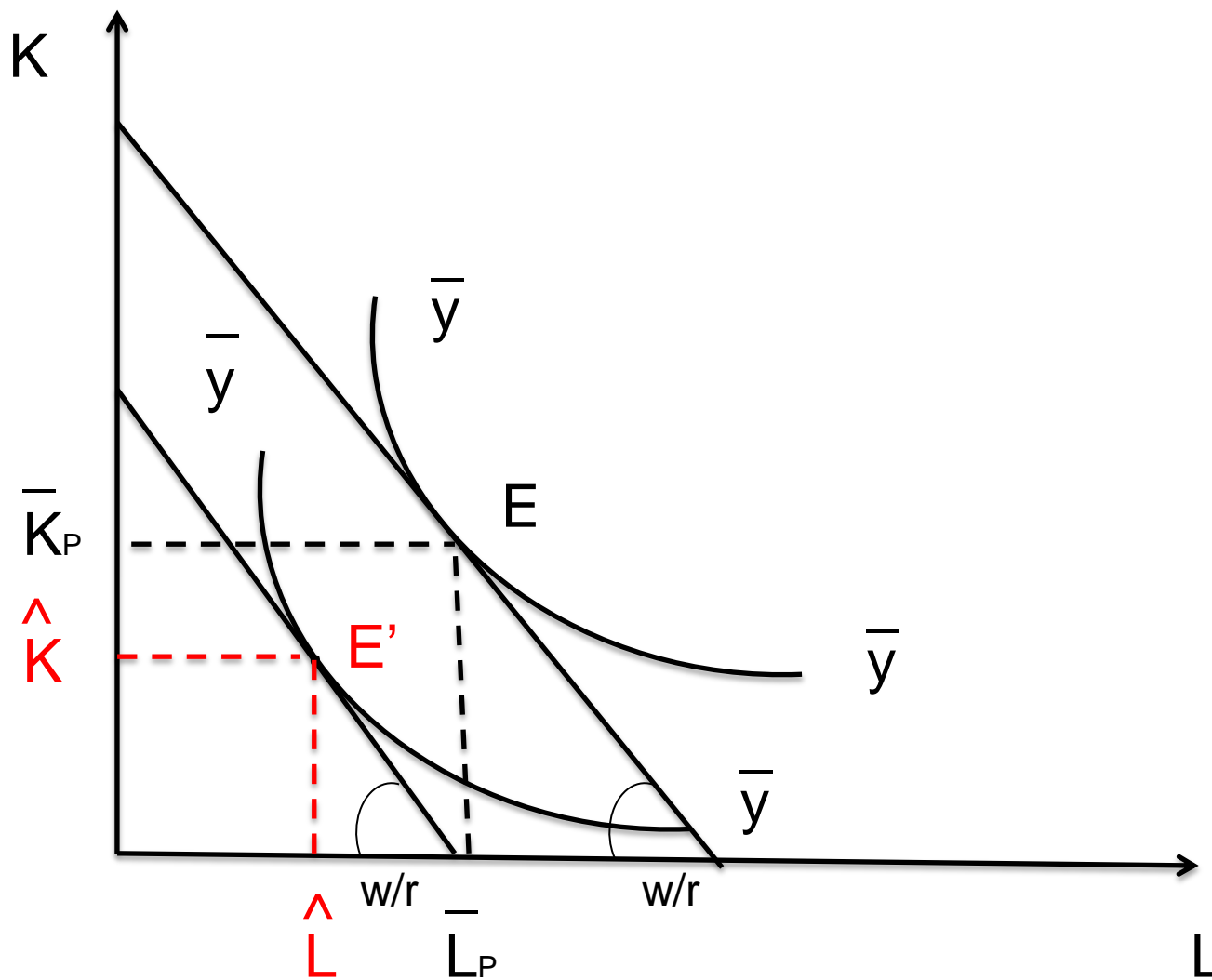
### HOWEVER:

“But the places occupied by these branches in the general production is, even in the most developed countries, far from important” (ibidem).

