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How to support Italian firms to invest in Data and Software? Why does it matter?

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Introduction

Investing in Data and Software (D&S) is a necessary condition for firms to enhance AI adoption and applications. D&S may enhance the productivity of other types of intangible investments (Bontadini et al., 2026). In our research, we focus on R&D and argue that firms investing in D&S benefit from lower market uncertainty and might ‘afford’ the intrinsic uncertainty of investments in basic and applied research, the innovation input *par excellence*. Our evidence on Italian firms supports this conjecture and points to complementarity between D&S expenditures and R&D: firms that invest in both have higher labour productivity (Mohades and Savona, 2025). This paper discusses policy instruments that magnify the productivity effects of R&D by jointly supporting R&D and D&S investments.

In what follows, we first briefly compare Italy’s intangible investment with that of other European economies and across sectors. We then present our firm-level evidence and discuss its implications for innovation policy.

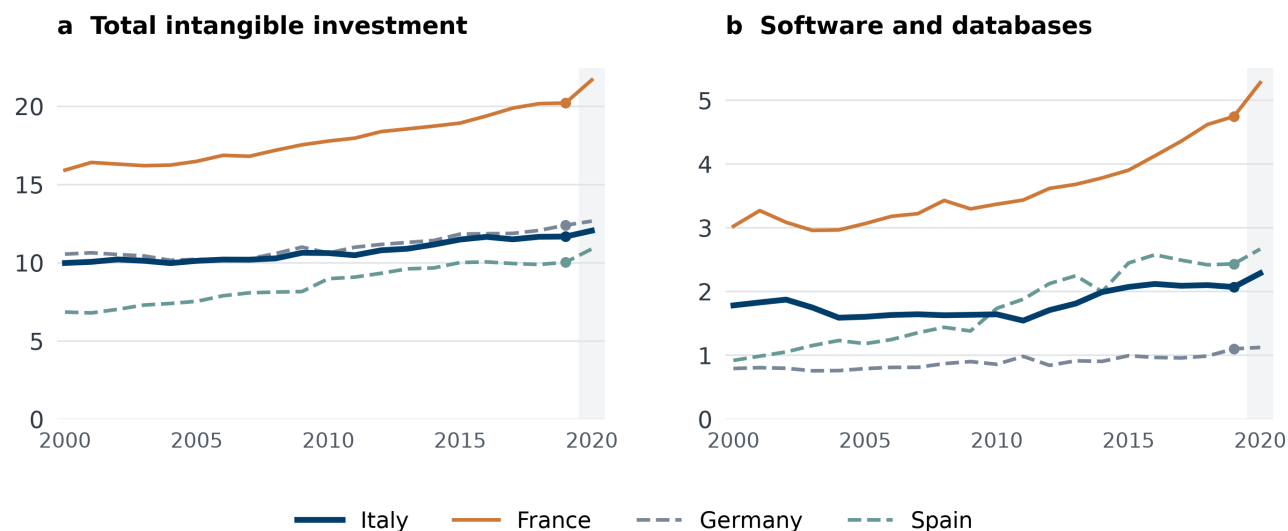
Intangible investments: Italy and Europe

EUKLEMS & INTANProd (Bontadini et al., 2023) record €140.0 billion of intangible investment in Italy’s market economy in 2019, equivalent to 11.7% of adjusted gross value added. D&S accounted for €24.8 billion, or 2.1% of value added. These investments are central to Industry 4.0, where machinery and production systems increasingly adopt and use software, databases, and research.

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Figure 1. Intangibles in Italy and Europe since 2000

