DO INNOVATING ENTERPRISES PERFORM BETTER? NEW EVIDENCE FROM FRAME SBS AND CIS DATA INTEGRATION

Valeria Tomeo, Valeria Mastrostefano

Abstract. Most of economic literature has insisted on the role of business investments in innovation as one of the key drivers of productivity and economic growth. Nowadays policymakers through the ambitious National Recovery and Resilience Plan (PNRR), have also emphasized the importance of innovation in enhancing enterprises' competitiveness and productivity as well as in supporting the twin green and digital transformation and in building enterprises' resilience. The aim of this study is twofold. It investigates the relationships between the enterprises' economic performances – measured through the statistical information system for estimating structural economic variables (FRAME SBS) - and enterprises' innovation activeness, as resulted by the European CIS survey. The second aim of this study is to give some evidence about the characteristics and performances of eco-innovators. The results from the special module on eco-innovation of the CIS 2020 confirm a strong attitude of innovators towards the introduction of new products and processes leading to less environmental impact. To integrate the two sources of business data – FRAME SBS and CIS - the calibration estimator methodology was applied. It is the same methodology adopted for the CIS estimates, but the proposed set of indicators exploits the information derived from the interaction between the two sources in substantial consistency with both. From our analysis a clear picture emerges: the innovation active enterprises showed better economic results in the COVID-19 pandemic' context too. Italian enterprises' productivity and profitability are strictly linked to the type and quality of innovation activities carried out. The findings also confirm that better economic performances are strongly associated with R&D-driven innovation attitude. Finally, the study suggests that better profitability and productivity are found in eco-innovators that chose business strategies aimed at implementing environmental sustainable models in the innovation process.

1. Introduction

It is well known that innovation drives productivity which in turn promotes economic growth. There is an extensive theoretical as well as empirical literature on the relationship between innovation and productivity that specifically recognizes innovation as one of the most important sources of multifactor productivity growth (Oecd, 2010). In particular, the impact of Research and Development (R&D) – a type of innovation investments aimed at producing new knowledge - on the productivity growth has been established by many quantitative studies (Guellec and Pilat, 2008). Besides, there is a long-standing view that innovation can have a

positive effect on profitability. Product innovations favorably affect a firm's market position while process innovations, strengthening its internal capabilities, makes the enterprise more flexible and adaptable and thus more capable in dealing with market pressures than a non-innovator (Geroski *et al.*, 1993). Understanding the impact of innovation on enterprise's economic performances (and vice versa) is crucial for (re)designing, monitoring and evaluating the results of economic policy. However, the complexity of the interactions between firms' innovative capabilities and its economic performances has led to a variety of results, reaching different (sometimes opposite) conclusions. In this sense, new empirical evidence is required for better understanding how innovation fosters productivity and if an inverse relationship between them exists, if there is a strict correlation between innovation and profitability, how the relationship between innovation and exports really works.

The aim of this work is to produce a set of indicators able to give new empirical insights on the close relationship between the structural characteristics of firms, their propensity to innovate (and different innovation modes) and their economic performances. To this aim, we integrated the information gathered both by a sampling (CIS) and exhaustive (FRAME SBS) sources and combining CIS qualitative indicators and FRAME economic variables through a method that qualified the results in terms of comparability and consistency according to the Istat statistical standards. This exercise allowed to add "hard" information (i.e. quantitative economic indicators) to the qualitative and more subjective information from innovation survey, without increasing response burden and producing estimates representative of the Italian population of enterprises.

The paper is structured as follows: Section 2 describes the main features of FRAME SBS. Section 3 focuses on the CIS approach in the measurement of innovation. Section 4 presents the list of innovation indicators chosen for data integration. Section 5 describes the data integration's methodology. Section 6 discusses the results obtained. Attention was also give to the economic performances of eco-innovators, given the growing importance of the issues of sustainable growth and green transition in the design of industrial policies. Section 7 presents the conclusions and some suggestions for future analyses.