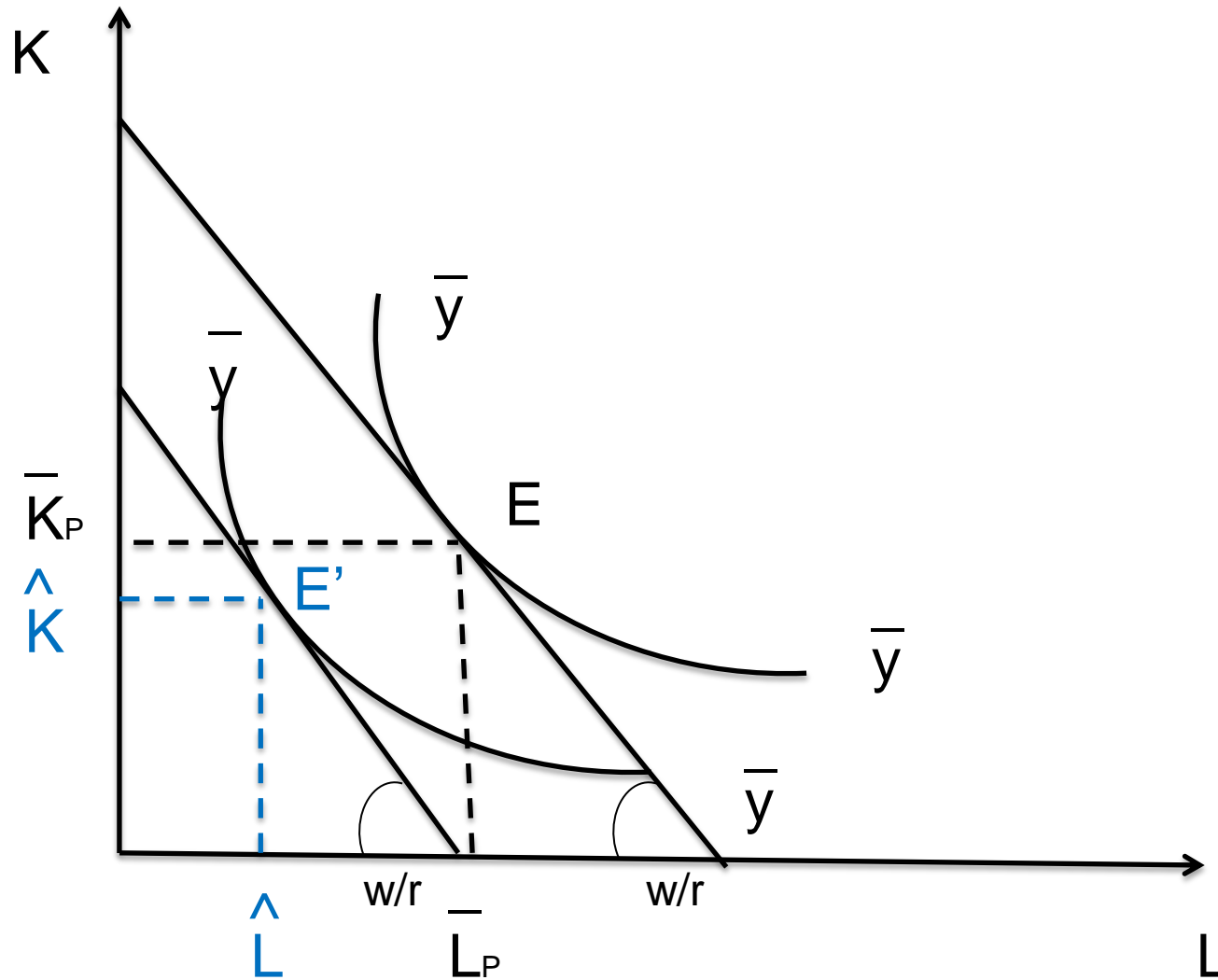
# THE TWO FACES OF INNOVATION



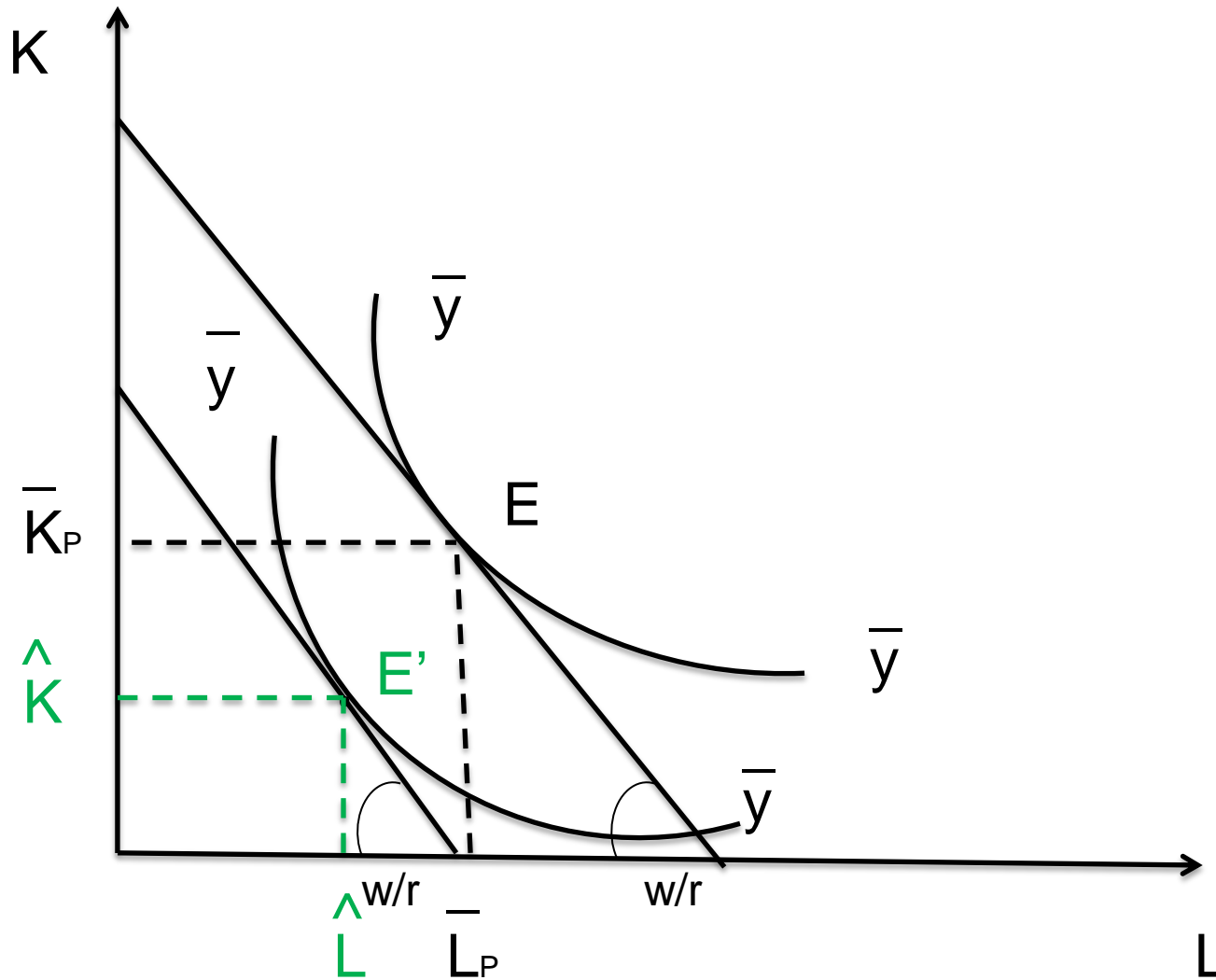
# THE DIRECT EFFECT OF PROCESS INNOVATION



