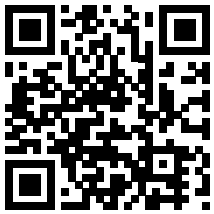
XI CONSILIATURA 2023-2028

ANNUAL REPORT ON PRODUCTIVITY IN ITALY 2026

NOVEMBER 2026

XI CONSILIATURA 2023-2028

ANNUAL REPORT ON PRODUCTIVITY IN ITALY 2026



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RESPONSIBILITY FOR INDIVIDUAL CONTRIBUTIONS

The analyses, interpretations and proposals presented in the individual contributions are the responsibility of their respective authors. Participation in the preparation of this volume does not imply agreement with the assessments expressed in other contributions, nor does it imply endorsement by the institutions to which the authors belong.

SCIENTIFIC AND EDITORIAL COORDINATION

Renato Brunetta and Luca Paolazzi.

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APPENDIX I – ARTIFICIAL INTELLIGENCE AND PRODUCTIVITY

Appendix I, entitled "Artificial Intelligence and Productivity: A Review of Empirical Evidence. Microeconomic and Macroeconomic Findings and Initial Insights into Agentic AI", was prepared by the Committee on the Economics of Artificial Intelligence, chaired by the President of CNEL Renato Brunetta and members Rosario Cerra, Scientific Coordinator, Francesco Crespi, Alessandro Rinaldi, Eleonora Pierucci, Dario Guarascio, Carlo Cambini and Emanuele Dagnino.

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STATEMENT ON THE USE OF GENERATIVE ARTIFICIAL INTELLIGENCE AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

In preparing this work, the authors used artificial intelligence tools to assist with the drafting and/or revision of certain parts of the manuscript. Following the use of these tools, the authors carefully reviewed, revised and verified the content and accept full responsibility for the accuracy and integrity of the published work.

ORIGINS AND MANDATE OF THE BOARD

The CNEL National Productivity Board operates within the framework of the Council Recommendation of 20 September 2016, 2016/C 349/01, which invites Member States in the Euro area to identify or establish bodies tasked with analysing developments and policies relating to productivity and competitiveness on the basis of transparent and comparable indicators and independent analyses. The mandate covers the drivers of long-term growth, innovation and the capacity to attract investment, businesses and human capital, as well as cost and non-cost factors relevant to international comparisons.

The Board was established by Determination of the President of CNEL No. 69 of 10 July 2024, Protocol No. 1943, adopted pursuant to Article 9 of the Rules governing CNEL's bodies, organisation and procedures, in the version currently in force, approved by the Assembly on 18 December 2025 and published in the Italian Official Gazette No. 5 of 8 January 2026. Its current composition was established by Decree of the President of CNEL No. 29 of 27 January 2026, Protocol No. 331.

THE EUROPEAN DIMENSION

The European Commission website features the Italian National Productivity Board among the European Productivity Boards, with a dedicated page on Italy setting out its mandate and publications. Comparisons with other national bodies provide an opportunity to discuss methods, evidence and policies, and to situate Italy's specific characteristics within the broader European Union framework. The Board's institutional position within CNEL brings economic research into dialogue with the practical experience of representatives of the productive sectors, while safeguarding the independence of the analyses and ensuring that responsibility for individual contributions remains clearly identifiable.

Carlo Altomonte, a CNEL Council member appointed by the President of the Italian Republic, oversees Italy's participation in the European project ProdTool – NPB 2.0 (Micro-Data Analysis Tool 2.0 for Comparative Productivity Studies at National Productivity Boards), which focuses on business competitiveness and is funded by the European Union through the Technical Support Instrument (TSI). At the national level, the Committee's activities are carried out in collaboration with Istat, while at the European level, they are conducted in close operational coordination with the corresponding bodies in Austria, Finland, Germany, Greece, Malta, the Netherlands and Slovenia.

THE WORK PROGRAMME AND PUBLICATIONS

The Board's work programme is conceived as an ongoing activity focused on knowledge-building, dialogue and in-depth analysis. The Annual Report serves as the programme's main synthesis document: it reconstructs trends in Italian productivity in comparison with other countries, examines its determinants and differences across sectors, geographical areas and firms, and provides evidence to inform policy discussions. Bringing together different contributions makes it possible to connect aggregate indicators with the economic and organisational processes that shape them.

The Report is complemented by a series of Working Papers devoted to specific issues and methodological developments. These papers allow individual research areas to be examined in greater depth, each according to its own timeframe and level of detail, thereby informing both the annual synthesis and subsequent work. The volume refers to them through dedicated boxes and references to the full publications, collected in Appendix II. The Report and the Working Papers thus constitute interconnected components of a single research programme.

EVIDENCE, INTERPRETATIONS AND PROPOSALS

The working method distinguishes between the results of statistical analyses, their interpretation and economic policy recommendations. Sources, scope, observation periods and methodological choices are specified in each contribution. Dialogue among researchers, institutions and social partners makes it possible to test interpretations and discuss the conditions required to implement proposals, without presuming that all authors or their respective institutions endorse every assessment contained in the volume.

UPDATING THE INFORMATION BASE

Statistical material and quantitative analyses reflect the information available at the time the individual contributions were prepared, before the presentation of the 2026 Public Finance Planning Document (*Documento programmatico di finanza pubblica*, DPFP), approved by the Council of Ministers on 2 October 2026. The President's Introduction and the updates to the narrative sections also take account of the latest estimates set out in the DPFP, particularly those relating to potential growth and the contribution of total factor productivity. These updates enrich the interpretation of the findings and should be read in light of differences in methodology, scope and reference period compared with the Report's quantitative analyses.

TRANSLATION NOTE

This English edition of the Report was translated from the original Italian by Michela D'Ambrosio.

INTRODUCTION

Prof. Renato Brunetta, President of CNEL

Productivity as a Development Project; From the First Edition of the Report to an Ongoing Programme of Knowledge-building; Strengths and Persistent Weaknesses in a Recovery That Must Be Consolidated; Firms, Skills and Territories; Collective Bargaining and the Labour Market in the Analysis of Productivity; Worker Participation in the Creation and Sharing of Value; Young People and Italy's Attractiveness in Shaping the Future of Production; Research and the Diffusion of Innovation; The Automotive Industry and the Renewal of Productive Capabilities; Measuring Value amid Economic Transformation; Participatory Artificial Intelligence and Business Transformation; Advanced Robotics, Work and the Welfare State: A Civil-Economy Perspective; Productivity of Institutions and Public Services; A Shared Italian and European Responsibility.

PRODUCTIVITY AS A DEVELOPMENT PROJECT

Italy has the resources to embark on a new phase of development. The 2026 Productivity Report describes a country that has responded to profound shocks, expanded employment, increased its educational attainment and invested in new technologies, while productivity growth remains weak and persistent differences remain across businesses, sectors and territories. Looking at both the strengths and the weaknesses together helps identify the transformations currently under way and the conditions required for them to underpin broader and more sustainable growth.

The Report should be read alongside the work undertaken by the National Council for Economics and Labour (CNEL) on the labour market and collective bargaining, workers' participation in businesses, participatory artificial intelligence, public and social services, young people, and demographic and territorial change. Taken together, these strands of work reveal a coherent vision of development. Research, the social partners and local communities make the Council particularly well placed to examine the relationship between productive capacity and living conditions. In doing so, the Council looks not only at the rigour of economic analysis, but also at the social and organisational conditions that enable people and businesses to fulfil their potential. Bringing these strands of work together makes it possible to understand how value is generated, which choices can increase it, and how its benefits can reach individuals and the country as a whole.

Productivity concerns the capacity to improve people's lives through work, knowledge and the organisation of resources. Real incomes, the quality of services and the strength

of social protections all depend on it, particularly in an ageing country. Making the most of every skill, ensuring that each investment generates greater value, and spreading innovation are essential to reconciling prosperity, social cohesion and the freedom of choice of younger generations. This responsibility also entails ensuring that young people can fulfil their ambitions in Italy, a matter that concerns both individuals and the country's productive capacity.

The decisive challenge is to turn these advances into broadly shared growth, through investment, skills and innovation that reinforce one another and reach a wider share of the productive system. Ensuring continuity in positive transformations, opening up development opportunities and supporting those facing the most difficult transitions are responsibilities shared by the country as a whole.

The Council Recommendation of 20 September 2016 identifies the joint analysis of productivity and competitiveness as the task of National Productivity Boards. For the CNEL, this means examining how innovation and product quality, energy costs, access to finance and the functioning of institutions affect the country's ability to attract investment, businesses and skills. Competitiveness that supports better pay and employment opportunities strengthens the European social model.

FROM THE FIRST EDITION OF THE REPORT TO AN ONGOING PROGRAMME OF KNOWLEDGE-BUILDING

The 2025 Report, the first produced by the National Productivity Board, reconstructed the prolonged slowdown in Italian productivity and highlighted the importance of differences within the productive system, focusing on skills, intangible investment, business growth and territories. It also identified the need to explore more deeply the relationship between reforms, institutions and economic outcomes, through continuous policy monitoring. This year's work builds on that approach and broadens the questions it asks.

The 2026 Report moves from European comparisons to the determinants of productivity, and then to territorial trajectories and business behaviour, linking aggregate indicators to concrete processes. It examines which investments sustain national productivity dynamics, where innovation is concentrated, where skills are put to use, and what helps businesses improve. The result is an overall assessment, open to the further analysis needed to guide economic policy.

Cooperation with Istat and the Bank of Italy is an essential foundation of this work. The quality of the data, the rigour of the analysis and the scientific authority of these institutional partners provide a solid knowledge base for the comparison. This body of evidence is complemented by contributions and perspectives from the academic community and the social partners. The relationship between empirical analysis, interpretation and policy proposals thus takes a form consistent with the nature of the CNEL, which the Constitution recognises as an institutional forum for social dialogue, where economic knowledge meets the experience of work and production.