2. The FRAME SBS system

Statistical production methodologies, in response to the need to fully capture the factors of economic competitiveness, have focused on constructing relevant, high-quality and coherent microdata with macroeconomic aggregates, such as those provided by National Accounts. The information system adopted by ISTAT for the annual production of business economic account estimates, the FRAME SBS system, addresses these needs (Seri *et al.*, 2016). The FRAME SBS is an integrated system of administrative and statistical data, produced annually by ISTAT to

estimate the economic results of businesses, based on the units (approximately 4.4 million) included in the Statistical Archive of Active Enterprises (ASIA), the statistical business register produced annually by ISTAT according to European Business Register regulations. The FRAME SBS is integrated with ASIA both in terms of the list of units and the identifying characteristics of the businesses (economic activity, legal form, number of employees, revenue class, location). The system, produced from the economic results of 2012 onwards, uses innovative methodologies to integrate administrative data from Chamber of Commerce sources (financial statements), tax data (Sector Studies, IRAP - Regional Tax on Productive Activities, Unico model), and social security data (monthly declarations related to employees from UniEmens, which feed the Annual Register of Labor Costs in Enterprises – RACLI, produced by Istat) and data from structural business surveys (Survey on Small and Medium Enterprises - PMI, sample survey on enterprises with up to 250 persons employed, and Survey on the system of enterprise accounts - SCI, a census survey on enterprises with 250 or more persons employed). The FRAME SBS is regularly used to produce structural business statistics (SBS), both for submission to Eurostat and for national dissemination through Istat's institutional channels, and was also designed as a data input register for National Accounts (NA) estimates, used as an information source starting from the 2014 general revision of economic accounts (Arnaldi *et al.*, 2020).

The FRAME SBS includes information on structural characteristics (size, sector, location) and key economic account items (turnover, value added, operating margin, personnel costs). This dataset offers multiple advantages: it ensures full coherence between official estimates of structural variables and National Accounts aggregates at the sectoral level; the dataset serves as a platform for further integration with other sources of statistical and administrative microdata; finally, it becomes the reference structure for the convergence and coherence of numerous surveys on specific aspects of the Italian economy and for multipurpose surveys on the main factors of business competitiveness, ensuring coherence over time.

3. The CIS approach in measuring innovation.

Innovation is a broader concept than R&D. Firstly, because R&D is just an innovation input. Then, innovation is an activity that may be combined with R&D or not: non R&D-based innovation is of growing importance. A need of new survey to complement R&D data has arisen at the end of last century to measure innovation outputs and non-R&D innovation inputs. This is why the EU launched the Community Innovation Survey (CIS) in 1992[1]. The main challenges of the CIS are:

[1] For details: The Community innovation survey 2020 (CIS2020) (europa.eu) Community Innovation Survey – New features

to detect any sorts of informal innovation that traditional indicators such as R&D expenditure or patents are not able to capture; to take into account the variety of innovation patterns and the diversity in innovation strategies, activities and performances of enterprises in EU; to detect the external drivers and enablers of innovation and the factors hampering innovation. Such information provides an important tool to support policy makers in developing and monitoring policy and evaluating the results of the policy. Indeed, the CIS produces policy-relevant indicators widely used in EU and national policy reports, such as the European Innovation Scoreboard[2], as well as in the SDGs report, BES report and Rapporto sulla competitività[3]. Since 1992, the CIS has evolved into the largest innovation survey in the world. Since its launch, the CIS is complied with the conceptual and methodological criteria defined within the framework of the OECD and Eurostat: the OECD Oslo Manual[4] and the Eu Regulation 2152/2019 on European Business Statistics (EBS)[5]. The CIS measures innovation in business enterprises during a 3-year period[6]. In order to ensure a sound comparability across countries, all the CIS waves have a harmonized survey questionnaire, composed of standard modules and focused (rotational) questions. It takes place every two years and it is a sample survey (more precisely, it is a combination of sampling for firms with 10-249 number of persons employed - NPEs - and census survey for units with 250+ NPEs). Final data are weighted and calibration estimators methodology is used for the estimation process[7]. The response rate in the CIS2020 was 62.3%, that is about 25,000 of respondents, of which about 23,000 active in 2020 and representative of the whole population of enterprises with at least 10 number of persons employed.

[2] European innovation scoreboard - European Commission (europa.eu)

[3] Publications – Istat

4 The Oslo Manual is the international reference guide for collecting and using data on innovation. It in continuous evolution. The first version was published in 1992. It has been revised on three occasions and we are now at the 4th edition.