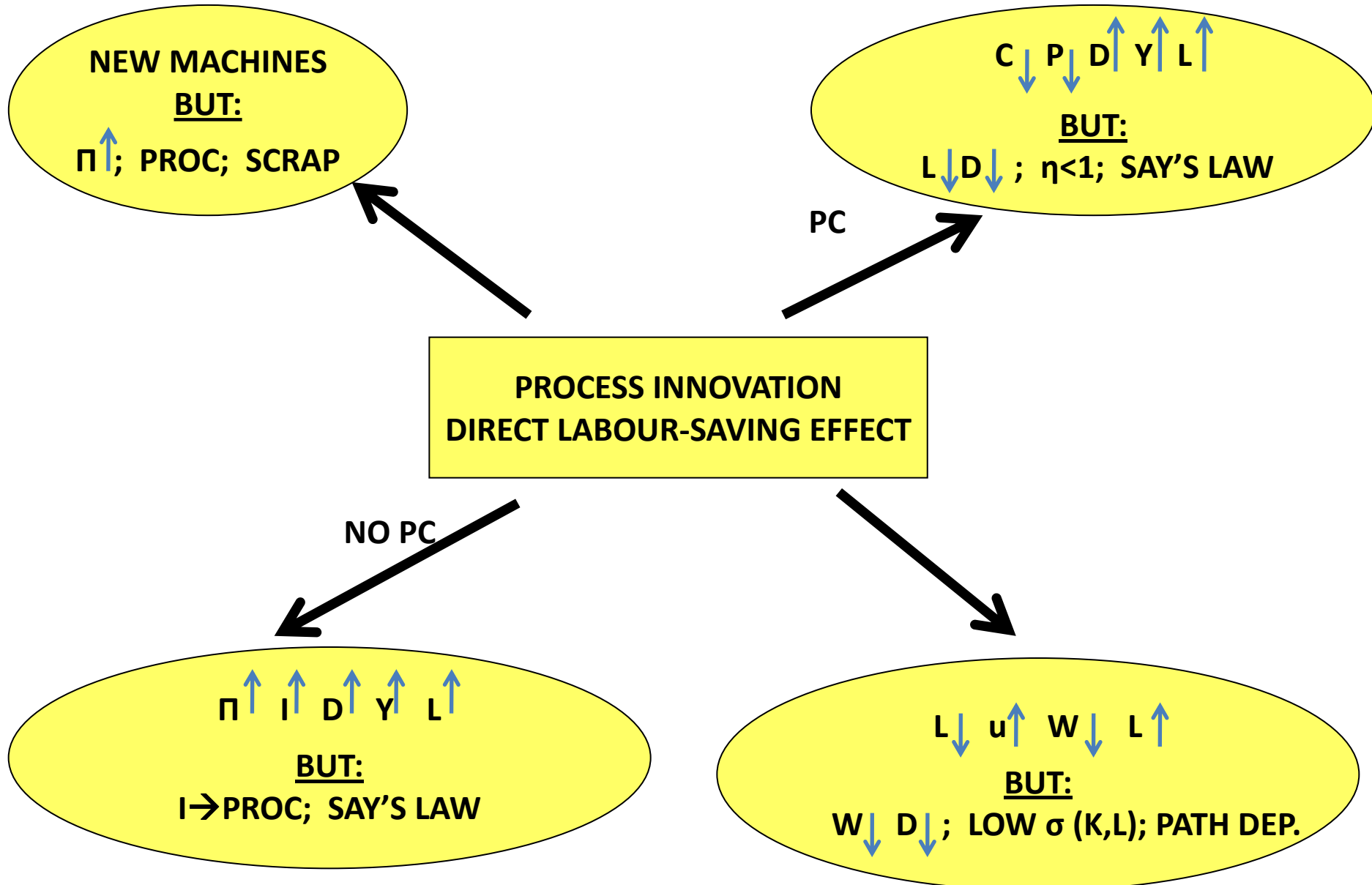
# LABOUR-SAVING INNOVATION



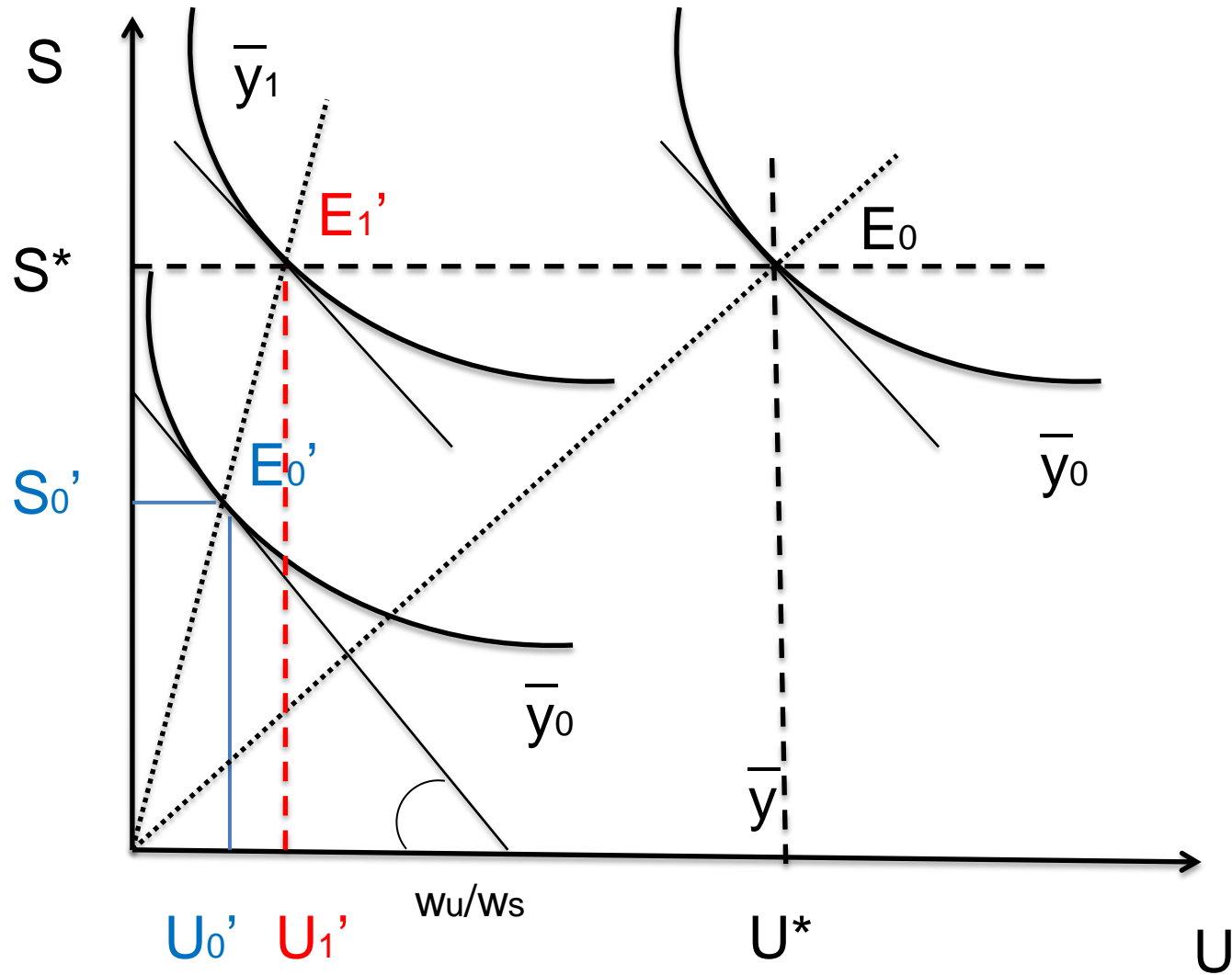
# CAPITAL-SAVING INNOVATION



# THE COMPENSATION MECHANISMS



# THE SKILL-BIASED TECHNOLOGICAL CHANGE MAKES THINGS MUCH MORE COMPLICATED



# RECENT THEORETICAL MODELS ARE BASED ON THE SAME COMPENSATION FRAMEWORK

**Examples:** Neary, 1981; Stoneman, 1983; Kautsolacos, 1984; Hall and Heffernan, 1985; Waterson and Stoneman, 1985; Dobbs *et al.*, 1987; Layard *et al.*, 1991.

Indeed, “**compensation cannot be assumed ex ante**” (as implicitly done by theoretical studies), since the final employment outcome depends on crucial parameters such as the % of product innovation, the demand elasticity, the elasticity of substitution between K and L, and so on.

In fact, since the '90s, no further relevant theoretical contributions are put forward, with the focus moving to the **empirical studies**, much less conventional and more original (for a critical discussion of the recent theoretical models and for aggregate and sectoral empirical studies, see Vivarelli, 1995; Vivarelli and Pianta, 2000).

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.

# PREVIOUS MICROECONOMETRIC STUDIES (1)

The advantage of the firm-level analysis is the possibility to better proxy technological change and innovation and to deal with large dataset; the disadvantage is that we cannot take into account the complex (intersectoral) nature of the compensation theory.

## CROSS-SECTION STUDIES

Entorf-Pohlmeier, 1990: **positive** impact of product innovation, West Germany.

Zimmermann, 1991: **negative** impact, West Germany.

Klette-Førre, 1998: not clear-cut (**negative**) impact of R&D intensity, Norway .

Brouwer *et al.*, 1993: **negative** effect of R&D, **positive** of product innovation, the Netherlands.

Cross section analyses (mainly based on OLS and or probit) are severely limited by **endogeneity** problems, cannot take into account the **unobservables** and may over-estimate the positive impact of innovation because of the **business stealing** effect.

