# WP5 - The double role of innovation and technical change: demand/job-creation *vs* job-destruction

Units involved: SSSA, SPO, UNIBI

ISIgrowth General Assembly - Brussels, June 2016

# Introduction

- Technology is tacit, rarely transferable and not easily substitutable. The innovation-employment nexus is highly complex.
- Understanding this nexus is crucial to deliver smart, sustainable and inclusive growth,

# Introduction

- Technology is tacit, rarely transferable and not easily substitutable. The innovation-employment nexus is highly complex.
- Understanding this nexus is crucial to deliver smart, sustainable and inclusive growth,
- . . . and maybe also to save you from unemployment.

Probability that computerisation will lead to job losses within the next two decades, 2013
(1=certain)

| Job | Probability |
|---|---|
| Recreational therapists | 0.003 |
| Dentists | 0.004 |
| Athletic trainers | 0.007 |
| Clergy | 0.008 |
| Chemical engineers | 0.02 |
| Editors | 0.06 |
| Firefighters | 0.17 |
| Actors | 0.37 |
| Health technologists | 0.4[illegible] |
| Economists | 0.43 |
| Commercial pilots | 0.55 |

# WP5 Objectives

- Understand the relation between innovation activities and firms performance
- Clarify relation between innovation and employment dynamics, disentangling the role of different forms of innovation on different type of workers
- Investigate transmission channels through which innovation affects firms performance
- Study the role of fiscal end monetary policies in shaping the relation between technological change and employment dynamics

# WP5 Deliverables

- DD 5.1 [Jun 2016, SSSA done]: empirical wp on R&D effort and performance
- DD 5.2 [Jun 2017, SPO tbc]: empirical wp on product and process innovation and job-creation and job-destruction
- DD 5.3 [Dec 2016, SPO tbc]: effect of innovation on different types of workers
- DA 5.4 [Dec 2017, tbd]: theoretical paper on transmission channels
- DP 5.5 [Jun 2018, tbd]: theoretical paper on the complementarity between Schumpeterian, fiscal and monetary policies.

# DD 5.1 Persistence of innovation and patterns of firm growth

## Contributors

- D. Guarascio and F. Tamagni

## Background

- Large literature on innovation and firm growth (for reviews, see Audretsch et al., 2014; Bianchini et al., 2016)
- Large literature on persistence of innovation and its determinants (reviews in Le Bas and Scellato, 2014; Raymond et al., 2010)

$\Rightarrow$ Here: what is the link between persistence in innovation and sales growth ?

## Research questions

- Do persistent innovators grow more than other firms ?
- Do persistent innovators exhibit higher persistence in their growth trajectories ?

# Key contributions

- Exploiting a long in time (1990-2012) panel of Spanish firms (ESEE dataset, maintained by SEPI and Spanish Ministry of Industry), we:
  - Provide a "long-run" notion of persistent innovator, more precise than relying on CIS waves
  - Consider persistence in different innovation activities: R&D, product and process innovation, patenting
  - Address not only if there is a "growth-premium" for persistent innovators, along the different innovation indicators, but also if persistence in innovation associates with persistence of growth (growth-persistence premium)
  - Explore heterogeneity in the two premia along the quantiles of the sales growth rates distribution, via standard quantile regressions

# Empirical setting

- We divide the dataset in two sub-periods: 1990-1999 and 2000-2012
- We use the first period to identify persistent innovators:
  - For each innovation proxy we count the number of years a firm is engaging that specific innovation activity
  - We define a persistent innovator dummy (*Pers*) equal to 1 if a firm performs innovation for at least 7 out of 10 years
- We use the second period to regress:

$$G_{it} = \beta_0 + \beta_1 \, Pers_i + \beta_2 \, X_{it} + u_{it} \tag{1}$$

where $\beta_1$ is the growth-premium for persistent innovators, and

$$G_{it} = \alpha_0 + \alpha_1 \, G_{it-1} + \alpha_2 \, Pers_i + \alpha_3 (G_{it-1} \times Pers_i) + X_{it} + u_{it} \tag{2}$$

where $\alpha_3$ is the "growth-persistence" premium.

- Notes:
  - This setting intended to break simultaneity between definition of *Pers* and growth
  - We address "selectivity" into *Pers* via a first-step Probit on the probability to be persistent, and then adding the fitted probabilities (p-score) to the controls $X$

# Persistent innovators

- Out of 5304 firms in the sample, we identify:
  - ✓ 428 persistent innovators in R&D
  - ✓ 113 persistent product innovators
  - ✓ 268 persistent process innovators
  - ✓ 36 persistent patenters
- The groups are not fully overlapping
- Growth distribution of Pers. and Non-Pers. innovators do not differ much
- Pers. Innovators are (in median and in distribution): older, larger, more productive and more R&D intensive

# Results

- ✓ No clearcut growth-premium for persistent innovators.
- ✓ No growth-persistence premium for persistent innovators.

# Future developments

- Within this specific work:
  - ✓ Compare results with other definitions of persistent innovators (other identification criteria in the literature)
  - ✓ Extend the analysis to growth of employees
- Within the project:
  - ✓ Repeat the exercise on comparable data from other countries available to partner units ?
  - ✓ If similar data (long panel) not available, at least on CIS waves ?