The plurality of contributions is an asset, provided that the respective responsibilities remain clear. Statistical evidence, scientific assessments and the views of representative organisations all contribute to the same debate, albeit in different ways. Interpretations and proposals are tested against the evidence, without assuming that data alone can de-

termine collective priorities. The Report's public value stems from this dialogue, which combines analytical independence with transparency in its reasoning.

The editorial structure also reflects this evolution. It is designed to connect the overall assessment with a series of thematic Working Papers devoted to specific topics. This connection is provided by summary boxes in the volume and an appendix containing references to the full publications, which are available in digital format. This enables readers to move from the general overview to a closer examination of methods and arguments. The Annual Report brings together the findings of an ongoing research programme that makes the National Productivity Board's body of knowledge more accessible. As with the work carried out by CNEL's other bodies, this process is linked to all research activities carried out under the *Programme of the XI Consiliatura*, with a view to developing a shared understanding of the country's various economic and social priorities.

STRENGTHS AND PERSISTENT WEAKNESSES IN A RECOVERY THAT MUST BE CONSOLIDATED

The analysis presented here also takes account of the updates in the 2026 Public Finance Planning Document (*Documento programmatico di finanza pubblica*, DPFP), which post-date the preparation of the Report's statistical material, in line with the methodological clarifications set out in Chapter 1.

In the international comparison of the economy as a whole, the Report documents average annual GDP growth of 1.0% in 2019–2025, higher than in Germany and France. Hours worked increased by an average of 1.3% a year, while output per hour worked fell by 0.3%. These averages include the post-pandemic recovery and the subsequent slowdown. Italy has demonstrated its capacity to recover, but the expansion of employment must now be accompanied by a stronger improvement in productivity.

The increase in employment is an achievement of considerable economic and social value. For those entering the labour market, it means income, independence, participation and the prospect of a future. Since employment growth can alter the composition of employment and therefore average productivity, it needs to be analysed by sector and activity, rather than solely through aggregate figures. The next step is to enable those in work to generate more value through appropriate skills, tools and organisational arrangements.

The recovery has also brought competitive strengths to the fore that deserve to be developed further. Goods exports have proved resilient in the face of a succession of shocks, and Italy's production specialisation shows signs of evolution, underpinned by the quality of its products, knowledge of markets and supply-chain relationships. The challenge is to broaden participation in these processes, so that the achievements of the most dynamic businesses also benefit suppliers, related services and local areas.

Another positive development concerns the composition of capital. Digital and intangible components have been growing faster than tangible capital for some time, signalling modernisation, although this has so far coincided with weak growth in capital per hour worked. Technological quality and the scale of capital relative to labour must be considered together. Improving capital equipment while making it accessible to a broader range of businesses is therefore part of the same modernisation effort.

For 2025, the analysis of the market economy points to a less pronounced decline in productivity and a slightly positive contribution from capital intensity once again. These developments need to be monitored alongside the continuing weakness of total factor productivity.

The revisions incorporated into the 2026 DPFP provide a more favourable picture of total factor productivity and Italy's growth potential. This is a development to be recognised and examined further, by assessing its significance in comparison with Europe and its capacity to translate into lasting improvements.

Confidence must translate into a strategy that ensures continuity in investment. Businesses make decisions on the basis of expected demand, available skills, the cost and duration of financing, and the predictability of rules. Real incomes and the quality of public demand also help make innovation sustainable. Productivity policy must bring these factors together and foster projects capable of delivering results over time.

FIRMS, SKILLS AND TERRITORIES

The Report shows a country characterised by different development trajectories. Firm-level analyses for 2012–2020 identify processes of catch-up towards the sectoral frontier and a relationship between business growth and productivity dynamics. Improvements within individual businesses must be able to reach markets, people and resources, not least because the performance of the productive system as a whole depends on the weight acquired by its most dynamic activities.

Firm size should be understood as part of this process. Small businesses preserve valuable skills, adaptability and local relationships. At the same time, certain investments require organisational functions, professional specialisations and financial capacity that are difficult to sustain on a small scale. Different growth pathways must be made viable, whether through the expansion of individual firms, mergers and other forms of aggregation, networks, or collaboration along supply chains. Economic policy can help identify the obstacles that prevent each of these arrangements from realising its potential.

The increase in the educational attainment of the workforce is one of the most significant advances documented by the Report. The returns on education also depend on the activities in which skills are used, the responsibilities assigned to workers, and the demand for highly qualified professionals from businesses and public administrations. The gap between rising educational attainment and the spread of skilled occupations therefore raises questions about how organisations operate. Skills policy concerns both the education system and the productive system, which must be capable of using and developing what people have learned.

Continuing education, corporate academies and links with educational institutions can help bring these elements together, provided that they support investment and organisational change, reach smaller businesses and cover the entire course of people's working lives. Managerial quality is particularly important: capable managers can recognise opportunities, select technologies, organise work and make the most of people's abilities, translating investment into results.

The territorial dimension calls for policies that reflect actual development processes. Growth in GDP per capita may reflect an increase in the share of the population in

employment, higher productivity per employed person, or both, as well as changes in demographic composition. Where the employment base has expanded, investment, services and professional opportunities need to be strengthened; where productivity is advancing, knowledge and benefits need to be more widely disseminated. Closing territorial gaps requires attention to the development trajectories and capabilities of individual places.

Territorial cohesion is therefore an integral part of building a stronger productive system. Reliable infrastructure, accessible services, links with research and capable public administrations create opportunities for talent and enterprise beyond established hubs. Southern Italy and the country's inner areas offer opportunities that deserve appropriate policy instruments. The aim is to broaden the geography of development by combining greater participation in employment with professional growth, innovation and the lasting presence of productive activities.

This is the approach underpinning the initiative "Forum CNEL-TER", which connects economic, social and institutional networks so that the resources and knowledge can contribute to a common project. The Council's work on inner areas and the loss of access to essential services demonstrates the practical relevance of this approach. Care services and reliable transport connections can free up time for work and open up opportunities, while their absence can constrain the choices available to families and businesses. Assessing the accessibility, quality and sustainability of services means considering economic participation and the ability of people to remain in their communities together.

COLLECTIVE BARGAINING AND THE LABOUR MARKET IN THE ANALYSIS OF PRODUCTIVITY

The relationship between productive capacity and people's living and working conditions is examined every year in the CNEL Report on the Labour Market and Collective Bargaining, whose 27th edition was approved in April 2026. The Information Commission combines public sources with the information held in the National Archive of Collective Labour Agreements and Accords, providing a shared basis for analysing employment, pay and working conditions in the light of industrial relations rules and practices.

Collective bargaining helps determine the conditions under which productivity is generated and the ways in which its results are shared. Work organisation, training, working hours, performance-related bonuses and company welfare concern both a firm's ability to create value and the quality of the professional experience. Examining these provisions alongside investment and skills makes it possible to observe how productive choices interact with workers' needs. It is on this ground that dialogue between the parties connects business development with the quality of work.

The link with the Report on Productivity therefore makes it possible to examine changes within firms through the lens of collective agreements and the conditions of those who work in them. Fragmented data sources make it necessary to continue improving comparability and interoperability, so that the agreements applied, employment and wages can be examined together. More integrated knowledge helps assess how innovation, organisation and industrial relations contribute to development, and how their effects are distributed among people.

WORKER PARTICIPATION IN THE CREATION AND SHARING OF VALUE

Workers' participation in business life further strengthens the connection between production and people's living conditions. Involving those who understand processes, needs and critical issues can help turn investment and technology into tangible improvements, while making better use of skills and responsibilities. Different forms of participation—in management, work organisation, profits and capital ownership—alongside consultation, concern both the creation and the sharing of value. Collective bargaining can support their implementation in different productive settings.

Through its National Permanent Commission for Workers' Participation, the CNEL gathers and promotes business-level experience, monitors its spread and examines how participation takes shape in decision-making and operational processes. Comparing this work with productivity analyses can help clarify which organisational conditions foster innovation and how the resulting benefits translate into pay, training, safety and quality of work. These effects must be assessed in light of the characteristics of individual businesses and the contexts in which they operate.

The work on participation thus completes the Council's vision of development by linking business competitiveness to the contribution of people, particularly during technological transitions, when tasks, professional roles and responsibilities change. Decisions about the productive future must draw on knowledge acquired through work and offer those who contribute to it meaningful opportunities for growth. The quality of organisations also influences their attractiveness to younger generations.

YOUNG PEOPLE AND ITALY'S ATTRACTIVENESS IN SHAPING THE FUTURE OF PRODUCTION

I regard Italy's attractiveness as a component of productivity policy. Offering young people skilled employment, responsibilities and scope for entrepreneurial initiative concerns their freedom to shape their future and, at the same time, the country's capacity to renew its economy. This is why the CNEL has consulted young Italians living abroad on their reasons for leaving, what they have found elsewhere and the conditions that might encourage them to return.

With the same objective, the CNEL established the Forum of Young Economic and Social Forces, which is responsible for the Generational Impact Assessment (*Valutazione d'Impatto Generazionale*, VIG) of the Council's acts and draft legislation. This involves assessing in advance how each proposed measure may affect young people and future generations. The instrument is similar to that provided for government measures under Law No. 167 of 2025 and is consistent with the European Commission's Strategy on Intergenerational Fairness, adopted in March 2026, which aims to integrate the *youth check* permanently into the European Union's legislative process.

The CNEL's work on young Italians living abroad and on Italy's attractiveness to young people from advanced economies addresses a central development challenge: how to turn education and experience into value. Between 2011 and 2024, the net migration balance for Italians aged 18 to 34 was negative by approximately 441,000 people,

with consequences for the future availability of labour, professional renewal and the renewal of organisations.