[5] Along with the Regulation, an Implementing Act dedicated to the topic 'business innovation' is adopted in order to produce internationally comparable statistics and indicators: Regulation - 2019/2152 - EN - EUR-Lex (europa.eu)

[6] According to both the Oslo Manual and the CIS, an innovation is: a new or improved product or process (or combination thereof), introduced on the market or brought into use by the firm; it can be simply new or improved to the firm; it could have been originally developed by other enterprises or organisations. There are two types of innovation: product innovations (including changes to product design) and business process innovations (for one or more business functions related to both the core activity of producing and delivering products for sale, and other supporting operations characterizing the most advanced services activities - administrative, ICT and marketing activity). The CIS covers all the firms active in the economic Nace sections from B to M. Regarding the CIS 2020, the reference period is from the beginning of 2018 to the end of 2020, even if questions on expenditures and turnover from innovative products refer just to the last year of the period (2020).

[7] Better information on target population, sampling design, data collection and data treatment, weights calculation method, dissemination of the data is available in the Report published at every survey's edition. The last one is available at the following website: L'innovazione nelle imprese. Anni 2018-2020

4. Research aims and methodology adopted in the CIS indicators chosen.

In this context, although we had to limit the analysis to a small set of innovation indicators, we chose both traditional indicators and new, more complex, indicators.

A first group is composed of indicators measuring the propensity to innovate and the attitude to do it through R&D investments (Table 1). These indicators are widely known and commonly used in the international context to measure the relations between innovation and competitiveness.

However, the CIS allows to build innovation indicators that can differentiate between modes of innovation and can thus provide a clear picture of innovation within different firms, economies, and countries (European Commission, 2024). Over time the CIS data have indeed revealed the presence of a great variety across innovation strategies and processes of Italian enterprises (Evangelista and Mastrostefano, 2006; OECD, 2009). Innovation profiling can differentiate innovators in several groups and hence allows to explore empirically the concept of variety in innovation, taking into account the complex and multidimensional nature of innovation[8]. Using variables related to different innovation dimensions - knowledge, novelty, implementation - and combining them in non-overlapping categories, a second group of CIS indicators made possible to identify five different innovation profiles. Additionally, we decided to include some indicators for environmental innovation, given the new challenges for achieving sustainable growth and the growing importance of policies for green transition. Among the eco-innovators, particular attention was given to R&D performers. Finally, we took a look at those eco-innovators that undertake innovation aimed at reducing energy use.

5. Methodology for the construction of the final indicators

The aim of this paper is to integrate data from an exhaustive source (FRAME SBS) and a sample survey (CIS) by combining economic variables and qualitative indicators. The methodology used was tested in ISTAT by applying it to the integration with the ICT survey data (Nurra *et al.*, 2024) and guarantees comparable and consistent results according to ISTAT statistical standards. New statistics and indicators from this work could produce additional insight into the enterprises' strategies and performances and suggests new views for economic analysis and support for policy making. This work exploits past experiences and Italian best practices for the implementation of microdata integration from different sources.
The FRAME SBS represents the central data source for microdata integration.

[8] Full information is available in the following document: Innovation profiling – first results

Table 1 – *CIS indicators chosen for data integration with the FRAME – SBS.*

Propensity to innovation/R&D
1. **Innovation-active** enterprises (e. with innovation activities) (% on total enterprises) *of which:* o **R&D** performers (e. that undertook in-house or contracted out R&D activities) (% on total enterprises) 2. **Non innovative** enterprises (e. without innovation activities) (% on total enterprises)
Innovation Profiles (IPs)
1. **In-house product innovators with market novelties**: enterprises that develop with own substantial capabilities and introduce into the market original product innovations (% on total enterprises) 2. **In-house product innovators without market novelties**: enterprises that develop in-house and introduce into the market other product innovations (% on total enterprises) 3. **In-house business process innovators**: enterprises that produce in-house and brought into use only process innovations (% on total enterprises) 4. **Innovators that do not develop innovations themselves**: enterprises that acquired innovations outside (% on total enterprises) 5. **Innovation-active enterprises**: enterprises that worked on innovations but didn't implement them (% on total enterprises)
Green innovation
1. **Eco-innovators**: innovators generating environmental benefits (% of total innovators) *of which:* o With R&D/No R&D o Innovation aimed at reducing energy use 2. **Innovators not oriented to environmental issues**: innovators that do not generate environmental benefits (% of total innovators)

Among different strategies, the calibration estimators approach was deemed the most appropriate for integrating data from the FRAME SBS with the CIS survey. This method leverages the interplay between a comprehensive register and sample data to generate economic indicators (Seri *et al.*, 2016).

