

# **Diving into the “Digital Age”: a new task-based approach to inter-groups wage inequality in Italian provinces**

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## **Extended abstract**

Inter-groups wage inequalities in Italian workforce are a well-known and documented phenomenon (Lilla and Staffolani, 2009; Devicienti et al., 2019); these disparities, usually analysed through the lens of the endowment of skills, are under the pressure of multiple drivers (Luca and Fana, 2021) among which technological change play a pivotal role. If in the past these transformations were referred mainly to robotization and automation – and ICTs -, nowadays they are even more significant because they occur under the load of a totally new and extreme disruptive phenomenon: digitalisation.

Inequalities between groups have been initially analysed through the lens of skills, highlighting the difference between high and low skills workers with the former taking advantage in terms of employment and wages upon the latter (i.e. the so-called “Skill-Biased Technical Change”, Autor et al., 2002).

In the early 2000s a new trend of “polarization” of the workforce took place at the expense of middle skilled workers experiencing a shrinking of their salaries and occupation (Spitz-Oener 2006; Autor and Dorn 2006; 2009; Goos et al. 2014). This phenomenon occurred in Italy as well; indeed, between 1995 and 2015, both high and low-skill occupations grew at rates exceeding 4.5% between 1995 and 2015. Conversely, there was a roughly 10% decline in middle-skill jobs (OECD, 2017; Cirillo et al., 2021).

This shift led to the emergence of a new conceptual framework, the so-called “Routine-Biased Technical Change” (RBTC), which removes skills from the center of analysis and interprets new labor market phenomena according to the degree of "routiness" of the work performed (Autor et al., 2003). In this setting, even the very concept of "work" changes, becoming a "bundle of tasks", meaning a set of tasks performed by workers (Autor 2013; Autor and Dorn, 2013). Accordingly, remuneration for work is no longer based on the skills possessed, but rather on how much the tasks performed by workers are routinized, arguing that the more repetitive a job is, the higher is the chance to be replaced by machines and thus the more penalizable it is in the labor market; conversely, the “non-routine” jobs are expected to be less exposed to substitutability.

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In our opinion, this theoretical debate presents three significant gaps that we intend to fill.

- (1) The whole body of studies regarding inequality in wage distribution due to the impact of new technologies dedicated its attention mainly to robotization and automation processes (see Acemoglu and Restrepo, 2020 for US, and Caselli et al., 2021 and Dottori, 2021 for Italy); this is largely justifiable since robots threatened to massively replace workers, especially low skilled ones. On the other hand, much less consideration has been given to digital technologies, due to their extremely complex and multifaced nature. Nevertheless, economic theory does not help us in assessing the final effect of digitalization on the workers' wage share; in fact, new digital technologies can create jobs without augmenting their productivity (Autor and Salomons, 2018) and the impact of new digital technologies on inter-group wage disparities is based on how the productivity and reinstatement effects of digitalization interact across various occupational categories (Capello et al., 2024). The result on wages depends on many contextual factors, and there is still no theoretical explanation for that.
- (2) The second novelty regards the division of the workforce into groups; up to now, the most common method is based on skills but - following the shift from SBTC to RBTC - tasks rather than skills seem to be able to better explain recent labor market dynamics (i.e. polarization). At the same time, there are lesser contributions in literature that aim to explain inter-groups wage inequality following the tasks division proposed in the "task-based approach" (see Sebastian and Biagi, 2018 for a review); in addition, these works present so far two main limits: firstly, their subdivision of workforce into groups according to tasks is made thinking more at robotization rather than digitalization, and secondly they analyzed task dimensions already combined rather than accounting for their effects per se.

According to this reasoning, we propose a twofold step forward in the conceptual and empirical investigation of such phenomena:

- we challenge the absolute centrality of the concept of *routiness* in explaining wage and occupation dynamics: indeed, digitalization makes automation of task just a matter of time in many cases (Frey and Osborne, 2013) and technical displacement is (gradually) no longer confined to routine tasks but enhanced to other, non-routine manual and cognitive tasks;
  - we argue for the necessity of accounting the effects on tasks dimension separately before combining them between each other: in particular, digitalization is strongly connected with the *cognitive* dimension, and it is expected to enhance knowledge flows by providing effective tools to act as mediums and enablers for knowledge work (Schmenner, 2004). At the same time, digital technologies are already automating *cognitive non-routine tasks*: software and algorithms in machines can perform increasingly complex tasks, and they will continue in the future as well.
- (3) Finally, we firmly believe that *where* a technology is adopted is extremely relevant in determining the effect on the labor market; in this sense, territories can act like a catalyst for inequalities (Camagni, 2020). Moreover, diverse labor markets respond differently to the integration of new digital technologies. While prevailing studies have generally presupposed that the effects of embracing technology are uniform across various regions, the dynamics of agglomeration economies can create substantial variability in labor markets outcomes based on their specific location. Particularly, due to urbanization economies originating from a rich and diverse assortment of sectors and functions and a consequent high variety of the urban workforce (Camagni, 1992; Duranton and Puga, 2020), metropolitan areas are likely to see an amplified productivity and reinstatement impact from the influx of these digital innovations for both low and high-skilled workers and across different task dimensions. As a result, urban centers may act as multipliers of wage disparities (Capello et al., 2024).