In the second half of the '90s, attention is moved to **longitudinal datasets and panel methodologies** (GMM-DIF; GMM-SYS; LSDVC).

# PREVIOUS MICROECONOMETRIC STUDIES (2)

## PANEL STUDIES

Van Reenen, 1997: **positive** impact of innovation, UK.

Doms *et al.*, 1997: **positive** effect of advanced manufacturing technologies, US.

Smolny, 1998: **positive** impact of product innovation, West Germany.

Greenan and Guellec, 2000: **positive** effect of innovation at the firm-level, but negative at the sectoral level (still positive for product innovation), France.

Greenhalgh *et al.*, 2001: **positive** impact of R&D, UK, but only in the High-Tech.

Piva and Vivarelli (2005): **positive** impact of innovation, Italy.

Harrison *et al.* (2008): **positive** effect of product innovation and (slightly) **negative** of process innovation (strong compensation in services), Germany-France-UK-Spain.

Hall *et al.* (2008): **positive** impact of product innovation, Italy.

Lachenmaier and Rottmann (2011): **positive** impact of innovation (including process innovation), no sectoral differences, Germany.

Coad and Rao (2011), **positive** impact of innovation, stronger for fast-growing firms, US (data only from high-tech manufacturing).

# NOVELTIES OF THIS STUDY IN COMPARISON WITH MOST OF PREVIOUS LITERATURE

**European coverage** (Lisbon-Barcelona policy targets) vs national datasets

**R&D is at the core of the 2020 Innovation Union Agenda:**  
however, a large strand of literature shows the positive effect of R&D on productivity but what about employment?

**Large international longitudinal datasets** vs either cross section or short panel

**Continuous variable (R&D)** vs proxies of innovation (often dummies)

**Sectoral splitting** vs aggregate studies (with three exceptions)

## **HOWEVER:**

The R&D indicator is characterised by several **limitations**

# SECTORAL ANALYSIS

- OECD STAN and ANBERD data
- 1996-2005
- Two digits NACE (STAN: M-21, S-17; Anberd: M-21, S-4)
- Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Portugal, Spain, Sweden, United Kingdom
- Real and PPP (base year 2000)
- Caveat: VA deflators from STAN include hedonic prices

# ECONOMETRIC SPECIFICATION

$$\log(E_{ijt}) = \rho \log(E_{ijt-1}) + \alpha_0 + \alpha_1 \log(w_{ijt}) + \alpha_2 \log(Y_{ijt}) + \alpha_3 \log(I_{ijt}) + \alpha_4 \log(R\&D_{ijt}) + \beta'S + \gamma'T + \varepsilon_{ij} + u_{ijt}$$

Dynamic demand for labour  
augmented with R&D

# METHODOLOGY

- GMM-SYS (Blundell Bond)
- We use both flow and stock formulation. In building capital and R&D stock, we classified industries according to technological level and assign different depreciation rates (4, 6 and 8% for capital stock; 12, 15 and 20% for R&D stock)

$$Z_{ijt} = \begin{cases} (1-\lambda_i)Z_{ijt-1} + R\&D_{ijt} & \text{if } t > 0 \\ \frac{R\&D_{ijt}}{g_{ij} + \lambda_i} & \text{if } t = 0 \end{cases}$$
$$K_{ijt} = \begin{cases} (1-\delta_i)K_{ijt-1} + I_{ijt} & \text{if } t > 0 \\ \frac{I_{ijt}}{g_{ij} + \delta_i} & \text{if } t = 0 \end{cases}$$

**Table 4. Dependent variable: number of employees in log scale.**

	(1) GLS	(2) WG	(3) GMM-DIF	(4) GMM-SYS
<b>log(E<sub>ijt-1</sub>)</b>	0.959 [0.018] <sup>***</sup>	0.772 [0.034] <sup>***</sup>	0.470 [0.075] <sup>***</sup>	0.920 [0.038] <sup>***</sup>
<b>log(W<sub>ijt</sub>)</b>	-0.059 [0.025] <sup>**</sup>	-0.170 [0.056] <sup>***</sup>	-0.292 [0.103] <sup>***</sup>	-0.174 [0.049] <sup>***</sup>
<b>log(I<sub>ijt</sub>)</b>	0.025 [0.005] <sup>***</sup>	0.054 [0.011] <sup>***</sup>	0.034 [0.017] <sup>*</sup>	0.050 [0.014] <sup>***</sup>
<b>log(R&amp;D<sub>ijt</sub>)</b>	0.005 [0.001] <sup>***</sup>	0.008 [0.003] <sup>**</sup>	0.049 [0.014] <sup>***</sup>	0.025 [0.005] <sup>***</sup>
<b>log(Y<sub>ijt</sub>)</b>	0.021 [0.019]	0.025 [0.028]	0.166 [0.054] <sup>***</sup>	0.026 [0.033]
<b>const.</b>	-0.074 [0.049]	0.749 [0.211] <sup>***</sup>		-0.459 [0.124] <sup>***</sup>
<b>S</b>	Yes	No	No	Yes
<b>T</b>	Yes	Yes	Yes	Yes
N Obs	2295	2295	1907	2295
Hansen p value			166.95 0.025	206.25 0.059
N instruments			146	203
AR(1) p value			-3.64 0.000	-4.97 0.000
AR(2) p value			-0.31 0.758	-0.88 0.380

Notes: robust standard errors in brackets. E stands for number of employees, Y for Value Added, R&D for research and development expenditures, I for gross fixed capital formation and W for labour compensation. One, two and three stars indicate significance respectively at 10, 5 and 1 percent. T, the number of cross-sections, is equal to ten. Instruments include lags from one to four included (two to five for the autoregressive term).