Investment as a percentage of adjusted gross value added

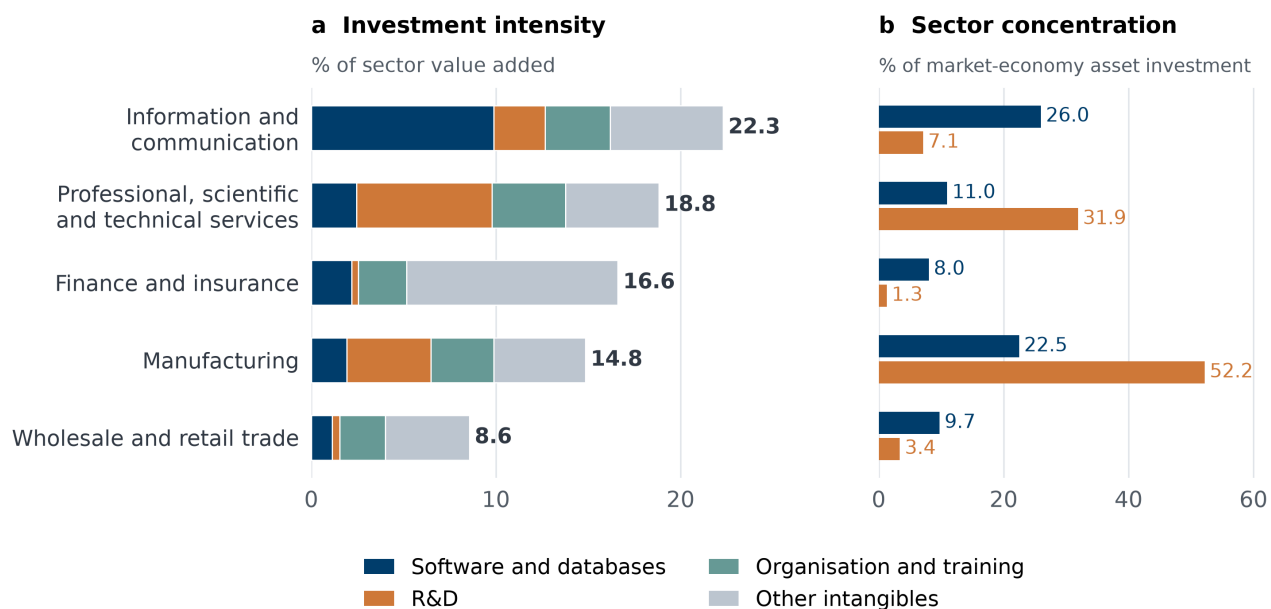


Source: authors' calculations from EUKLEMS & INTANProd. Published market-economy aggregates; current-price investment divided by adjusted gross value added. Dots mark 2019; shading marks 2020. Software and databases are measured jointly. See Data and sources for definitions.

Italian intangible intensity increased from 10.0% of adjusted value added in 2000 to 11.7% in 2019. The 1.7 percentage-point increase compares with 4.3 points in France, 1.8 in Germany and 3.2 in Spain. Italy and Germany were almost level in 2010, at 10.6%, but Germany reached 12.4% by 2019. Italy has therefore increased its intangible investment, but more slowly than several of its main European comparators, which themselves face a sizeable digital and intangible investment gap with the United States and, more recently, the United Kingdom.

The Italian increase also differed markedly across assets. Between 2000 and 2019, R&D rose from 1.4% to 2.1% of adjusted value added, while organisation and training increased from 2.4% to 3.0%. D&S rose only from 1.8% to 2.1%, with little change after 2015. Italy remained above Germany in D&S in 2019, but below Spain (2.4%) and France (4.7%).

Five sectors accounted for 80.1% of Italy's market-economy intangible investment in 2019: manufacturing, professional and technical services, wholesale and retail trade, finance and insurance, and information and communication. Their investment profiles, however, differ considerably (Figure 2).

Figure 2. The sectoral composition of Italian intangible investment in 2019

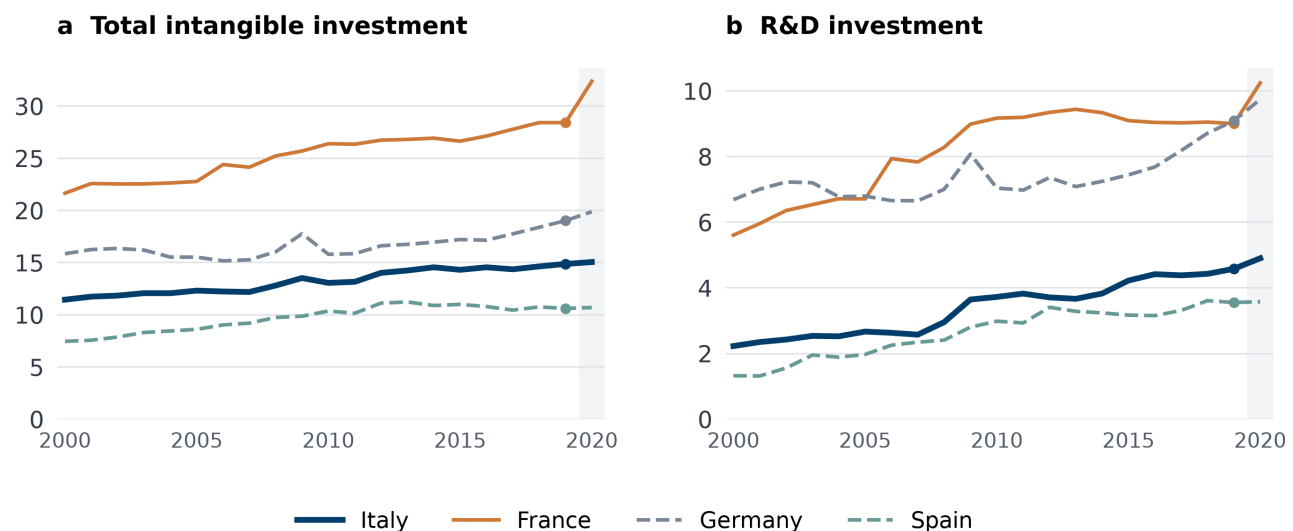
Source: authors' calculations from EUKLEMS & INTANProd. The five largest sectors by total intangible investment, ordered by sector intensity. Panel a uses each sector's adjusted value added; panel b uses market-economy investment in the corresponding asset. NACE sections J, M, K, C and G. Other intangibles are defined under Data and sources.