The same objective guides the CNEL's work on planning immigration flows, with a view to linking regular immigration to actual labour demand. This requires knowledge of sectoral and territorial skills needs, recognition of qualifications, training, decent employment and integration. Making better use of people already in Italy, alongside greater participation by women and young people, can help address the ageing of the workforce. Migration management and inclusion must be tackled together, through a holistic approach centred on people and development.

Productivity and the quality of work must advance together. Productivity gains create scope for better pay, and businesses and the social partners contribute to turning that scope into real opportunities. Attractive working conditions can, in turn, support innovation, while adequate remuneration and stable career paths help retain skills and make investment in training more sustainable. Organisational choices are crucial in this respect. Assigning responsibilities, making recruitment and career progression transparent, recognising achievements and making full use of people's knowledge all help strengthen their contribution. Meritocracy thus acquires a clear economic and social meaning, pointing to the need to widen opportunities for advancement to all those with the necessary abilities, including people from less advantaged backgrounds.

Evidence from the CNEL's Report on young Italians abroad makes this perspective tangible. It highlights the need for pay commensurate with skills, opportunities that match investment in education and training, merit-based assessment and career progression, substantive gender equality, a faster and more effective public administration, and, for those returning to Italy, well-designed, subsidiary incentives that support individual choices without substituting for fundamental reforms.

The demand for equality from young women makes this commitment more challenging, as career quality, work–life balance and access to positions of responsibility influence decisions about whether to stay or leave. Similarly, the skills of people arriving from abroad must be recognised and put to appropriate use. A system that makes better use of the professional expertise available broadens its development opportunities. Attractiveness, participation in employment and the effective use of skills must therefore be addressed together.

The credibility of a professional future also depends on the surrounding environment. Affordable housing, reliable services, predictable administrative timelines and good transport connections can make a job offer or research project viable. Italy's cultural heritage and quality of life are important assets, but their attraction is greater when accompanied by sustainable economic and professional conditions. University cities, productive territories and emerging centres of specialisation can bring these elements together by involving businesses, universities and public administrations. The CNEL's proposals on housing policy therefore also concern access to employment and occupational mobility.

Freedom of movement, particularly within Europe, is an opportunity for growth. Skills acquired abroad can foster scientific cooperation, entrepreneurial initiatives and trade, including through relationships established before or maintained alongside a possible return to Italy. Policy should nurture these connections and facilitate the transition between international experience and opportunities in Italy. For a country integrated into

European supply chains, participating in the circulation of knowledge also means welcoming people, ideas and different ways of organising work.

The Council's initiatives concerning young people thus contribute to an integrated understanding of the findings of the National Productivity Board and underline the need to make development opportunities more accessible and tangible in people's lives. Measures should be assessed according to their capacity to open up career paths and make the most of skills, enabling businesses and public administrations to innovate. Young people must be involved in this assessment today, bringing their experience to bear on the decisions that affect them. Entrusting them with responsibilities is already a way of strengthening the country's future productivity.

RESEARCH AND THE DIFFUSION OF INNOVATION

The quality of Italian research is a strength. Studies of total factor productivity, innovation and technology transfer help clarify the transition from knowledge production to practical application. A scientific result can open up an economic opportunity, but developing it requires skills capable of assessing its potential, producing prototypes, identifying needs and facilitating engagement with investors. Ensuring continuity throughout this process is one of the most important responsibilities of productivity policy.

Universities and research institutions contribute through stable relationships with businesses, public administrations and communities. Technology transfer offices, competence centres and innovation networks can facilitate these relationships. The range of available instruments calls for clear responsibilities and coordination, so that businesses and researchers can identify the appropriate contacts and pathways. Basic research retains the value of its long-term perspective, and the ability to support its subsequent development broadens the opportunities it creates.

Cooperation with other European National Productivity Boards has demonstrated the value of this approach. Research conducted in other countries—for example, into the origins of large businesses—highlights the substantial investments that precede the realisation of profits. Studies on innovation policy also point to the complementarity between scientific capabilities and specialised finance. For young innovative businesses, the duration and timing of financing must be aligned with the time required to develop products, markets and organisations. Venture capital, credit and support services providing specialist expertise can play complementary roles at different stages of growth.

The contribution of young innovative businesses must be assessed throughout their life cycle, since experimentation, patents and entry into new markets may precede the emergence of consolidated economic results. Across Europe, there is a shared understanding that public support should reflect the nature of projects and their development prospects, with assessment mechanisms suited to the risks involved and the time required for innovation. Promising initiatives also need more accessible markets and financing suited to the stages following start-up.

The analysis of incentives requires an understanding of which investments the support actually makes possible and what results they produce, distinguishing between take-up of the incentive, increases in capital, employment and productivity. The evidence

suggests that the entire business transformation project should be considered, including tangible and intangible assets, training, organisation and specialised services. Monitoring and evaluation can help improve policy instruments without undermining the predictability businesses need when making decisions.

The same applies to the energy transition. Energy availability and costs influence production decisions, while the scope for efficiency gains varies across activities and businesses. Instruments tailored to starting conditions can make investment more effective, combine innovation with environmental objectives and reduce supply-chain vulnerability. Industrial policy must be judged by its ability to set out clear objectives, recognise the links between activities and assess the effects of interventions over time. This is the perspective underpinning the CNEL's observations and proposals on Made in Italy, logistics and distribution. Transparency in supply-chain relationships and the quality of work help distinguish organisational improvements from competition based on the erosion of workers' protections.

THE AUTOMOTIVE INDUSTRY AND THE RENEWAL OF PRODUCTIVE CAPABILITIES

The automotive crisis brings into sharp focus this responsibility of industrial policy. The CNEL's work on the conversion and diversification of the supply chain, published in partnership with the newspaper *Il Sole 24 Ore*, examines the opportunities and the conditions required to realise them. Alongside declining production activities, there is a body of knowledge, skills and relationships from which new activities can emerge. The engineering capabilities, production organisation and supplier networks developed in the automotive sector—where much of its potential to generate further development resides—can support other areas of growth, provided policy facilitates the renewal of the supply chain and makes new uses of these capabilities viable.

The analysis identifies opportunities arising from the proximity of certain manufacturing activities and technologies, such as precision engineering, electronics, control systems and advanced materials. These may create pathways into segments of the defence sector and into dual-use civilian and military applications, while aerospace offers more selective opportunities. The main objective is to enter supply chains by providing components and specialised expertise. Projects already under way in some productive settings show that the scope for diversification depends on individual businesses and territories. Diversification complements the transformation of the automotive sector; given the size and characteristics of the markets involved, it would be unrealistic to expect it to offset losses across the board.

For productivity policy, the lesson is to make the most of what the productive system has learned. Improvements to existing processes can be accompanied by new combinations of knowledge, technology and organisation, capable of developing different products and services within existing or new businesses, generating more value from available resources and creating skilled employment. Results must be assessed in terms of real value added relative to the resources used, the investment required and employment prospects. Technological sophistication signals an opportunity, but productivity gains must be verified in the projects actually implemented.

Timing is decisive. Entering new supply chains may require certifications, updated equipment, additional skills and the confidence of new customers. These investments often precede revenue, while the markets concerned may be smaller and their cycles longer. If work teams and supplier networks are dispersed in the meantime, rebuilding these capabilities becomes more difficult. Preparing for the transition means linking finance, training and market access to credible industrial projects and supporting workers in moving towards genuine employment opportunities. Knowledge of local circumstances and dialogue with the social partners make it possible to identify opportunities and obstacles in good time.

A forward-looking industrial policy enables the productive system to renew its specialisations, ensuring that accumulated knowledge continues to generate development and skilled employment even as markets change. The CNEL's work, which connects analysis of economic transformations with the experience of businesses and workers, helps identify the opportunities for diversification and the steps needed to realise them. This is a responsibility shared by Italy and Europe, since access to supply chains, research and demand extends beyond the borders of individual territories.

MEASURING VALUE AMID ECONOMIC TRANSFORMATION

Attention to measurement runs through both editions of the Report and is broadened in this year's edition. In an economy characterised by services, intangible investment and differentiated products, interpreting indicators requires an understanding of prices, quality and the boundaries of economic activities. Distinguishing between productivity levels and productivity growth, improvements within businesses and compositional effects, and the use of existing productive capacity and its expansion makes it possible to develop more precise diagnoses, useful both for economic debate and for public decision-making.

Total factor productivity makes this need particularly clear. The residual in growth accounting reflects what is not explained by measured increases in inputs. It may include innovation and organisational improvements, but also unmeasured changes in factor quality, variations in capacity utilisation and measurement problems. Better measurement of skills and capital can alter the attribution of growth even when output remains unchanged. Italian research and the work of the European network demonstrate how useful these distinctions are in identifying where intervention is needed.

Understanding the determinants of total factor productivity requires economic and social factors to be considered together. Trust, reliable institutions and the ability to co-operate can improve the combination of labour and capital by facilitating the circulation of knowledge and coordination, as recognised in economic research and in work presented to the CNEL by the Organisation for Economic Co-operation and Development (OECD). The extent to which these effects are attributed to total factor productivity also depends on what existing measurements already capture in the quality of labour and capital. Some conditions associated with well-being may contribute to productivity, but well-being remains a broader objective with value in its own right.

Advanced services deserve particular attention. Knowledge-intensive services can create value at the level of the provider while improving the products and processes

of client businesses. Understanding their contribution requires these relationships to be tracked, alongside the treatment of intangible assets and the quality of services delivered. The possibility that their contribution is incompletely represented opens up a research agenda that distinguishes between benefits already captured in the accounts, effects that are difficult to measure and differences between statistical systems. Their significance for interpreting Italy's productivity gap requires comparative assessment.

The Working Paper on productivity measurement has also informed discussions with other European National Productivity Boards, helping to test the questions raised in Italy against experience elsewhere and identify shared challenges. Ireland's experience in measuring the intangible activities of multinational companies, for example, highlights the importance of supplementing aggregate indicators with measures that are relevant to the domestic economy. Comparability improves when methods and coverage are made explicit and indicators are used only for what they can genuinely reveal.