# DD 5.2 Technological innovation and the distribution of employment growth

## Contributors

- F. Calvino, L. Nesta and A. Secchi

## Background

- Positive effect of product innovation on employment growth at the firm-level. Process innovation has more ambiguous effects (compensation?) (for reviews, see Calvino and Virgillito, 2016; Vivarelli, 2014)
- Few contributions use longitudinal data (notable exceptions Triguero et al., 2014; Lachenmaier and Rottmann, 2011)

$\Rightarrow$ Here: what is the link between technological innovation and employment growth?

## Research questions

- What is the *firm-level* relationship between *different* types of innovation and employment growth? Does this relationship change along the employment growth distribution?

# Key contributions

- Exploiting a panel of Spanish manufacturing firms (PITEC dataset) between 2004-2012, we:
  - Carry on a dynamic panel analysis of the effects of different types of product and process innovation on employment growth
  - Split product and process innovation into their building blocks (goods, services, methods, auxiliary processes and logistics)
  - Depart from conditional averages via quantile regression in order to focus on the role of innovation driving employment growth of fast-growing or shrinking firms

# Variables of interest

## Employment growth (log differences)

$$G_{i,t} = log(E_{i,t}) - log(E_{i,t-1}) \tag{3}$$

## Product Innovation – new to the market

- Goods
- Services

## Process Innovation

- Methods of production
- Logistics, delivery or distribution systems
- Auxiliary processes (IT, maintenance, accounting)

# Empirical setting

- The estimated regression is:

$$\begin{aligned} G_{i,t} =& \alpha G_{i,t-1} + \beta_1 ProdInn_{i,t} + \beta_2 ProcInn_{i,t} + \\ & \beta_3 log(age_{i,t}) + \beta_4 group_{i,t} + \mu_i + v_{i,t} \end{aligned} \tag{4}$$

- Industry and year dummies (robustness year dummies alone)

## Methods

- Difference GMM (takes into account autocorrelation in growth rates and potential endogeneity issues)
- Quantile regression ($\epsilon_{i,t} = \mu_i + v_{i,t}$)

# Results

- ✓ Positive effect of product innovation (especially goods new to the market). No effect of process innovation.
- ✓ U-shaped effect of product innovation, process innovation decreasing in conditional quantiles.
- ✓ Do cannibalization effects and compensation mechanisms act differently over the conditional growth distribution?

# Discussion

- Effect of innovation of employment growth depends on the *type* of technological innovation undertaken
- Product innovation (especially goods new to the market) has positive effects while process innovation has more ambiguous effects
- Effects are *heterogeneous* over the conditional quantile of the employment growth distribution
- This might reflect the role of cannibalization and compensation mechanisms (over the conditional distribution)

# Future developments

- Within the framework of this work:
  - ✓ Repeat the exercise on comparable data for France and other countries
  - ✓ Different types of workers [DD 5.3]

- Within the project:
  - ✓ Complementarity of product and process innovation
  - ✓ Dynamic effects of innovation
  - ✓ Extension to a multi-equation framework to include sales and profits

DA 5.4 Theoretical paper on transmission channels.

- SSSA and SPO are taking care of this project

DP 5.5 Role of fiscal end monetary policies in shaping the relation between technological change and employment dynamics

- SSSA and SPO are taking care of this project

AUDRETSCH, D. B., A. COAD, AND A. SEGARRA (2014): "Firm growth and innovation," *Small Business Economics*, 43, 743–749.

BIANCHINI, S., G. PELLEGRINO, AND F. TAMAGNI (2016): "Innovation Strategies and Firm Growth," LEM Working Papers 2016/03, Laboratory of Economics and Management (LEM), Sant'Anna School of Advanced Studies, Pisa, Italy.

CALVINO, F. AND M. E. VIRGILLITO (2016): "The innovation-employment nexus: a critical survey of theory and empirics," LEM Working Paper Series No. 2016/10, Scuola Superiore Sant'Anna.

LACHENMAIER, S. AND H. ROTTMANN (2011): "Effects of innovation on employment: A dynamic panel analysis," *International Journal of Industrial Organization*, 29, 210–220.

LE BAS, C. AND G. SCELLATO (2014): "Firm innovation persistence: a fresh look at the frameworks of analysis," *Economics of Innovation and New Technology*, 23, 423–446.

RAYMOND, W., P. MOHNEN, F. PALM, AND S. S. VAN DER LOEFF (2010): "Persistence of Innovation in Dutch Manufacturing: Is It Spurious?" *The Review of Economics and Statistics*, 92, 495–504.

TRIGUERO, A., D. CORCOLES, AND M. C. CUERVA (2014): "Persistence of innovation and firmâĂŹs growth: evidence from a panel of SME and large Spanish manufacturing firms," *Small Business Economics*, 43, 787–804.

VIVARELLI, M. (2014): "Innovation, Employment and Skills in Advanced and Developing Countries: A Survey of Economic Literature," *Journal of Economic Issues*, 48, 123–154.