Information and communication had the highest intangible intensity among the five sectors, at 22.3% of adjusted value added, with D&S accounting for 9.9%. The sector generated 26.0% of Italy's D&S investment while accounting for only 5.4% of market-economy adjusted value added. Manufacturing was the largest investor in absolute terms, with €43.3 billion, or 30.9% of the market-economy total. It accounted for 22.5% of D&S investment and 52.2% of R&D. Professional, scientific and technical services contributed another 31.9% of R&D, bringing the two sectors' combined share to 84.1%. In finance and trade, R&D accounted for only around 0.4% of value added, and much of their intangible investment took other forms.

Manufacturing is particularly relevant for the Industry 4.0 comparison. Its intangible intensity rose from 11.4% of adjusted value added in 2000 to 14.8% in 2019, about twice the increase for the market economy as a whole. R&D increased from 2.2% to 4.6%, accounting for around 69% of that increase.

Figure 3. Intangible investment and R&D in manufacturing

Investment as a percentage of adjusted gross value added



Source: authors' calculations from EUKLEMS & INTANProd. Published manufacturing aggregate, NACE section C. Current-price investment as a percentage of manufacturing adjusted value added. Dots mark 2019, and shading marks 2020.

The increase was not enough to close the gap with France and Germany. In 2019, manufacturing intangible intensity stood at 28.4% in France, 19.0% in Germany, 14.8% in Italy and 10.6% in Spain. Part of this difference may reflect Italy's greater concentration of manufacturing in relatively low-productivity industries such as fashion, leather and food and beverages (Ascari & Trezzi, 2026).

R&D accounts for much of the difference between Italian and German manufacturing in 2019. German manufacturing invested 9.1% of adjusted value added in R&D, compared with 4.6% in Italy. Italy, however, invested more in D&S (1.9% vs 0.7%), while organisation and training were almost identical (3.4% vs 3.5%). Italy's largest gap to Germany, therefore, is in research investment and knowledge creation, and in the lack of a growing high-tech manufacturing industry.

Italy's gap with its European peers can result both from a lack of investment within sectors and from a poor allocation of resources to high-tech and high-value-added sectors. While the previous evidence suggests that reallocation between sectors has been slow, the manufacturing figures raise a within-sector question that requires firm-level data: whether firms that invest more in D&S also invest more in R&D.

D&S, R&D and productivity in Italian firms

Our firm-level analysis studies whether investment in D&S is associated with firms' research activity and productivity (Mohades and Savona, 2025). We use the Bank of Italy's Survey of Industrial and Service Firms, which covers 12,094 firms between 2002 and 2024 and records firms' expenditure on databases and on R&D. Because R&D also generates and uses data, we exploit the 2016 adoption of the General Data Protection Regulation (GDPR),

which raised D&S expenditure more in data-intensive sectors, to separate the effect of D&S on R&D from the reverse relationship.

We find a positive within-year relationship between D&S expenditure and R&D. A one-standard-deviation increase in D&S expenditure per worker is associated with an increase in R&D per worker of about 1.5 standard deviations.

Firms investing more in D&S do not appear to fund that investment by reducing R&D; instead, the two move together. The response is also specific to R&D, as D&S expenditure is not associated with higher investment in plant and machinery, transport equipment or tangible assets overall.

The productivity results point in the same direction. On their own, neither D&S nor R&D is associated with higher labour productivity. The estimated productivity contribution of D&S becomes positive as R&D intensity rises, while the contribution of R&D becomes positive once D&S intensity is high enough. The complementarity is not limited to the year of investment. Related work finds a similar complementarity between internally developed organisational capital and ICT, underlining the role of firms' internal capabilities in making digital investment productive (Bontadini, Jona-Lasinio and Nicoletti, 2026).