This research helps identify more accurately the value generated and understand how it can be increased, thereby informing decisions on investment, services and skills. Official statistics provide the common foundation, while scientific discussion and thematic research make them more useful for interpretation.

PARTICIPATORY ARTIFICIAL INTELLIGENCE AND BUSINESS TRANSFORMATION

Artificial intelligence must occupy a central place in the productivity research programme. One area of focus is the improvement of existing activities, from information analysis and decision-making to design and the organisation of processes and services. Potential benefits include shorter timelines, better quality and access to capabilities that were previously difficult to acquire. This opens up opportunities for experimentation in businesses and public administrations, where the assessment of benefits must accompany adoption.

A second dimension concerns the way businesses themselves operate. AI can help create new products and services, alter the division of tasks, open up new specialisations and change relationships between businesses and markets. More accessible cognitive tools can broaden the scope for economic initiative, and the ability to integrate them can redefine competitive advantages and the efficient scale of organisations. Technology, business models and the distribution of opportunities must therefore be examined together.

Italy is part of this transformation. According to the 2025 data cited in the accompanying studies, the share of businesses with at least ten employees using AI rose from 8.2% to 16.4% in a single year, with substantial differences by business size, sector and territory. This signals wider adoption, although the impact on productivity will depend on how the technology is actually used and integrated into day-to-day activities.

Technical capabilities can evolve rapidly, but their productive use does not happen automatically. It requires high-quality data, infrastructure, security and skills, as well as the ability to select tools, verify results, assign responsibilities and reorganise processes. Investment and learning may precede the full emergence of benefits. An ambitious policy must support this process, particularly for organisations that find it more difficult to access knowledge and services.

This transformation directly affects work. Some activities may be automated, while others may be enhanced by new analytical and operational capabilities. Occupational content will change, as will the opportunities through which people acquire experience. Training, practical experience and responsibility must develop together, creating genuine opportunities for young people to progress. The quality of entry into professional life is itself part of the renewal of businesses and public administrations.

In this context, involving people gives meaning to the concept of participatory artificial intelligence. Workers, their representatives and businesses must be able to contribute to decisions on how the technology is used, understand the aspects of its operation that are relevant to work, and discuss its effects before organisational choices are made. Those who know the processes can help identify useful applications, recognise errors and improve systems. Collective bargaining provides a forum for linking these objectives to training, professional responsibilities, data governance and the sharing of results. Participation thus becomes part of both value creation and the discussion of how value should be distributed.

The CNEL contributes to this process through OPERA, the Observatory for Policies and Industrial Relations for Participatory Artificial Intelligence. The guide produced in partnership with the newspaper *Il Sole 24 Ore* in May 2026 examined nine national collective labour agreements and nine company-level agreements, documenting cases in which the introduction of AI is accompanied by joint bodies, rules on data, transparency and skills development. These experiences make it possible to observe how innovation is actually introduced into workplaces. The Observatory's discussions with the National Productivity Board and the Information Commission link these cases to economic analysis and to the National Archive of Collective Labour Agreements and Accords held by the Council. The economic and social effects of these practices must be assessed on an ongoing basis.

This analysis is complemented by the contribution of the Committee for the Economics of Artificial Intelligence to the 2026 Report, which reviews the evidence on productivity gains and the conditions required for them to emerge in business processes and organisations. Bringing together economic analysis, the archive of collective agreements, participatory practices and social representation gives practical substance to the Council's integrated perspective. It makes it possible to examine together how much value is created, how work and skills are changing, and what opportunities are opening up for wages, service quality and people's lives. The same perspective should guide the development of advanced robotics, linking the measurement of innovation to discussion of its consequences for the country as a whole.

ADVANCED ROBOTICS, WORK AND THE WELFARE STATE: A CIVIL-ECONOMY PERSPECTIVE

The convergence of artificial intelligence and advanced robotics extends the discussion to physical activities and working environments, since integrating perception, decision-making and execution can open up new applications in production and services. Italy's capabilities in mechanical engineering, electronics, sensors and industrial processes provide a concrete foundation for participating in this transformation, both by adopting these technologies and by developing the supply chains and professional expertise that make them possible.

The transition from technological possibilities to actual applications must be monitored, since the timing and scope of adoption depend on reliability, safety, operational autonomy and the cost of use. Potential benefits include reducing the most physically demanding tasks, improving working conditions and addressing shortages of skills and labour. Realising these opportunities requires an understanding of which tasks machines can perform, which human capabilities will become more valuable, and how organisations must evolve.

Occupational transitions must be prepared through training, guidance and support towards new or transformed activities. Dialogue between businesses and workers' representatives can help guide these choices in advanced robotics as well, making new responsibilities and pathways for skills development clear. The quality of industrial relations contributes to the economic and social sustainability of investment.

The sustainability of the welfare state gives this transformation a significance that extends beyond individual production processes and raises the question of how potential productivity gains can be translated into well-being. In an ageing society, higher productivity can expand the resources available for services and social protection. However, changes in the relationship between capital and labour, in income distribution and in forms of employment may alter the foundations on which social protections are financed. These processes must be studied together to understand how growth in the value produced can sustain adequate protection over time. The strength of these foundations also depends on Italy's ability to attract young people and achieve broader participation in employment. Productivity and the development of people's capabilities must reinforce one another.

The sustainability of the welfare state is not merely a matter of resources; it also depends on society's ability to reconcile different, and sometimes conflicting, needs, build trust and manage demographic, technological and labour-market transitions in a highly complex geopolitical environment. Intermediate bodies can play an essential role here by representing needs and skills, listening to local communities, and bringing people, businesses and institutions together.

Through this dialogue, welfare, public services, work, skills and territorial cohesion can be considered together as dimensions of a single challenge: the country's ability to generate growth and translate it into well-being and opportunity. This perspective is close to the tradition of civil economy, which understands development in terms of income and wealth as well as relationships, trust and quality of life. Within this space for dialogue between institutions, businesses, workers and society, the CNEL intends to fulfil its role in providing knowledge, listening and proposals, translating the experience of intermediate bodies and the findings of research into insights that can inform public decisions.

PRODUCTIVITY OF INSTITUTIONS AND PUBLIC SERVICES

The functioning of institutions shapes development. Predictable administrative timelines, reliable services and effective coordination influence investment decisions and everyday life. Public-sector productivity must therefore be assessed alongside service quality, accessibility and outcomes for those who use services. A capable administration makes opportunities accessible that would otherwise remain merely formal.

This is also the perspective underpinning the CNEL's 2026 *Report to Parliament and the Government on the Quality and Levels of Services Provided by Central and Local Public Administrations to Businesses and Citizens*. The Report calls for the capabilities developed during the period of the National Recovery and Resilience Plan (PNRR) to be made permanent within public institutions. Objectives-based planning, clearly assigned responsibilities and the assessment of results are important for public administration as much as for government action. Investment, research and skills develop over longer horizons than individual programmes and governments, and the continuity of strategic objectives across political changes provides a reliable framework for their development.

Digitalisation and interoperability are essential. Securely usable information, coordinated procedures and connected databases can reduce duplication and give time back to citizens and businesses. The simplicity of a service from the user's perspective also depends on coordination between administrations, whether someone is starting a business, pursuing an education or bringing a professional project to Italy. Technical and managerial skills, recruitment and training are needed to ensure that digital tools translate into more accessible services and more effective decisions.

Listening to service users must become a permanent part of this approach. The experience of those who deliver services can reveal difficulties that activity indicators may overlook, such as repeated steps, uncertain timelines, unclear information, or services that formally exist but are difficult to access. Gathering this evidence, examining it alongside outcome data and adjusting processes enables public administrations to learn. User satisfaction thus enriches the assessment of service quality and accessibility, alongside effectiveness, equity and the use of resources.

European experience shows the value of establishing clear methods for measurement and impact assessment whenever a new intervention or service is introduced. In Finland, an experiment involving primary care found that a digital channel could increase the number of contacts without producing measurable savings or a statistically significant reduction in in-person visits during the period observed. This finding suggests that all indicators, including access, costs and service delivery, should be considered together from the design stage, rather than focusing only on those for which improvements are expected. Other cases have linked payments to employment-placement services to additional outcomes verified against a comparison group, making the relationship between objectives and incentives explicit.

This capacity to learn is part of public-sector modernisation. Experimentation, evaluation and adjustment require usable data, expertise and ongoing relationships with research. The resources invested in developing these capabilities build an asset that can improve subsequent decisions. From this perspective, locating the National Productivity Board within a constitutionally significant body such as the CNEL is the Report's real added value. It makes it possible to connect productivity analysis with collective bargaining and the labour market, participation within businesses, the governance of technological change, the evaluation of public services, and demographic and migratory trends. At the same time, listening to productive-sector organisations and economic and social stakeholders brings these areas back to the concrete conditions under which people, businesses and territories can develop.

A SHARED ITALIAN AND EUROPEAN RESPONSIBILITY

Participation in the network of National Productivity Boards gives the programme a concrete European dimension. Workshops and meetings organised by the European Commission, in which the CNEL participates, most recently in September 2026, provide opportunities to compare diagnoses, methods and institutional practices. Differences between countries help explain how business organisation, skills, finance and administrative capacity interact. Cooperation is more valuable when experiences are examined in light of the conditions that made their results possible and the adjustments required to apply them in other contexts.

This perspective is enriched by regular exchanges with the OECD on the relationship between productivity, inclusion and well-being, as well as by discussions with the Italian Parliamentary Budget Office. At its September 2026 meeting, the latter highlighted the demographic outlook for potential output and the contribution of the PNRR to strengthening administrative capacity. These contributions connect the conditions for growth with the quality of public decisions and the sustainability of their financing.