**Table 5. Dependent variable: number of employees in log scale (flows and stocks)**

	(1) GMM-SYS	(2) GMM-SYS	(3) GMM-SYS
$\log(E_{ijt-1})$	0.922 [0.032]***	0.954 [0.039]***	0.958 [0.037]***
$\log(W_{ijt})$	-0.042 [0.045]	-0.021 [0.063]	-0.065 [0.037]*
$\log(K_{ijt})$	-0.012 [0.015]	-0.019 [0.011]*	
$\log(I_{ijt})$			0.038 [0.010]***
$\log(Z_{ijt})$		0.008 [0.004]*	0.015 [0.007]**
$\log(R\&D_{ijt})$	0.024 [0.008]***		
$\log(Y_{ijt})$	0.098 [0.035]***	0.083 [0.043]*	0.015 [0.034]
<b>const.</b>	-0.764 [0.218]***	-0.488 [0.144]***	-0.324 [0.279]
<b>S</b>	Yes	Yes	Yes
<b>T</b>	Yes	Yes	Yes
N Obs	2014	1744	1989
Hansen	203.50	188.99	188.97
p value	0.076	0.238	0.237
N instr	203	201	202
AR(1)	-4.87	-4.73	-4.62
p value	0.000	0.000	0.000
AR(2)	-1.57	-1.66	-1.02
p value	0.118	0.096	0.306

Notes: robust standard errors in brackets. E stands for number of employees, Y for Value Added, R&D for research and development expenditures, Z for R&D stock, I for gross fixed capital formation, K for capital stock and W for labour compensation. One, two and three stars indicate significance respectively at 10, 5 and 1 percent. T, the number of cross-sections, is equal to ten. Instruments include lags from one to four included (two to five for the autoregressive term).

**Table 8. Dependent variable: number of employees in log scale.**

	(1) LSDVC	(2) LSDVC
$\log(E_{ijt-1})$	0.897 [0.013]***	0.829 [0.018]***
$\log(W_{ijt})$	-0.140 [0.019]***	-0.154 [0.024]***
$\log(I_{ijt})$ -LT	0.024 [0.008]***	0.031 [0.008]***
$\log(I_{ijt})$ -MT	0.029 [0.009]***	0.033 [0.009]***
$\log(I_{ijt})$ -HT	0.069 [0.008]***	0.080 [0.009]***
$\log(R\&D_{ijt})$ -LT	0.002 [0.004]	0.002 [0.004]
$\log(R\&D_{ijt})$ -MT	0.001 [0.005]	0.004 [0.006]
$\log(R\&D_{ijt})$ -HT	0.017 [0.007]***	0.026 [0.008]***
$\log(Y_{ijt})$	0.001 [0.008]	0.010 [0.008]
<b>T</b>	Yes	Yes
N Obs	2295	2295
Initial estimator	GMM-SYS	GMM-DIF

Notes: bootstrapped standard errors in brackets (50 iterations). E stands for number of employees, Y for Value Added, R&D for research and development expenditures, I for gross fixed capital formation and W for labour compensation; HT means High Tech (industries 30, 32, 72, 73), MT Medium Tech (industries 23-29, 31, 34-37, 55, and 74), LT Low Tech (the remaining sectors). One, two and three stars stay for a statistical significance respectively at 10, 5 and 1 percent. T, the number of cross-sections, is equal to ten.

# CONCLUSIONS FROM THE SECTORAL ANALYSIS

- R&D expenditures (good predictors of product innovation) have a job-creating effect
- The labour-friendly nature of R&D emerges in both flow and stock specifications
- Further support for the 2020 Innovation Union policy strategy
- However, the job creation effect of R&D expenditures is concentrated in the high-tech sectors only

# MICRO ANALYSIS: DATA (1)

The firm-level data used in this study were provided by the JRC-IPTS, extracted from a variety of sources, including companies' annual reports. The original data sources comprise leading quoted European companies. The construction of a longitudinal database was carried out through the following procedure.

## **First step: data extraction**

The following criteria have been adopted:

- ▶ selecting only those companies with R&D>0 in, at least, one year in the 1990-2008 time span;
- ▶ selecting the following variables: Country; Industry code at 2008; R&D expenses; Capital expenditures; Sales; Employees, Wages.
- ▶ expressing all the value data in the current national currency.

## **Second step: deflation of current nominal values**

Nominal values were commuted into constant price values through GDP deflators (source: IMF) centred in year 2000. For a tiny minority of firms reporting in currencies different from the national ones, we opted for deflating the nominal values through the national GDP deflator, as well.

# MICRO ANALYSIS: DATA (2)

## **Third step: values in PPP dollars**

Once obtained constant 2000 prices values, all figures were converted into US dollars using the PPP exchange rate at year 2000 (source: OECD).

## **Fourth step: the format of the final data string**

The obtained unbalanced database comprises 677 companies, 2 codes (country and sector) and 4 variables (see above) over a period of 19 years (1990-2008).