One reason D&S may support research is that it improves demand information. Innovation is inherently uncertain because firms do not know in advance whether new products or processes will succeed. Better information about sales and market conditions can reduce part of that uncertainty and make R&D investment easier to sustain. Our forecast-error analysis is consistent with this mechanism: from the mid-2010s onward, part of the relationship between D&S and R&D runs through smaller errors in firms' forecasts of their sales growth. This timing coincides with the diffusion of big data analytics, machine learning and cloud computing, in line with evidence that the effects of digital technologies differ across stages of their diffusion cycle (Jaccoud et al., 2026).

How existing instruments can support a data-enhanced R&D investment

Italy's digitalisation and datafication challenge goes beyond investing in hardware and software. Skills and managerial capabilities are especially important for smaller firms (Calvino et al., 2022). A software investment may also require staff time to reorganise records, integrate databases and adapt working practices before it contributes to production or research. The distinction between asset categories in the statistics is therefore less clear-cut inside the firm.

The Deloitte memorandum provides a historical overview of support instruments (Canini and Stefanucci, 2026). Italy's 2018 digitalisation voucher covered hardware, software, specialist services and ICT training, reimbursing up to 50% of eligible expenditure with a €10,000 ceiling. Spain's Kit Digital instead organised support around categories of digital solutions and approved providers. Estonia's digital-transition grant combined technology, research, training and project personnel within a digitalisation roadmap. The programmes differ in what they consider part of an intangible investment, regardless of their relative success on this point.

This matters because adopting a digital technology involves more than buying the technology itself. Italy's voucher, for example, allowed firms to purchase services and training alongside hardware and software. Estonia went further by including research and project personnel. For the firm-level relationships documented above, the important

question is which parts of the investment process are eligible: acquiring the digital input, developing the capabilities needed to use it, or applying it directly to research.

However, the policy portfolio for supporting intangible investments is not only limited to easing funding hurdles. In some cases, redefining accounting standards and practices can allow firms to indirectly benefit from renewing their software and databases. For example, in the UK, for accounting periods beginning on or after 1 April 2023, qualifying R&D expenditure can include data licences and cloud computing services used in eligible research (HMRC, 2024). The same D&S investments can therefore be treated differently depending on the activity for which they are used. Our research shows that combining D&S and R&D is associated with higher firm productivity. Therefore, including D&S expenditures in R&D accounts, when used for innovation purposes, can become a common practice in Italy.

Financial incentives and data-access rules address different constraints. R&D tax credits lower the cost of eligible research, while rules governing access and reuse determine which information firms can obtain and use. This distinction may matter most for smaller firms with relatively little proprietary data. Data rules can also shift investment. In our analysis, GDPR adoption raised D&S expenditure more in data-intensive sectors, and R&D rose with it. A clearer legal framework for data can therefore support firms' incentives to invest in D&S and, through it, in R&D.

The firm-level evidence suggests that D&S and R&D should not be considered in isolation: firms that invest more in D&S also invest more in R&D, and productivity is higher when the two are combined. This matters for Italy, where intangible intensity has grown relatively slowly, and manufacturing combines a sizeable R&D gap with France, which has higher investment in D&S.

Notes: Data and sources

The figures use the 1995–2020 series from the analytical module of EUKLEMS & INTANProd and the 2023 variable dictionary, with charts beginning in 2000. Investment variables measure annual gross fixed capital formation at current prices, in millions of euros for the countries shown as investment flows.

Adjusted gross value added combines national-accounts value added with investment in intangible assets that fall outside the national-accounts asset boundary. The published market-economy aggregate excludes NACE sections L, O, P, Q, T and U, while manufacturing corresponds to section C. Sector shares of national investment use the published market-economy aggregate as the denominator; sector intensities use each sector's own adjusted value added. We use the published aggregates directly and do not add overlapping sector classifications.

Software and databases are reported jointly, so the data do not allow us to isolate investment in data alone. Organisation and training combine organisational capital with employer-provided training. Other intangibles include industrial design, brands, new financial products and other intellectual-property products. Figure 2 selects the five sectors with the largest total intangible investment in 2019 rather than those with the highest growth rates. Percentage-point changes refer to differences in investment-to-value-added ratios.

The firm-level evidence draws on the INVIND database of the Bank of Italy. More details are provided in Mohades & Savona (2025).

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