Among the issues discussed, advancing the frontier of knowledge and broadening its use is essential for both Italy and Europe. Research, technology transfer, finance and accessible markets must enable businesses to experiment and grow. Greater scale must go hand in hand with contestable markets and opportunities for new competitors to establish themselves. European cooperation can strengthen each of these stages, opening up opportunities that go beyond national borders.

The Letta and Draghi reports show how much European competitiveness depends on overcoming market fragmentation, ensuring access to energy at sustainable costs, and turning savings into investment in European businesses. No Member State has, on its own, the critical mass needed to address these challenges. Italian productivity also depends on Europe's ability to act collectively.

A new "Hamilton moment" is needed: a step change in our common capacity to finance investment and make decisions. In May 2020, the decision to incorporate the Recovery Fund into the Next Generation EU plan, in response to the economic and social crisis caused by the COVID-19 pandemic, paved the way for the joint financing of the recovery. Today, that choice must be carried forward through European Union-level coordination to build a common energy market, move towards common defence and complete the banking and capital markets unions. European savings must find opportunities in Europe that can support innovation, businesses and employment. Timely decision-making is itself a condition for productivity.

This perspective includes further enlargement to the east and the possibility of the United Kingdom returning to the European project in the future. The partnership with Canada can strengthen the network of our economic and democratic relationships. Solidarity with Ukraine and its reconstruction within a major European plan form part of the same responsibility: equipping Europe to manage change and offer its citizens security, development and freedom.

The debate on industrial policy also highlights the responsibility to choose clear objectives. Productivity, employment, cohesion and resilience to shocks require careful assessments of benefits, costs and alternatives. A policy that supports employment must also be judged by the concrete opportunities it creates for the people concerned, while an

investment in one part of a supply chain may have effects extending beyond the recipient business. The quality of policy choices depends on making these relationships visible and verifying their effects over time.

For the CNEL, the Report is one stage in an ongoing programme of work, in which further analysis must be followed by discussion of proposals and monitoring of results, while keeping evidence, interpretations and choices clearly distinguishable. The "network of networks" that the Council has sought to strengthen and make a defining feature of its 11th term of office—through ninety interinstitutional agreements and memoranda of understanding signed to date with an equal number of public and private partners—fosters dialogue with public administrations, businesses and workers, bringing the conditions required for implementation into the analysis. In this way, the diversity of experience can strengthen the country's capacity to make decisions.

Italy has capabilities on which to build a demanding but well-founded confidence in its future, and this work seeks to help turn them into broader opportunities for growth, participation and well-being. Rising productivity strengthens employment, makes long-term investment more sustainable and expands the resources available to a community to care for its members. Whether a young person can find a job in Italy that matches their abilities, assume responsibilities and build a life plan is one measure by which the quality of this development should be judged.

Reading the Council's reports and proposals together provides a coherent framework and lays the groundwork for addressing business competitiveness and people's well-being in terms of the enabling factors that allow territories to remain vibrant. Collective bargaining, workers' participation and the shared governance of innovation help explain how productive capacity can translate into better pay, stronger skills, higher-quality work and improved services. The Productivity Report acquires its full significance by describing these relationships and guiding the assessment of their effects. In this way, the CNEL seeks to contribute to the country's decisions by bringing knowledge together with the responsibility of institutions and the social partners, so that economic progress creates concrete opportunities for today's generations and those to come.

1 MEASURING PRODUCTIVITY: WHAT THIS REPORT SAYS AND HOW TO READ IT[1]

PART ONE
METHODOLOGICAL CONSIDERATIONS

1.1. MEASURING TO IMPROVE

Like its predecessor, the CNEL's 2026 Report on Productivity in Italy faces the challenging task of providing empirical evidence of the Italian productive system's ability to compete in markets and ensure economic well-being for residents, as well as of supplying policymakers with the information they need to design policies capable of improving these outcomes. This approach rests on the conviction that it is difficult to improve what cannot be measured.

This task involves measuring both the level and the dynamics of productivity, with a view to identifying its main determinants. However, the logical process underlying any measurement—that is, defining what is to be measured and, consequently, devising the appropriate measurement method—cannot be followed directly. The complication lies in the fact that, in this case and in many others, it is the measurement method itself, namely the statistical convention adopted for measurement, that determines and thus defines what is actually being measured. This is the opposite of what would be desirable.

This premise is essential to correctly reading and interpreting the statistical productivity measures presented in the chapters of this Report, particularly those concerning the analysis of productivity dynamics across the productive system as a whole and within individual sectors. The aim is to assess improvements or deteriorations and, even more importantly, to analyse relative performance in comparison with other countries comparable to Italy.

1.2. WHAT ARE WE ACTUALLY MEASURING: FROM VOLUME TO VALUE

If we were to compare the physical productivity of two hectares of agricultural land used to grow the same crop, the task would appear relatively straightforward: we would measure the ratio between the quantities harvested from the two plots over a given period and

1. By Pasquale Lucio Scandizzo and Giovanni Tria, with contributions from Paola Bonacci and Nicola Rossi, members of the National Productivity Board and of the CNEL Panel of Experts.

then seek possible explanations for any differences, such as natural soil fertility, the fertilisers used, machinery and labour. Labour productivity on the two plots could likewise be measured as the ratio between output produced per unit of time and the amount of labour employed over the same period, with differences explained by reference to the other production factors used. This would make it possible to compare the productivity of the two plots, track changes over time, assess the effects of changes in technology and factor quality, and readily convert the productivity measure into a measure of profitability by introducing the prices of output and inputs.

The simplicity of this example is useful because it makes clear to the reader that this type of measurement cannot be directly applied when interpreting the empirical evidence provided by the productivity measures in this Report. The physical, or volume-based, concept of the productivity of a factor or set of factors becomes conceptually inappropriate and analytically impracticable as soon as we compare businesses producing different products, or the same product using different technologies. Returning to the example of cultivation on the two plots, if the crops are different and the production technologies may also differ, a comparison based on quantities is no longer feasible. We must instead resort to the concept of value: that is, compare the value of output per unit of time with the value of the production factors used.

This means that, when considering labour productivity, we must relate a product measured in market value to a physical unit of labour, such as an hour worked or an employed person. In the case of total factor productivity, measurement in value terms also affects the denominator of the ratio, because aggregating production factors requires weights that reflect their market values and the resulting distribution of the net value of output among them. It should also be remembered—and this caveat must be borne in mind throughout the Report—that total factor productivity is not a direct measure of technological or organisational progress. It is an accounting residual: the portion of output growth that cannot be explained by measured growth in inputs. As a residual, it combines innovation, unaccounted-for differences in factor quality, measurement errors and, as discussed below, the efficiency with which resources are allocated across businesses and sectors[2].

Under the conventional productivity measures adopted in this Report, which ensure consistency with reports produced by other European Productivity Boards, deflators make it possible to move from values, that is, observed nominal magnitudes, to quantities. However, since the accuracy of this conversion varies across sectors, measured productivity also partly reflects the capacity to create value as recorded in market transactions.

1.3. DEFLATION, PRICE INDICES AND INTERNATIONAL COMPARISONS

The difficulty of measuring productivity in the strict sense of efficiency therefore stems from the complexity of separating the price component from the value of output in or-

2. For the multidimensional decomposition of the residual and the classification of the critical literature into six measurement wedges, see CNEL Working Paper No. 3.

der to isolate the quantity component[3]. This separation inevitably involves approximations, reflecting both the information available and the statistical conventions adopted. As a result, productivity measures—both levels and rates of change—may be sensitive to the method used to deflate nominal values, in other words, to the price indices employed. These are significant difficulties, but they do not, in themselves, undermine the reliability of the indicators; rather, they determine how those indicators should be interpreted.

Carrying out this operation requires a number of important choices that are not always consistent across countries. These include the type of deflator used for sectoral value added; the use of producer or consumer price indices; the treatment of import and export prices, which in open economies transmits changes in the terms of trade into productivity measures; and the techniques used to adjust for product quality. The heterogeneity of the methods adopted by national statistical institutes makes comparisons between countries sensitive to choices and conventions that have nothing to do with productive efficiency. Comparisons of productivity levels also raise a problem associated with index-number theory: the result depends on the price system used to value quantities, and changing the price base can change the ranking, within the range defined by valuations at the prices of either country. This is known as the Gerschenkron effect[4]. The point is not to dismiss the empirical evidence represented by productivity levels or dynamics as insignificant, but to understand more clearly what is actually being measured, so as to avoid misleading interpretations and erroneous conclusions.

1.4. INNOVATION, MARKET POWER AND MEASURED VALUE

Consider, for example, the assessment of the effect of innovation on productivity. Innovation may increase productivity, measured as the ratio of the value of output to production inputs. However, this increase may result from a genuine improvement in productive efficiency, from a temporary monopoly reflected in a relative price advantage, or from both[5]. Conversely, technical efficiency alone may paradoxically reduce the market value of a good to zero, even while increasing well-being. The classic example is the photographic technology incorporated into smartphones. By bringing the marginal cost of taking photographs with that type of device and in that format virtually to zero, it has also reduced their price to zero and, consequently, the value that statistics can record. When we take a photograph with a smartphone, we do not generate GDP,

3. See the box devoted to this issue in this chapter and, on the role of deflation methods in productivity comparisons, S. De Nardis, *LEAP*, Luiss, 2026, working paper.

4. On the Gerschenkron effect and the range defined by the Laspeyres and Paasche estimates, including references to the literature on international comparisons of productivity levels, see CNEL Working Paper No. 3.

5. J. De Loecker, J. Eeckhout, G. Unger, *The Rise of Market Power and the Macroeconomic Implications*, Quarterly Journal of Economics, 135(2), 2020, pp. 561-644. If a firm introduces an exclusive innovation, it gains greater market power and can charge a higher price for the new product until its competitors introduce the same or other innovations, thereby eroding the firm's competitive advantage.

but as consumers we enjoy a highly useful good and therefore one of considerable value, albeit not market value. The gap between the value or utility created and the value measured is an integral part of the measurement problem that this Report seeks to highlight[6].