The calibration estimates methodology is the same used in the estimation process of the CIS sample survey. However, the initially proposed set of indicators does not duplicate published estimates, whether directly or indirectly. Instead, it takes advantage of the data derived from combining the two sources, ensuring substantial or complete consistency with both.

The differences between the application of the two methodologies are shown below:

- The statistical archives for estimates is FRAME SBS referred to year t. The sampling of the CIS is carried out from ASIA referred to the year t-1 while the final CIS estimates are calculated from ASIA referred to the year t.

- The FRAME SBS doesn't cover the section K.
- A small number of enterprises that reported innovation activities in the CIS survey were removed from ASIA (and FRAME SBS) for the year t for various reasons, including changes in the number of persons employed, changes in the NACE code, and demographic events that redefined the target population. Despite these adjustments, more than 96% of the CIS sample remained eligible for the analysis.
- About overlapping information, the FRAME SBS source was privileged.
- With regards to the model used for the calibration of the weights in the CIS survey (totals for the variables Number of enterprises and Number of persons employed by NACE), the use of FRAME SBS was crucial to consider within the known totals those related to Value Added and Turnover.

The methodological framework employed is structurally identical to that of the CIS survey. Consequently, the same criteria used for the currently published estimates can be applied to evaluate the accuracy and precision of the produced estimates. The analysis was conducted using the ReGenesees software (Zardetto, 2015), which implements methods commonly used by ISTAT for economic surveys.

Additionally, the adopted strategy produces microdata files with a weighting system that represents the entire population, similar to the survey, so it was possible to reproduce the CIS indicator estimates, though replicating these estimates is not the aim of this work. These estimates are entirely consistent with the published ones, ensuring the reliability of the results (consistency with FRAME SBS is assured by design in the new estimation domains). However, it is crucial to emphasize that the goal of this work was to create a series of indicator tables that integrate information from both FRAME SBS and the CIS survey.

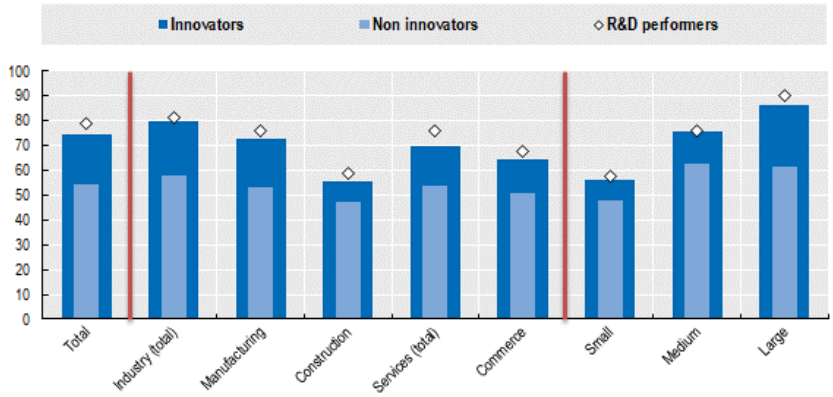
6. Empirical insights from data integration.