Since one of the main purposes of this study is to distinguish across high-tech and medium/low-tech sectors, a third code was added, labelling as High-tech the following sectors:

- ▶ Drugs;
- ▶ Computer and office equipments;
- ▶ Electronic and other electrical equipment and components;
- ▶ Communication equipment;
- ▶ Aircraft and spacecraft;
- ▶ Measuring, analyzing and controlling instruments.

# ECONOMETRIC SPECIFICATION

Dynamic demand for labour  
augmented with R&D:

$$\Delta l_{i,t} = \alpha \Delta l_{i,t-1} + \beta_1 \Delta y_{i,t} + \beta_2 \Delta w_{i,t} + \beta_3 \Delta r \& d_{i,t} + \beta_4 \Delta gi_{i,t} + \Delta v_{i,t}$$

Where:

**L** = employment

**Y** = sales (business stealing effect)

**W** = wages (cost of labour)

**GI** = gross investment

**R&D** = R&D expenditures

Lower case letters indicate natural logarithms

# ECONOMETRIC METHODOLOGY

A common problem of any dynamic specification is the **endogeneity** of the lagged dependent variable; → IV techniques (Arellano, 1989; Arellano and Bond, 1991; Arellano and Bover, 1995; Ahn and Schmidt, 1995; Blundell and Bond, 1998).

Blundell and Bond (1998) developed the **GMM-SYS estimator**, more appropriate in case of high persistency of the dependent variable and when the between component of the variance is dominant (both conditions are present in our data).

However, recent studies (Kiviet, 1995; Judson and Owen, 1999; Bun and Kiviet, 2001 and 2003) show that GMM-estimators exhibit a weak performance in case of a **low n**. This is actually our case, especially when we deal with the sectoral splitting.

Therefore, we used the Least Squares Dummy Variable Corrected (**LSDVC**) estimator. This procedure is initialised by a GMM-SYS estimate, and then relying on a recursive correction of the bias of the fixed effects estimator. Bruno (2005a and 2005b) extended the LSDVC method to unbalanced panels, as the one used in this study.

Accordingly with Bun e Kiviet (2001) - showing that the estimated asymptotic standard errors may provide poor approximations in small samples - the statistical significance has been tested using **bootstrapped standard errors** (50 iterations).

**Table 3: Econometric results - Whole sample****Dependent variable: log(Employment)**

	(1) POLS	(2) Fixed Effects	(3) LSDVC
Log (Employment-1)	0.796*** (0.016)	0.629*** (0.098)	0.691*** (0.015)
Log (Sales)	0.121*** (0.016)	0.242*** (0.063)	0.212*** (0.015)
Log(R&D expenditure)	0.018*** (0.004)	0.033* (0.018)	0.023** (0.010)
Log(Gross investments)	0.044*** (0.007)	0.063*** (0.011)	0.064*** (0.008)
Log(Wage)	-0.068*** (0.009)	-0.066*** (0.021)	-0.060*** (0.006)
Constant	-0.400*** (0.090)	-1.138*** (0.360)	
Wald time-dummies (p-value)	4.75*** (0.000)	2.87*** (0.000)	48.94*** (0.000)
Wald country-dummies (p-value)	4.15*** (0.000)		
Wald sectoral-dummies (p-value)	5.18*** (0.000)		
	R <sup>2</sup> 0.99	R <sup>2</sup> (within) 0.82	
<i>N. obs</i>		3,049	
<i>N. of firms</i>		677	

Note:

- Standard-errors in parentheses, robust standard-errors in POLS estimates;

- \* significance at 10%, \*\* 5%, \*\*\* 1%.

**Table 4: Econometric results – Manufacturing sectors****Dependent variable: log(Employment)**

	(1) POLS	(2) Fixed Effects	(3) LSDVC
Log (Employment-1)	0.829*** (0.016)	0.707*** (0.094)	0.772*** (0.016)
Log (Sales)	0.102*** (0.016)	0.208*** (0.058)	0.179*** (0.020)
Log(R&D expenditure)	0.010** (0.005)	0.032* (0.018)	0.025* (0.013)
Log(Gross investments)	0.041*** (0.006)	0.054*** (0.011)	0.054*** (0.009)
Log(Wage)	-0.063*** (0.010)	-0.064*** (0.021)	-0.055*** (0.008)
Constant	-0.330*** (0.104)	-0.991*** (0.332)	
Wald time-dummies (p-value)	2.52*** (0.000)	2.07*** (0.008)	39.08*** (0.001)
Wald country-dummies (p-value)	4.03*** (0.000)		
Wald sectoral-dummies (p-value)	4.71*** (0.000)		
	R <sup>2</sup> 0.99	R <sup>2</sup> (within) 0.82	
<i>N. obs</i>		2,331	
<i>N. of firms</i>		499	

Note:

- Standard-errors in parentheses, robust standard-errors in POLS estimates;

- \* significance at 10%, \*\* 5%, \*\*\* 1%.