This example shows that, if productivity measures are understood as measures of the capacity to create economic value and therefore purchasing power for the community—which is what they actually measure—they provide important information about the behaviour of the economic system. However, the explanations and policy implications may differ from those that would follow if attention were confined to technological backwardness or the quality of production factors. These measures primarily provide information about the capacity to operate in markets in response to the incentives offered, on the one hand, by the market and, on the other, by rules and institutions. One implication runs throughout the Report: characteristics of the productive system commonly treated as structural givens, such as average business size or the sectoral composition of employment, are themselves largely the result of these incentives. They should therefore be understood as outcomes to be explained, rather than as immutable constraints.

1.5. NON-MARKET SERVICES

A further caveat is necessary to understand the significance of territorial and international comparisons, both for the economy as a whole and for individual sectoral aggregates. Not all prices determining the value of output are formed in competitive markets. Productivity measurement presents specific difficulties in many service activities where a substantial share of provision takes place within public administration or in markets with administratively regulated prices, and where the service has no market price in any case. There is no market value for defence, education, healthcare, social care or basic research services, because their price is conventionally determined by their cost. Consequently, productivity is measured in a way that allows the denominator of the ratio to influence its numerator. It is true that European statistical systems now use direct measures of output volume for some of these activities. However, adjustments for service quality remain largely incomplete, and the fundamental problem is unchanged.

A distinction must nevertheless be drawn between levels and growth rates. In terms of levels, productivity in non-market services is not necessarily low. Since their value added largely corresponds to labour income, it is in fact higher than that of many private services. It is the growth rate that is slower, owing to the characteristics of a production process that offers limited scope for technical substitution, as described by the Baumol effect, and because output measurement—even where it now relies on direct volume indicators for healthcare and education—captures quality improvements only

6. S. Basu, L. Pascali, F. Schiantarelli, L. Serven, *Productivity and the Welfare of Nations*, American Economic Review, 112(4), 2022.

partially. Similar difficulties in recording changes in the quality of output affect many market services and, more generally, sectors in which intangible components play a significant role; they do not necessarily imply a systematic underestimation of productivity. In these sectors, the relative increase in costs is partly a natural consequence of their production characteristics[7]. At the same time, it is difficult to argue that these services do not generate well-being for the community or that their existence does not form part of its real purchasing capacity. This also explains the paradox that much of the increase in the supply of skilled labour and the use of advanced technologies in these sectors does not show up in productivity statistics. As the box on the services sector also demonstrates, however, the low growth of Italian productivity cannot be attributed entirely to the expansion of services.

1.6. THE RESULT RUNNING THROUGH THE REPORT: EXTENSIVE GROWTH

The caveats outlined above are not merely preliminary considerations. They provide the key to interpreting the central finding that emerges consistently from the following chapters, despite their use of different sources and methods: since the mid-1990s, growth in the Italian economy has been driven by an increase in the quantity of labour employed, rather than by productivity gains. Between 1995 and 2025, labour productivity increased by an average of 0.2 per cent per year, compared with 1.1 per cent in the EU27, while hours worked grew by 0.5 per cent, in line with the European average. The divergence became even more pronounced over the period 2019–2025: GDP grew by an average of 1.0 per cent per year, a rate higher than that of Germany and France, but labour input increased by 1.3 per cent and labour productivity declined by 0.3 per cent. For the period under consideration and on the basis of the data examined, recent aggregate growth in Italy is therefore entirely attributable to extensive growth. The same pattern reappears in the breakdowns by territory and by business. In the interpretation advanced in this chapter, its consistency across these three levels of analysis—the aggregate economy, territories and individual businesses—is one of the Report's most significant findings.

This diagnosis concerns observed data for the period under consideration. The favourable revisions incorporated into the 2026 Public Finance Planning Document (DPFP) call for further investigation into the extent to which Italian productivity dynamics may be more favourable than previously estimated. Italy's relative position will need to be verified through international comparisons based on harmonised statistical data[8].

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7. W. J. Baumol, *Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis*, American Economic Review, 57(3), 1967, pp. 415-426.

8. MEF, 2026 Public Finance Planning Document (DPFP), Table I.3.2 and the focus section "Factors Underlying the Update of Medium-Term Potential Growth Estimates", pp. 69–73 (internal pagination), comparing the estimates with those in the April 2026 Economic and Financial Planning Document (DFP). Under the baseline scenario, average potential growth for 2026–2029 increases from 0.7% to 0.9%; the contribution of total factor productivity (TFP) to potential growth is revised upwards by approximately 0.15 percentage points per year on average over 2020–2025 and by approximately 0.11 percentage points over 2026–2035. These revisions concern the contribution to potential growth, not TFP growth rates or measures of international catch-up, and should not be added to the Report's data series. Separately, the forecast for real GDP growth in 2026 has been raised from 0.6% to 1.0%. The revisions alone do not demonstrate causal effects of the reforms.

1.7. LEVEL AND DYNAMICS

To avoid misunderstanding this finding, it is essential to distinguish carefully between two dimensions that public debate tends to conflate. Italy's hourly productivity level is lower than those of France and Germany, both at current prices and in purchasing power parity terms, but it remains that of an advanced economy. What most clearly distinguishes Italy is the stagnation of productivity dynamics, which has been eroding its relative position for more than two decades. Keeping these two dimensions separate helps guide policy: closing the gap in productivity levels also requires removing the obstacles that prevent the factors already accumulated from generating returns.

This distinction is particularly important when interpreting the most recent period. The decline in productivity recorded between 2023 and 2025 is partly the accounting counterpart of strong employment growth, which has brought more workers into activities with below-average productivity. From the perspective of inclusion, this represents an improvement over non-employment; from the perspective of the productivity index, it appears as a deterioration. International comparison nevertheless requires caution. Hours worked in Italy increased at a rate similar to that of the EU27, while output grew less. From a well-being perspective, the appropriate reference is GDP per capita, which has increased less in Italy than elsewhere since the beginning of the century. The composition effect therefore helps explain the recent decline, but a more disaggregated analysis is needed to account for the gap with other countries. The relationship between aggregate variables does not, in itself, distinguish between these two interpretations: a decline may signal either a deterioration in efficiency or an expansion of the productive base. Composition effects are not, in themselves, a measurement problem. Distinguishing them from changes in the productivity of individual businesses requires aggregate analysis to be supplemented by the microeconomic evidence presented in Chapter 5. The conventions governing what counts as output nevertheless affect both the measurement of income and that of productivity, a question that also forms part of the debate on moving beyond GDP as a single indicator.

1.8. THE APPROACH ADOPTED IN THIS REPORT: SCOPE AND LIMITATIONS

These premises help clarify the scope of the Report, which should be made explicit from the outset. The Report systematically develops standard growth accounting and empirically examines the role of intangible capital and the allocation of resources across businesses and sectors. Within this scope, it documents a system in which production factors are available and progressively improving, yet are combined in units and contexts that prevent them from fully realising their potential. Skills exist but are used in jobs that do not require them; efficiency improves, but in businesses that do not grow; and employment expands, but in activities with lower measured productivity. Alongside the delays documented in the chapters in human capital, research and innovation, the binding constraint lies in the distance from the technological frontier and in the mechanisms—or the absence of mechanisms—needed to close that gap by reallocating resources towards more productive uses.

Productivity is one determinant of competitiveness, whose assessment must also take account of relative prices, quality, input costs and the ability to attract resources.

The Report's analyses contribute to this diagnosis; integrating competitiveness indicators represents a further development of the research programme.

Three dimensions fall outside the empirical and analytical framework employed here. These are not gaps, but areas for future work: (1) the measurement of market power, namely the divergence between prices and marginal costs, which simultaneously affects the measurement of productivity and its distributive interpretation; (2) productivity as relevant to well-being, which requires a comprehensive assessment of externalities, natural capital and product quality; and (3) artificial intelligence considered not as a technology embodied in existing capital, but as an autonomous production factor with the characteristics of an imperfect public good[9]. Defining these boundaries is not a defensive caveat. It enables readers to understand what the evidence presented in the following chapters can and cannot support, and why productivity measurement, far from being merely a preliminary technical issue, is already part of the answer to the problem addressed by the Report.

This scope calls for a vocabulary that should be clarified from the outset, since it will recur in the reading guide[10]. The underlying image is that of a wedge inserted between two planes, forcing them apart. A measurement wedge is what comes between the number we call productivity and the reality that number is intended to represent. Whenever statistical conventions overlook a relevant factor or record it incompletely, a systematic gap emerges between the measure and the quantity being measured. This gap has a direction and a sign: it is not a random error that cancels out over time, but a distortion that can persistently alter the diagnosis.

There are six such wedges. The first concerns standard growth accounting: changes in labour quality that are not measured separately become mixed into the residual, the part of growth that the accounts cannot explain. The second concerns intangible capital: software, data, research and organisational capabilities are capital in their own right, but the accounts record only part of them, thereby underestimating both investment and output. The third relates to resource allocation: the same endowment of factors generates very different amounts of value depending on the businesses and sectors in which it is employed. The fourth concerns market power: when prices diverge from costs, measured productivity rewards those able to raise prices, regardless of whether they have achieved any corresponding improvement in efficiency. The fifth concerns the gap between what is measured and productivity as relevant to well-being: production that causes pollution appears more productive in the statistics than it really is, while production that improves product quality receives less recognition than it deserves. The sixth wedge concerns artificial intelligence, which should be considered a production factor in its own right, capable of independently expanding the range of tasks it can perform and, by its very nature, escaping current measurement conventions. In terms of these wedges, this Report empirically develops the first three, while the fourth, fifth and sixth remain, as noted above, part of the stated research agenda.

