UNIVERSIDAD COMPLUTENSE MADRID

The Effects of Product and Process Innovation across the Value Chain on Different Type of Employment: An Empirical Case of Spanish Manufacturing Firms

ANDRES BARGE-GIL, GUILLERMO ARENAS DIAZ, JOOST HEIJS

Seville, 2019

Motivations

- Renewed interest on the relationship between technical progress and employment
- Dramatic reduction of employment during last economic crises
- Lack of evidence on:
  - Effect on different types of workers
  - Effect through the production chain

Goal

- This paper analyzes the inter- and intra-sectoral employment effects of the introduction of product and process innovation by the providers, clients and competitors (PCC) on the focal firm

- Applying the methodology proposed by:

  - Harrison et al. (2014) (They analyzed the effect of product and process innovation on employment for four European countries: UK, France, Spain and Germany)

  - Javorcik (2004) (Adaptation of Javorcik methodology for calculation of intra- and inter-sectoral effects)

Our contribution

- The effects of process and product innovation introduced by Competitors, Providers and Clients on **focal firm Employment**

- Analysis of different effect on **high- and low-skilled workers**

- Influence of firm innovation on firm employment in **bad times.**

Production Chain Innovation and employment of focal firm

Competitors

- **New products** may reduce focal firm employment: business stealing → ↓Employment
- **New processes** may reduce focal firm employment: business stealing → ↓Employment

Providers

- **New products** by providers may replace our workers or better complement them→ ↓↑Employment
- **New processes** by providers made our inputs cheaper → ↑Employment

Clients or Customers

- **New products** by customers may require different inputs thus damaging our business→ ↓Employment
- **New processes** by customers may require different inputs thus damaging our business → ↓Employment

Basic Harrison et al. model (2014)

$$l - g_1 - \pi = \alpha_0 + \alpha_1 d + \beta g_2 + \varepsilon_i$$

Where:

$l = employment\ growth$

$g_1 = sales\ growth\ due\ to\ old\ products$

$\pi = prices\ growth\ at\ the\ industrial\ level\ (\pi)$

$\alpha_0 = the\ efficiency\ of\ production\ of\ old\ products$

$\alpha_1 = the\ impact\ of\ introducing\ process\ innovation\ only$

$d = only\ process\ innovation\ (dummy\ variable)$

$\beta = relative\ efficiency\ between\ the\ production\ of\ new\ and\ old\ products$

$g_2 = sales\ growth\ due\ to\ new\ products$

$\varepsilon_i = error\ term$

Extended Harrison et al. model (2014)

Basic Harrison's et al. model

$$l - g_1 - \pi = \alpha_0 + \alpha_1 d + \beta g_2 + \gamma_1 Comp_{proc} + \gamma_2 Comp_{prod} + \gamma_3 clients_{proc} + \gamma_4 clients_{prod} + \gamma_5 prov_{proc} + \gamma_6 prov_{prod} + \varepsilon_i$$

$Comp$=Competitors

$clients$=Clients or Costumers

$prov$=Providers

Sub-index:

proc=process innovation

prod= product innovation

Adaptation of Javorcik methodology

Step 1. Calculating the competitors variables

- For process Innovation:

$$Competitors\ proc_{jt} = \frac{\sum_{i \forall i \in j}(d * sales_{it})}{\sum_{i \forall i \in j} sales_{it}}$$

- For product Innovation:

$$Competitors\ prod_{jt} = \frac{\sum_{i \forall i \in j}(g2 * sales_{it})}{\sum_{i \forall i \in j} sales_{it}}$$

Adaptation of Javorcik methodology

Step 2: Calculating technical coefficient to know the share (%) of each sector in each industry downstream and upstream

- Technical coefficient of providers

$$\frac{z_{iw}}{x_w} = \sigma_{jm}$$

where σ_{jm} is the share of industry j's inputs that is purchased from industry m taken from the input-output tables.

- Technical coefficient of clients

$$\frac{z_{iw}}{x_i} = \propto_{jk}$$

where $\propto_{jk}$ is the share of industry j's production that is sold to industry k taken from the input-output tables.