In 2018-2020 period, 50.9% of industrial and service enterprises with 10 or more NPEs carried out innovation activities, with a fall of about 5 percentage points compared to the previous period (2016-2018). The health emergency was one of the main causes of the reduction of innovation active enterprises, mentioned by 64.8% of them[9]. The industrial sector showed the highest propensity to innovation: 58.5% versus 47.2% of services and the propensity to innovate increases with firms' size: among small enterprises (10-49 employees) one half was active in innovation while in large enterprises three fourth were engaged in innovation activities. R&D is the

[9] An innovation active enterprise is an enterprise that has carried out innovation activities. An innovator is the enterprise that has carried out successfully innovation activities leading to the introduction of a product innovation on the market or a process innovation internally. So, an innovation active enterprise is just a potential innovator.

main component of innovation expenditures, representing 50.6% of total. Results from the ad-hoc module of the CIS on eco-innovation confirm the tendency of adopting product and process innovations with lower environmental impact. During the 2018-2020 period, 40.3% of innovators reported having introduced one or more eco-sustainable innovations, and 25.4% introduced innovations that led to greater energy efficiency[10]. From data integration with the FRAME SBS, it is confirmed what showed in most empirical literature: innovation leads to an increase of productivity. In 2020, despite the pandemic crisis and its economic impact, innovators had better economic performances than those oriented to more cautious and conservative competitive strategies (Figure 1). Innovation-active enterprises have higher levels of labor productivity than non-innovative ones, both as total and in each class. Additionally, enterprises active in R&D show on average higher productivity values than the other innovation active enterprises, reaching the highest value in large enterprises.

Figure 1 – *Labour productivity (value added per employee) of Italian enterprises by economic activity, size class and type of enterprises. Year 2020 (thousands of Euro).*



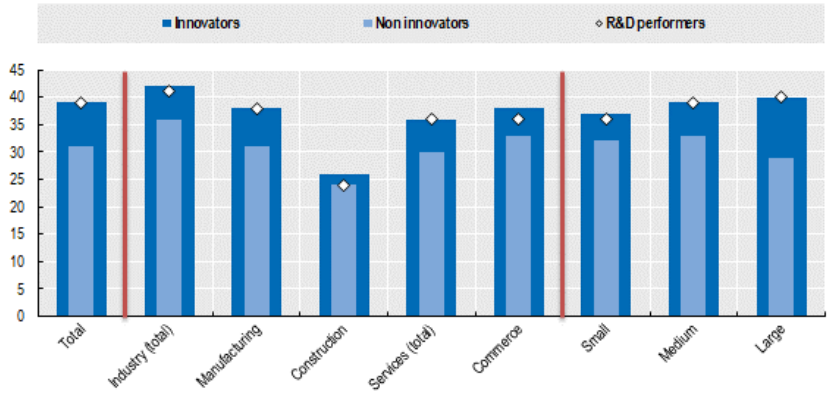
Authors'elaborations on Istat data

It is thus confirmed the association between innovation and profitability: innovation-active enterprises are the enterprises with the highest profits (Figure 2). Specifically, R&D performers show better economic performances, both as a whole and in the enterprises of the same average size. Among innovators, large enterprises and those operating in the manufacture experienced the highest profitability margins than reported by non-innovative enterprises in the same classes. More complex indicators, able to capture different dimensions of innovation at the same time - both

[10] Further details are available at the following website: L'innovazione nelle imprese. Anni 2018-2020

from input and output side, about firms' strategies and innovation processes and modalities, allow to define a variety of innovation profiles and to improve significantly the explanatory power of CIS indicators (European Commission, 2023).

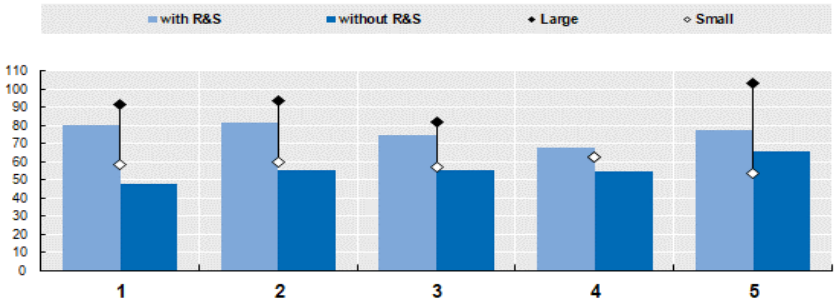
Figure 2 – *Profitability (operating margin per value added) of Italian enterprises by economic activity, size class and type of enterprises. Year 2020 (%).*



Authors'elaborations on Istat data

From profiling innovators, a clear-cut result has arisen. Innovators are characterized by different productivity levels, varying in relation to the firms' innovation choices: more sophisticated innovators, that is enterprises oriented towards more complex, diversified and pro-active strategies, are those with greater productivity levels (Figure 3).