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9. P. L. Scandizzo, P. Bonacci, *Productivity in Complex Systems*, CNEL Working Paper No. 2, 2026.

10. The terminology and organisation of the critical literature into six measurement wedges are taken from CNEL Working Paper No. 3, to which the reader is referred for a detailed treatment.

BOX

Productivity in Complex Systems: Analysis, Conceptual Frameworks and a Comparative Perspective Across European Countries | National Productivity Board, Working Paper No. 2, April 2026

Productivity is a complex phenomenon that cannot be reduced solely to the quantitative dynamics of inputs and outputs. It is closely linked to the institutional, technological, organisational and structural features of different economic systems. In this regard, a comparative analysis of advanced economies and, above all, of the main national productivity reports makes it possible to develop an interpretative framework capable of identifying common conceptual approaches, critical issues and questions, as well as policy recommendations.

Conceptual Frameworks, Unifying Themes and the Puzzle of National Productivity Reports

Pasquale Lucio Scandizzo

Comparative analysis shows how the apparent uniformity of productivity studies—based on indicators such as labour productivity and Total Factor Productivity (TFP) and on methodologies falling within the framework of growth accounting—conceals significant differences in theoretical frameworks, policy priorities and the questions that different countries seek to answer. National productivity reports reflect, in fact, the economic culture, characteristics of productive systems and major economic and social transformations of their respective national contexts.

A first central issue concerns the limitations of traditional productivity measures. Labour productivity, although an immediate indicator, is affected by the quantity and quality of other productive factors employed, while TFP, being calculated as a residual relative to the growth of observable inputs, also incorporates measurement errors, changes in capital utilisation, economies of scale, market-power effects and productive components that are not adequately captured. Particular importance attaches to the problem of intangible capital—research and development, software, organisation, brands and relational capital—the partial exclusion of which from capital stocks may result in an overestimation or, in some cases, an underestimation of TFP. This makes it necessary to interpret the productivity residual with caution and to improve its measurement progressively.

The comparison across countries therefore highlights a plurality of national productivity narratives. In the United States, the prevailing interpretation focuses on the technological frontier, innovation and the so-called productivity paradox, namely the difficulty of translating the rapid diffusion of digital technologies into an acceleration of aggregate productivity. In the United Kingdom, the dominant issue is the productivity puzzle that emerged after the 2008 crisis, associated with low productivity growth, weak investment, sectoral composition effects and large territorial disparities. In France, productivity is interpreted from a more systemic perspective, linked to the functioning of institutions, the structure of the labour market, competition, and the objectives of social cohesion and ecological transition. Germany approaches the issue through the lens of *Strukturwandel*, that is, the profound transformations simultaneously affecting industry, energy, mobility and demographic structure. Spain, by contrast, is characterised by the theme of incomplete convergence, with growth historically driven by employment but accompanied by weak or negative TFP dynamics and pronounced

fragmentation in firm size. The Netherlands, lastly, approaches productivity from the perspective of a small, highly open economy, with particular attention to intermediation effects, R&D investment and changes in the labour market.

Beyond national specificities, several recurring themes emerge. The first is the growing importance of **technology diffusion**: productivity depends not only on the ability to innovate at the frontier, but also on the speed with which innovations and new technologies are adopted by firms at the lower end of the productivity distribution. The second is the need to improve the measurement and capitalisation of intangible assets, which are becoming increasingly important in knowledge-based economies. The third concerns the relationship between productivity and inequality, since productivity gains may become concentrated in the most advanced firms and translate into widening dispersion in wages and profits. The fourth concerns the difficulty of measuring productivity in expanding service sectors, particularly healthcare, education and care, where output and qualitative improvements are difficult to capture using traditional indicators.

There are also unresolved questions: how to distinguish, within TFP, technical efficiency from rents associated with market power; how to assess well-being beyond GDP and outputs that are not directly measured, such as leisure time, environmental quality and social cohesion; and, above all, how to identify causal relationships between institutions, economic policies and productivity. In this respect, international comparison shows that differences between countries concern not only indicators, data and methodologies, but also the initial questions and perspectives through which productivity dynamics are interpreted.

Overview of Productivity Reports in Selected European Countries

Paola Bonacci

The Council Recommendation of 20 September 2016 invited euro-area Member States to identify or establish National Productivity Boards tasked with analysing productivity and competitiveness developments and the main challenges in these areas. The analysis therefore reviews the national productivity reports available for a number of euro-area countries and, among non-euro-area countries, Denmark.

The comparison first highlights the strong heterogeneity of national conditions and, consequently, of the causes identified as underlying productivity trends and of the corresponding policy responses.

In **Austria**, for example, long-term labour productivity growth is attributed primarily to developments within individual sectors, while a more limited component derives from the reallocation of employment across sectors. Recommendations focus above all on innovation, technology diffusion, training, active labour-market policies and the energy transition.

The case of **Finland** highlights the strong contribution of ICT technologies to productivity growth in the 1990s and early 2000s and the subsequent slowdown following the financial crisis. Across the different countries, the role of human capital, investment, research and development, digitalisation and sectoral structure also emerge, with varying degrees of intensity.

The case of **France** is particularly significant. Digitalisation is positively associated with TFP, but its diffusion remains uneven across firms and sectors, while European in-

vestment in advanced digital technologies remains below US levels. The coexistence of large, highly productive firms and a broad base of less productive SMEs also generates significant productivity dispersion. Priorities therefore include strengthening investment in R&D and digital technologies, developing artificial intelligence, and enhancing skills and human capital.

For **Germany**, the analysis highlights the structural transformations affecting the productive model, while **Greece, Ireland, Portugal** and the other countries examined display specific combinations of factors relating to investment, human capital, productive structure, international openness and innovation capacity.

The **Netherlands** offers a particularly detailed analysis of productivity dispersion across firms, market entry and exit dynamics, and the role of exporting firms. The analysis shows that exporting firms are, on average, more productive than non-exporting firms and that their suppliers also constitute a relatively more productive group. This points to the importance of encouraging the diffusion of knowledge and spillover effects along production chains, while accompanying export-support policies with appropriate monitoring of their effects on productivity.

A further significant element emerges from the example of **Slovakia**, characterised by a marked duality between foreign-owned and domestic firms. The former display significantly higher productivity levels, while the latter face shortcomings in managerial and technological capabilities, difficulties in achieving economies of scale, limited access to finance and foreign markets, and substantial fragmentation in firm size.

Broadly speaking, the review of selected countries shows that, despite the diversity of national circumstances, several common policy priorities recur: fostering investment in physical and intangible capital; strengthening research and innovation; accelerating the diffusion of digital technologies; developing skills and human capital; supporting firms' growth in size and managerial capacity; facilitating the reallocation of resources towards more productive uses; and strengthening links between firms, foreign markets and global value chains.

Overall, the Working Paper shows that productivity is neither a uniform phenomenon nor one that can be unambiguously interpreted through a single indicator. Its dynamics depend on the interaction between technology, human capital, investment, productive structure, firm organisation, institutions and the capacity to reallocate resources. The comparison of national experiences points, on the one hand, to the need to improve measurement methodologies and, on the other, to the opportunity to develop productivity policies that address not only innovation at the frontier, but also its diffusion, the conditions that enable more productive firms to grow, and the capacity of the economic system to transfer knowledge, skills and resources towards more efficient uses.

PART TWO
A READING GUIDE TO THE CHAPTERS

1.9. THE REPORT'S LINES OF INTERPRETATION AND ANALYTICAL BLOCKS

This Report offers readers three interpretative approaches, each serving a distinct yet complementary purpose. The first, developed in the first part of this chapter and revisited in the CNEL Working Papers—which, although published as separate volumes, form an integral part of the Report—organises the main questions surrounding contemporary productivity. These include the slowdown in productivity that paradoxically accompanies technological acceleration, and the polarisation between businesses at the technological frontier and those lagging behind. Both issues are examined alongside the empirical framework underpinning the analysis. The concluding section will then draw the findings together and consider their implications for economic policy.

The second and third approaches, developed in the second part of this chapter, provide a guide to reading the Report's core analytical content. To help readers navigate it, the Report's core is organised into three sections. The first comprises Chapters 2 and 3, which develop growth accounting at the aggregate level: the dynamics of labour productivity in comparison with other European countries and its accounting determinants. The second comprises Chapters 4 and 5, which extend the analysis to territories and individual businesses. The third examines the policy implications and comprises the conclusions, which bring together the diagnosis and the policy considerations. The following pages do not seek to summarise these contributions. Rather, for each section, they identify the caveat readers should bear in mind, which of the three concepts—labour productivity, the productivity of individual factors, or total factor productivity—is being examined, and how the findings relate to one another. The first part of this chapter should be understood in the same way: it set out six methodological caveats intended to prevent the common pitfalls of uninformed assessment: (1) conventional productivity measures value rather than volume; (2) deflation and statistical conventions affect both levels and dynamics; (3) total factor productivity is a residual that must be broken down into its components; (4) non-market services are valued at cost; (5) growth must be examined in terms of both its extensive and intensive components; and (6) productivity levels and dynamics are distinct dimensions.

The Report's chapters draw on different institutions and research groups, each with its own sources and conventions. This diversity is an asset, but it requires readers to accommodate occasional shifts in perspective, which these pages aim to facilitate.