Nevertheless, the spatial diversity in how digitalization correlates with inequalities has not been extensively discussed in the academic debate, apart from few exceptions such as Fossen and Sorgner (2022), Autor and Dorn (2013) and Acemoglu and Restrepo (2020) which however did not compare the impacts in different settlement types, such as urban versus non-urban areas.

In particular, we decided to study the case of Italian NUTS3 regions due to its high relevance: despite Italy's current position at the lower end of Europe's digital investment spectrum (measured by DESI, see OECD, 2018), in fact, there is a concerted effort to improve its ranking and change this trajectory, as testified by the huge investments located for enhancing digitalization in the current PNRR national plan and by a significant increase in the number of businesses employing ICT for data exchange, growing from just 21.5% in 2012 to 36.5% in 2017, (Cirillo et al., 2021).

Moreover, the huge differences in both within and between Italian regions make Italy an extremely remarkable case study; indeed, often large urban centres and rural areas coexists within same regions. It is interesting, therefore, to study how digitization will impact at the territorial level given all this variety.

So, the present paper aims to contribute to this debate. We argue that the analysis of the RBTC may be challenged from the advent of new digital technologies and from their pervasiveness; in fact, digitalisation is the first innovation so far that by its very nature does not replace work entirely, but is also capable of complementing it, thus increasing the productivity of some tasks, replacing others, and changing the way others more are performed, without necessarily displacing workers (Ballestar et al., 2021).

(1) The question we ask here, then, is: *which groups of workers could benefit most from digitalisation?*

In fact, the division into groups, consistent with the "task-based approach," is no longer done according to skills but according to the tasks being performed by workers (Acemoglu and Autor, 2011; Acemoglu and Restrepo, 2022). The nature of digital technologies, which according to some authors do not merely affect workers according to the degree of routiness of their tasks (Frey and Osborne, 2017), leads us to also consider the "cognitive" and "manual"- as well as the "routine" and "non-routine"- dimensions per se, then crossing these dimensions with each other. Indeed, digitalisation can have a major impact on "knowledge" workers, most of which lie in the "cognitive" dimension, supporting the idea of building distinct task dimensions (Franssila et al., 2015; Yu et al., 2018).

Moreover, digitalisation does not have an equal speed of penetration over every territory; on the contrary, it affects cities and "non-cities" differently, entering the former more quickly and pervasively (Camagni et al., 2023). Importantly, the operation of agglomeration economies in large urban centers (Camagni and Capello, 2015) favours the attraction of investments, which enable the construction of the necessary digital infrastructure; moreover, in cities there is greater capacity of governance, and more resources are available to manage the entire process, in a sort of virtuous circle.

(2) The further question we ask then, by focusing on the case of Italian NUTS3 regions is *whether employment and wage inequalities among different occupational groups vary between cities and countryside and whether such difference defines an explanation in the different occupational groups that are affected by digitalization.*

In other words, we want to understand whether the spatial dimension plays a role in influencing the dynamics of inter-groups wage inequality. In this perspective, space does not simply "host" an unequal distribution of resources but plays an active role in promoting inequalities.

Empirically, we merge (1) the ICP dataset (Inapp), which is the Italian version of O\*Net data, the most extensive repertoire providing extremely detailed qualitative and quantitative data on tasks, the work environment, and organizational characteristics of workplaces, focusing on occupations and (2) the Labour Force Survey (Istat), which is the largest survey carried out in Italy to track the dynamics of the labor market on a quarterly basis, offering data on labor market institutions, employment, wages, etc. Using this merged dataset, we operate a factor analysis based on the variables concerning the tasks performed by workers, which allows us to construct indices that tell us the percentage that each professional unit (5-digit level of detail of the ISCO classification) scores in the task dimensions (cognitive, manual, routine, non-routine). In this way, we can build a taxonomy of occupations, that allows us to know the composition of the workforce by task dimension in Italian provinces, jointly with information on wages and employment.

Moreover, we employ the ICT dataset (Istat), which collects data on the use of digital technologies at the firm level, for companies with at least 10 employees active in industry and in non-financial services until 2019, using cloud computing adoption by firms as a proxy for digitalisation intensity. Since these data are provided at NUTS2 level, we apportion them at NUTS3, using the level of specialization in the private sector and the share of households with broadband access as weights for our estimation; this method follows Camagni et al. (2023), in line with the literature (Acemoglu and Restrepo, 2020). Then, through a spatial regression model and using digitalisation as the main explanatory variable, we measure how much digitalisation influences the different distribution of wages across different occupations and Italian provinces, while also examining what role the spatial dimension plays in determining the distribution and the intensity of phenomenon.

In conclusion, this study contributes to the literature in both regional and labour studies fields in three directions. First, by conducting a factor analysis (based on tasks) on Italian workforce data, we have successfully partitioned the workforce into distinct task dimensions. This work also reframes the technical change debate in the literature, focusing on the specific role of digitalisation in fostering wage inequalities and regional disparities and offering a conceptualization and empirical measurement of the task-based approach, specifically adapted for the digital age. Lastly, we conceptually elaborate the role of territories in promoting wage inequalities under the pressure of new digital technologies, considering the specificities of Italian context.

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