Figure 3 – *Labour productivity of Italian enterprises by innovation profile and firm's size. Year 2020 (value added per employee).*

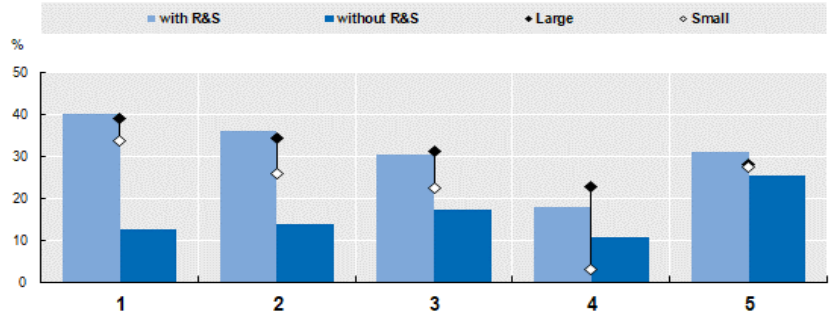


1. In-house product innovators with market novelties; 2. Other in-house product innovators; 3. In-house process innovators; 4. Innovators that do not develop innovations themselves; 5. Innovation-active enterprises

Authors'elaborations on Istat data

Looking at the presence of innovators in foreign markets, a close association between the high level of innovation and the propensity to exports results from integration (Figure 4). More export-oriented enterprises are the most sophisticated innovators: better exports' performances are associated to more complex strategies based on investments in R&D and on the development of new products for their reference markets.

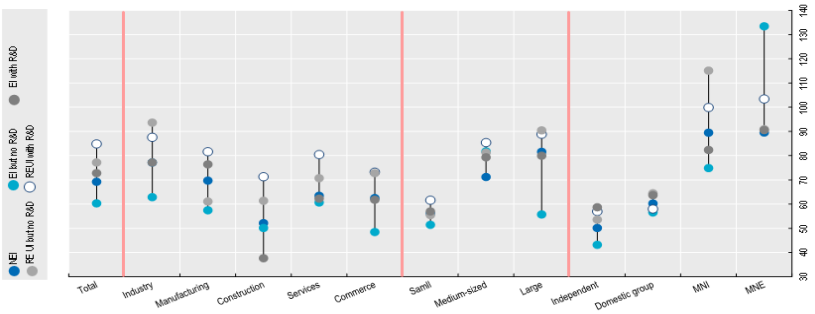
Figure 4 – *Exports of Italian enterprises by innovation profile and firms' size. Year 2020 (% on revenues).*



1. In-house product innovators with market novelties; 2. Other in-house product innovators; 3. In-house process innovators; 4. Innovators that do not develop innovations themselves; 5. Innovation-active enterprises
Authors' elaborations on Istat data

Turning to the green innovation, during the period 2018-2020 enterprises that implemented eco-sustainable measures, particularly in energy efficiency, are those with better economic results among innovators. In general, enterprises that adopted eco-sustainable innovative measures did not record better performance than enterprises less sensitive to environmental issues, except for foreign-controlled multinationals and medium-sized enterprises (Figure 5).

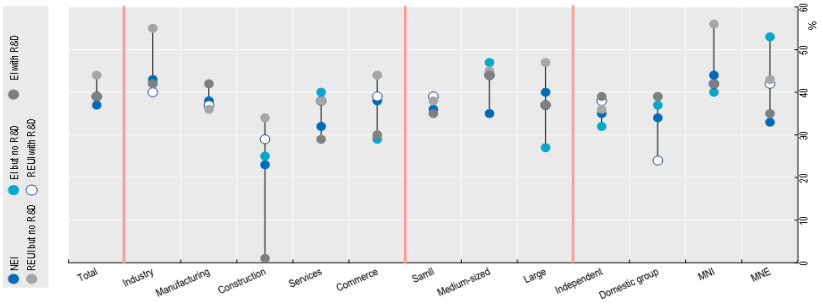
Figure 5 – *Labour productivity of innovation active enterprises by economic activity, size class, corporate control and innovation profile. Year 2020 (thousands of Euro).*



NEI: no environmental innovation; EI: environmental innovation; REUI: innovation aimed at reducing energy use
Authors' elaborations on Istat data

However, enterprises that invested in innovative low-energy consumption technologies, especially if their investments had a R&D component, show a significant productivity gap compared to those that innovated without considering environmental issues. The profitability analysis also reflects a similar general trend: eco-sustainable innovative choices correspond to higher profitability levels, although at the level of firms' categories, the resulting picture is not always clear-cut, and the indicators do not always show consistent directions (Figure 6).

