

Digital technologies and firm performance: Industry 4.0 in the Italian economy

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Abstract ID: 22

Inviato: 02/05/2021

Evento: XIX Workshop Annuale SIEPI

Argomento: XIX Workshop Annuale SIEPI

Parole chiave: Industry 4.0; productivity; labour; firm performance

There are great expectations on the performance-enhancing effects of investments in new digital technologies (Syverson 2011; Brynjolfsson and McAfee 2014). Digital technologies should enable firms to improve business processes, to automate routine tasks and to reduce costs of interactions with suppliers and customers, thus increasing firm productivity (Bartel et al. 2007; Akerman et al. 2013; Graetz and Michaels 2018). However, empirical evidence at the firm levels is still scant (NAS 2017; Raj and Seamans 2019). Moreover, the available evidence is overwhelmingly focused on robotics, which is only one of a broader cluster of new enabling technologies (Martinelli et al. 2021) and is not unanimous in reflecting the revolutionary expectations placed on this new production paradigm (Acemoglu et al. 2014; DeStefano et al. 2018; Cette et al. 2017; Gal et al. 2019).

The links between adoption of digital technologies and productivity are complex, and their empirical identification has remained a challenge because of the scarcity of appropriate microdata (Raj and Seamans 2019). This has made the analysis of firm-level effects of adoption difficult or altogether impossible in many economic contexts. This is unfortunate because only the use of firm-level data can shed light on productivity and performance dynamics of today's businesses, so that management can make informed strategic decisions and policy-makers design suitable measures to support technical change and/or adapt to possible unanticipated consequences of the digital transformation of production.

In this paper we aim to contribute to this research agenda and help to fill the gap in the micro-level evidence on the performance effects of new digital technologies. By using new and original data on a large sample of Italian firms, we assess how and to which extent new digital technologies (Internet of Things, Robotics, Big Data Analytics, Augmented Reality, and Cybersecurity) affect labour productivity, (average) wages and firm growth. The data are drawn from the Rilevazione Imprese e Lavoro (RIL for short), run by the Inapp (Istituto nazionale per l'analisi delle politiche pubbliche). We exploit specific questions contained in the 2018 wave of the survey, which collected detailed information on investments in digital technologies associated with the so called 'Industry 4.0' paradigm (Kagermann et al. 2013) in a representative sample of Italian firms. We merge these data with Orbis archive records over the period 2010-2014-2018 and obtain a panel of approximately 3,000 firms. We explore the relationship between technology adoption, productivity and wage performance, and run further tests to evaluate whether the introduction of Industry 4.0 (I4.0) technologies

is associated with firm growth. A Diff-in-Diff approach allows us to mitigate concerns for unobserved heterogeneity and endogeneity. To foreshadow our main results, we find that the adoption of digital technologies exerts a positive effect on labour productivity, average wages and sales. In the terms of magnitude of the effect, the largest increment is recorded on productivity. Moreover, the positive impact of I4.0 appears to be especially strong for small and medium-size firms.

Abstract per sessione Fabio Landini