Adaptation of Javorcik methodology

Step 4: Calculating the variables of clients

- For process Innovation:

$$clients_{proc_{jt}} = \sum_{k\ if\ k \neq j} \propto_{jk} * (Competitors_{\ proc})$$

- For product Innovation:

$$clients_{prod_{jt}} = \sum_{k\ if\ k \neq j} \propto_{jk} * (Competitors_{\ prod})$$

Adaptation of Javorcik methodology

Step 3: Calculating the variables of Providers

- For process Innovation:

$$providers_{proc_{jt}} = \sum_{m\ if\ m \neq j} \sigma_{jm} * \frac{[\sum_{i \forall i \in m}(d_{it} * (sales_{it} - x_{it})]}{\sum_{i \forall i \in m}(sales_{it} - x_{it})}$$

- For product Innovation:

$$providers_{prod_{jt}} = \sum_{m\ if\ m \neq j} \sigma_{jm} * \frac{[\sum_{i \forall i \in m}(g2_{it} * (sales_{it} - x_{it})]}{\sum_{i \forall i \in m}(sales_{it} - x_{it})}$$

Where x_{it} are exports

Database and methodology

- We make use of manufacturing firms from PITEC (2006-2013)
  Harrison model specifically developed for the analysis of CIS-type surveys
- Main specification: IV random effects
- Two types of instruments: increased range of products as goal for innovation and importance of clients as sources of information
- High-skilled vs low-skilled: employees with/without university degree
- We additionally use input-output tables to develop indicators of product and process innovation through the production chain
  - from 2006 to 2009→ input-output from 2005
  - from 2010 to 2013→ input-output from 2010

Production chain innovation and firm employment (I)

Employment	Basic Model	Extended Model Product	Extended Model Process
d	-0.0287** [0.012]	-0.028** [0.012]	-0.028** [0.012]
g2 [b]	0.9292*** [0.036]	0.924*** [0.037]	0.923*** [0.036]
Competitors		-0.173*** [0.031]	-0.03 [0.041]
Providers		1.1102*** [0.127]	-0.137 [0.141]
Clients		-1.198*** [0.162]	-0.14 [0.155]
Constant	0.0815*** [0.009]	0.0835*** [0.019]	0.213*** [0.015]
Sargan Test p-value Observations	0.563 0.905 24,702	0.38 0.944 24,702	0.269 0.966 24,702

Production chain innovation and firm employment (II) for high-skilled workers

Employment	Basic Model	Extended Model Product	Extended Model Process
d	0.0078 [0.031]	0.01 [0.031]	0.01 [0.031]
g2[b]	1.1360*** [0.101]	1.134*** [0.102]	1.128*** [0.100]
Competitors		-0.171** [0.085]	-0.072 [0.105]
Providers		0.549 [0.344]	0.07 [0.391]
Clients		-0.372 [0.455]	-0.364 [0.450]
Constant	0.1514*** [0.025]	0.159*** [0.054]	0.253*** [0.041]
Sargan Test p-value Observations	2.415 0.491 20,379	2.52 0.472 20,379	2.583 0.46 20,379

Production chain innovation and firm employment (II) for low-skilled workers

Employment	Basic Model	Extended Model Product	Extended Model Process
d	-0.0311** [0.014]	-0.031** [0.014]	-0.030** [0.014]
g2 [b]	0.9228*** [0.044]	0.916*** [0.045]	0.920*** [0.044]
Competitors		-0.132*** [0.07]	-0.0138 [0.049]
Providers		1.071*** [0.158]	-0.07 [0.194]
Clients		-1.169*** [0.201]	-0.2305 [0.174]
Constant	0.0795*** [0.010]	0.125*** [0.024]	0.246*** [0.018]
Sargan Test p-value Observations	3.456 0.327 24,526	2.57 0.463 24,526	2.551 0.466 24,526

Main findings

For extended Harrison et al. model

- Product innovation by **competitors** reduces focal firm employment in general, high- and low-skilled employment.
- Large positive effect of product innovation by **providers** on general and low-skilled workers.
- Large negative effect of product innovation by **customers** on general and low-skilled workers.
- No effects of process innovation through the value chaing

For basic Harrison et al. model

- Constant positive: 'labor hoarding' effect during crises, specially for high-skilled labor.
- Positive effect of product innovations, larger for high-skilled labor.
- Negative effect of process innovation for low skilled labor only.

Conclusions

- Important effects through the production chain: providers (+) vs customers/competitors (-).
- Important effects of innovation on employment that differently affects different types of workers through value change.
- Low-skilled labor more dependent on innovations across the value chain than high-skilled workers.
- When analyzing firm innovation there is some evidence of skill-biased technological change and/or rotunie biased technological change.

Limitations and further research

- The analysis has been performed mainly for a recession period. May results be specific to such periods?
- We do not delve into firm heterogeneity when dealing with creative disruption
- Better proxy variables for innovation, specially process innovation are required.