**Table 5: Econometric results – Service sectors**

**Dependent variable: log(Employment)**

	(1) POLS	(2) Fixed Effects	(3) LSDVC
Log (Employment-1)	0.692*** (0.033)	0.364*** (0.043)	0.425*** (0.027)
Log (Sales)	0.194*** (0.033)	0.392*** (0.040)	0.362*** (0.030)
Log(R&D expenditure)	0.046*** (0.010)	0.068*** (0.027)	0.056** (0.022)
Log(Gross investments)	0.047*** (0.015)	0.076*** (0.021)	0.075*** (0.015)
Log(Wage)	-0.072*** (0.017)	-0.049*** (0.018)	-0.049*** (0.014)
Constant	-0.658*** (0.176)	-2.015*** (0.207)	
Wald time-dummies (p-value)	3.40*** (0.000)	1.99** (0.015)	24.51* (0.079)
Wald country-dummies (p-value)	3.67*** (0.000)		
Wald sectoral-dummies (p-value)	5.07*** (0.000)		
	R <sup>2</sup> 0.99	R <sup>2</sup> (within) 0.84	
<i>N. obs</i>		718	
<i>N. of firms</i>		178	

Note:

- Standard-errors in parentheses, robust standard-errors in POLS estimates;

- \* significance at 10%, \*\* 5%, \*\*\* 1%.

**Table 6: Econometric results - High-tech manufacturing sectors****Dependent variable: log(Employment)**

	(1) POLS	(2) Fixed Effects	(3) LSDVC
Log (Employment-1)	0.777*** (0.026)	0.465*** (0.047)	0.544*** (0.032)
Log (Sales)	0.115*** (0.025)	0.320*** (0.035)	0.278*** (0.035)
Log(R&D expenditure)	0.018** (0.008)	0.059*** (0.015)	0.049*** (0.015)
Log(Gross investments)	0.057*** (0.011)	0.050*** (0.011)	0.050*** (0.017)
Log(Wage)	-0.069*** (0.021)	-0.040* (0.025)	-0.033** (0.015)
Constant	-0.421*** (0.128)	-1.591*** (0.245)	
Wald time-dummies (p-value)	1.74** (0.035)	2.04** (0.013)	15.57 (0.483)
Wald country-dummies (p-value)	2.27*** (0.005)		
Wald sectoral-dummies (p-value)	3.69*** (0.005)		
	R <sup>2</sup> 0.99	R <sup>2</sup> (within) 0.80	
<i>N. obs</i>		685	
<i>N. of firms</i>		152	

Note:

- Standard-errors in parentheses, robust standard-errors in POLS estimates;

- \* significance at 10%, \*\* 5%, \*\*\* 1%.

**Table 7: Econometric results – Non high-tech manufacturing****Dependent variable: log(Employment)**

	(1) POLS	(2) Fixed Effects	(3) LSDVC
Log (Employment-1)	0.851*** (0.019)	0.769*** (0.086)	0.867*** (0.033)
Log (Sales)	0.105*** (0.020)	0.209*** (0.056)	0.170*** (0.031)
Log(R&D expenditure)	0.003 (0.006)	0.037 (0.022)	0.021 (0.018)
Log(Gross investments)	0.028*** (0.007)	0.051*** (0.015)	0.039** (0.019)
Log(Wage)	-0.059*** (0.012)	-0.063*** (0.020)	-0.060*** (0.008)
Constant	-0.372*** (0.132)	-1.077*** (0.301)	
Wald time-dummies (p-value)	2.45*** (0.001)	2.30*** (0.003)	43.35*** (0.000)
Wald country-dummies (p-value)	4.27*** (0.000)		
Wald sectoral-dummies (p-value)	4.30*** (0.000)		
	R <sup>2</sup> 0.99	R <sup>2</sup> (within) 0.84	
<i>N. obs</i>		1,646	
<i>N. of firms</i>		347	

Note:

- Standard-errors in parentheses, robust standard-errors in POLS estimates;

- \* significance at 10%, \*\* 5%, \*\*\* 1%.

# CONCLUSIONS AND CAVEATS

The main finding is the **labour friendly nature of firms' R&D**, the coefficient of which turns out as positive and significant, although not very large in magnitude.

Therefore, this outcome is consistent with the **Lisbon-Barcelona policy target**, reassuring about the possible employment consequences of an increasing R&D/GDP ratio across the different countries in the EU.

However, this policy implication deserves two important qualifications:

1. Although strictly related to the labour-friendly product innovation, R&D imperfectly captures the alternative mode of technological change that is the possibly **labour-saving process innovation**. This means that embodied technological change and process innovation with their possible adverse impact on employment are probably underestimated in this work.
2. The positive and significant employment impact of R&D expenditures is not equally detectable across the different sectors. While it is obvious in services and high-tech manufacturing, **this is not the case in the more traditional manufacturing sectors**. This is something that should be taken into account by a European innovation policy which considers employment as one of its specific targets.

*THANK YOU*

# IN THE DCs THIS IS OFTEN THE CASE: LS+SB TC

➤ If the HOSS assumption of homogeneous production functions and identical technologies among countries is relaxed, international openness may facilitate technology diffusion from developed to DCs, implying that **trade and technological change are complementary** mechanisms in fostering skill upgrading in the DCs.

➤ Robbins (2003) has called the effect of in-flowing technology resulting from trade liberalisation the **'skill-enhancing trade (SET) hypothesis'**: trade liberalisation accelerates the flows of imported embodied technological change (especially in machineries and intermediate input) to the South, inducing rapid adaptation to the modern technologies currently used in the North, resulting both in a labour-saving change and in a relative increase in the demand for skilled labour.

➤ Evidence for **SBTC in the DCs**: Berman and Machin (2000 and 2004); Pavcnik (2003, on Chile), Berman *et al.* (2005, on India), Meschi and Vivarelli (2009, on a panel of DCs ); Conte and Vivarelli (2011, on a panel of sectors/countries).