Figure 6 – *Labour productivity of innovation active enterprises by economic activity, size class, corporate control and innovation profile. Year 2020 (thousands of Euro).*



NEI: no environmental innovation; EI: environmental innovation; REUI: innovation aimed at reducing energy use
Authors'elaborations on Istat data

7. Conclusion

Data integration is a cost efficient way to improve and diversify existing statistics. Specifically, this integration's work may represent a significant potential in gathering new statistical evidence without increasing the burden placed on respondents and producing at the same time estimates representative of total population. However, some drawbacks exist and must be dealt with in the future. Firstly, there is no convergence at regional level: estimates obtained from this data integration's exercise cannot be used in regional analyses. If we want to replicate this work for analyzing how different are innovators across regions, we need to build another system of weights. Otherwise, we must look for alternative methodological solutions. Secondly, from this exercise we haven't got any information on the cause-and-effect relationships between innovation and economic performances, but we can provide just some basic clues about their associations. In the future, we should repeat this work according to a dynamic perspective, that is by integrating both CIS and FRAME SBS earlier data going back as many years as possible, in order to explore how successful innovation impacts on the economic performances in the longer run

and if there are inverse relationships between economic and innovation variables, since causation can run in the opposite direction.

References

ARNALDI S., AURELI P., CARUCCI A., CURATOLO S., DI FRANCESCANTONIO T., FARAMONDI A., FILIPPELLO R., NARDECCHIA R., PUGGIONI A., REGANO A., RIZZI R., SACCO R., SANZO R., SASSAROLI P. 2020. Il trattamento delle fonti amministrative per la costruzione del sistema informativo sui risultati economici delle imprese italiane (Frame SBS), *Istat Working Papers 6*, Istat.

EVANGELISTA R., MASTROSTEFANO V. 2006, Firm size, sectors and countries as sources of variety in innovation. In *Economics of Innovation and New Technology*, Vol. 15, No. 3, pp. 247-270.

GEROSKI P., MACHIN S., VAN REENEN J. 1993. The Profitability of Innovating Firms. *RAND Journal of Economics*, Vol. 24, No. 2, pp. 198-211.

GUELLEC D., PILAT D. 2008. Productivity growth and innovation in OECD. In OECD Eds. *Productivity measurement and analysis*, pp. 41-59.

NURRA A., SERI G., TOMEO V. 2024. Integration between data from register and sample surveys: enterprises classified by use of ICT and economic indicators, *Italian Journal of Economic, Demographic and Statistical Studies*, Vol. LXXVIII-1, pp.77-87.

OECD. 2009. *Innovation in Firms: A Microeconomic Perspective*. Paris: OECD Publishing.

OECD. 2010. *The OECD innovation strategy. Getting a head start on tomorrow*, Paris: OECD Publishing.

OECD. 2018. *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation, 4th Edition, The Measurement of Scientific, Technological and Innovation Activities*, Paris: OECD Publishing.

SERI G., ICHIM D., LUCHETTI F., COSTA S., NURRA A., MASTROSTEFANO V., SALAMONE S., PASCUCCI C., ORSINI D. 2016. Integrazione del Frame con altre indagini e fonti amministrative ai fini della produzione di indicatori complessi, *Istat Working Papers 17*, Istat.

ZARDETTO D. 2015. ReGenesees: an Advanced R System for Calibration, Estimation and Sampling Error Assessment in Complex Sample Surveys, *Journal of Official Statistics*, Vol. 31, No 2, pp.177-203.

Valeria TOMEO, Istat, tomeo@istat.it
Valeria MASTROSTEFANO, Istat, mastrost@istat.it