1.10. GROWTH ACCOUNTING: CHAPTERS 2 AND 3

Chapters 2 and 3 form the core of the Report's growth-accounting analysis. Drawing on OECD and Istat data, they provide the underlying series and a number of basic calculations, which serve both as the conventional empirical reference point and as the starting point for the questions examined throughout the rest of the Report. Chapter 2 places Italian labour productivity dynamics in a European context and documents their appar-

ent structural weakness, while also showing the other side of the picture: recent GDP growth has exceeded that of Germany and France, driven by hours worked—that is, by an increase in labour input—and merchandise exports have proved remarkably resilient. This has occurred despite a productive specialisation still tilted towards low- and medium-low-technology sectors and a marked lag in exports of knowledge-intensive business services (KIBS). The chapter also documents that the structural transformation of the Italian economy has been less pronounced than in the other major European economies, and that employment growth has been concentrated in relatively less productive sectors. Chapter 3 breaks down labour productivity dynamics into their two accounting determinants and establishes a finding that deserves particular attention, including because of the questions it raises about the possible influence of external factors not covered by the available data and of inherently imperfect measurement. The analytical tools employed, which fully reflect international statistical conventions, suggest that over the entire period 1995–2025 the modest increase in labour productivity is entirely attributable to total factor productivity, while the overall contribution of capital intensity has been zero. Indeed, the capital stock declined for more than a decade following the sovereign debt crisis. These findings will, of course, need to be reassessed in light of the revision to the national accounts recently released by Istat, which will have to be taken into consideration in the next Report.

Four caveats raised in the introduction to this Report apply directly here. The first concerns the distinction between levels and dynamics. The two chapters compare rates of change, and readers should resist the temptation to interpret them as judgements about productivity levels. The second concerns total factor productivity: using a common shorthand, the chapters refer to it as a measure of technological and organisational innovation. In light of the discussion in the introduction, however, it must be interpreted as a residual which, in addition to innovation, incorporates labour quality not accounted for separately, allocative efficiency and measurement errors[11].

This is not merely a terminological issue. Chapter 3 documents a substantial improvement in human capital, with skilled employment rising from one-fifth to one-third of total employment. When labour quality improves while labour input is measured in hours, part of that improvement is silently incorporated into the residual.

The third caveat concerns changes in sectoral composition. The shift of employment towards labour-intensive services, documented in Chapter 2, incorporates the natural effect of rising relative costs in sectors where the scope for technical substitution is limited, as described in the first part of this chapter. It should not be interpreted as though reallocating activity between sectors were the main available lever for improving productivity. As the findings on business-level heterogeneity show, the largest productivity gaps occur within sectors, rather than between them.

The fourth caveat concerns capital. Stagnating capital intensity is not a mere accounting detail. On the one hand, it may reflect a change in the composition of capital; on the

11. The OECD takes a similar view. Its latest *Compendium of Productivity Indicators* includes a box addressing the interpretative limitations of multifactor productivity as a residual, which is sensitive to output and input measurement errors, incomplete adjustment for labour and capital quality, and cyclical capacity-utilisation effects. OECD, *Compendium of Productivity Indicators 2026*, OECD Publishing, Paris, Box 4.2.

other, it may signal a slowdown in the entire accumulation process, pointing to expectations, uncertainty and access to credit. These issues are taken up again in the subsequent chapters and in the conclusions.

1.11. FROM THE AGGREGATE TO HETEROGENEITY: CHAPTERS 4 AND 5 AND THE ACCOMPANYING CONTRIBUTIONS

The Report's second section looks beneath the surface of aggregate results, and it is here that its diagnosis takes shape. Chapter 4, which examines the territorial dimensions of growth and productivity, is important for highlighting disparities across the country, but its findings should be interpreted with due caution. At the territorial level, only labour productivity is available; it is not possible to estimate even a conventional measure of total factor productivity. Consequently, the measured gaps conflate differences in efficiency with differences in capital intensity and are also affected by demographic trends, which can generate apparent convergence in GDP per capita.

The first section of Chapter 5, devoted to human capital, innovation and digitalisation, addresses the issue of intangible capital. Investments in knowledge, research, skills and organisation are only partially recorded in the national accounts, and this omission simultaneously depresses measured output and measured capital. The second section of Chapter 5, which examines convergence and business growth in size, shifts attention from the endowment of production factors to their distribution across businesses. It provides the key to interpreting the apparent aggregate paradox: stagnation in average productivity is compatible with the presence of businesses that innovate and grow if the mechanisms through which innovation spreads from frontier businesses to others have broken down, and if the weight of less productive businesses does not decline quickly enough for the contribution of innovative businesses to become visible in aggregate results.

The evidence presented in this section must also be interpreted in light of the caveats discussed above. The regional productivity disparities documented by the OECD also emerge within the same sector and business-size category, with gaps exceeding 20–25 per cent between the most and least developed regions. Territory matters, but as a context that either enables or prevents the productive use of resources, not as a predetermined destiny. The share of graduates among employed people has increased everywhere, narrowing territorial differences, without generating proportionate productivity gains. This confirms, from the perspective of human capital, the broader diagnosis that production factors are improving but the contexts in which they operate are failing to make full use of them. Businesses moving up the size ranking also display better productivity indicators than businesses, including larger ones, that remain in place. Growth in size is a process rather than a static condition, and the circumstances that promote or hinder it are reflected in aggregate productivity. The box on innovative start-ups completes the picture by examining market entry: new and innovative businesses remain a limited share of the productive system, and a minority of them accounts for most employment and revenue growth. Evidence on business creation and turnover should therefore be interpreted as indicating selective dynamism within the system.

1.12. WAGES, UNCERTAINTY AND PUBLIC POLICY: AN ANALYTICAL PERSPECTIVE

The Report's third section turns to the policy implications of the analysis. Market power is addressed in the conclusions, which devote a section to the issue and should be read with the caveat set out in the Report's introduction firmly in mind: productivity measured in value terms rewards those with pricing power. The divergence between productivity and wages may reflect rents, changes in workforce composition by skill level, or measurement effects, each with very different distributive and policy implications.

Uncertainty and resilience affect all the dynamics examined in the Report. When uncertainty about the economic returns on investment is high, businesses tend to adopt a wait-and-see approach and postpone capital accumulation. This provides one explanation for the stagnation in capital intensity documented in Chapter 3. A frequently overlooked corollary follows: stability and predictability in the regulatory framework and in incentive policies are themselves forms of productivity policy, because they influence the climate of confidence underpinning investment decisions.

As regards policy measures, the analysis of tax incentives in manufacturing businesses, together with the other evidence gathered, points to two findings that must be considered together, since taken separately they lead to opposite conclusions. The first is that the public incentive system, considered in isolation, is unable to change business decisions on a sufficiently broad scale. Available assessments indicate that incentives are used primarily by businesses already inclined to invest. Moreover, a census-based Istat survey shows that, on average, most manufacturing businesses that invested in digitalisation did not use any incentives, with differences across business-size categories. The impact of these measures therefore tends to reproduce the fragmented structure of the productive system rather than consolidate it.

The second finding is that the lag affecting Italian businesses is primarily organisational and managerial, rather than technological. The counterfactual analysis available for Italy indicates that subsidies and training alone are insufficient to close the managerial-efficiency gap with frontier businesses, whereas policies that directly address managerial inefficiency are effective[12]. The conclusion is that what is needed is a change in the design of incentive measures, rather than simply an adjustment to their scale: incentives should be more selective and linked to integrated business projects encompassing investment, advanced training, research and managerial capabilities, rather than the purchase of specific assets.

In addition, innovative conditionalities should be introduced for instruments used at territorial level. This would require a reorganisation of technology transfer, which is currently fragmented across numerous overlapping initiatives. All of this should form part of a national strategy that establishes lasting links between public research, patenting and business, as well as a support system for start-ups focused on the actual bottleneck—not business creation, but the ability to scale up—in an ecosystem where venture capital

12. F. Schivardi, T. Schmitz, *The IT Revolution and Southern Europe's Two Lost Decades*, Journal of the European Economic Association, 18(5), 2020, pp. 2441-2486.

and investment remain below the European average[13]. This policy approach also requires systematic verification that the combined benefits associated with business-size thresholds do not act as a disincentive to business growth. This policy design is consistent with the argument set out in the first part of the chapter: if business size and the composition of production are outcomes of the incentive structure, economic policy must act on the architecture of incentives, not merely on their symptoms.

The volume concludes with a section that brings together the diagnostic assessment of the main issues and an evaluation of policy effectiveness. It follows a logical sequence, moving from measurement to diagnosis and finally to an assessment of what has worked, both in the country's economic development model and in the policies implemented by the Government. It also confirms that many apparent controversies surrounding Italian productivity are, in reality, disputes about its measurement.

1.13. CONCLUSION: FIVE KEYS FOR THE READER

The following is a reminder of the main interpretative points for the chapters presented in these pages. First, the Report's productivity measures are measures of value, not volume, and they reward pricing power as well as technical efficiency. They do not distinguish whether an increase in nominal output results from higher quantities or higher prices, nor do they show how wages and prices influence one another. Second, productivity levels and dynamics are distinct dimensions. Italy's problem appears to concern primarily productivity dynamics, whose interpretation depends on the different estimates of productivity trajectories over time. Third, average aggregate productivity may decline even when no individual business performs worse, if the productive base expands towards activities with lower productivity. Before interpreting a decline as a deterioration, it is necessary to ask what has entered the average. Fourth, total factor productivity is a residual to be broken down into its components, not a synonym for innovation. Its informational value emerges only when its components are distinguished, which is the research programme pursued by the Working Papers accompanying this Report. Fifth, the structural characteristics of the productive system are outcomes of the incentive architecture, not natural givens. Treating them as exogenous leads to reassuring but misleading diagnoses and ineffective policies. Using these five interpretative points, the following chapters do not tell the story of an unproductive country in decline. Rather, they document, with the precision permitted by the measures available, a system that has accumulated better production factors than its allocation mechanisms are able to put to effective use. The implications for economic policy are addressed in the conclusions.

13. For the evaluation of the Start-up Act, see F. Manaresi, C. Menon, P. Santoleri, *Supporting Innovative Entrepreneurship: An Evaluation of the Italian Start-up Act*, *Industrial and Corporate Change*, 30(6), 2021; for the European comparison, European Commission, *European Startup and Scaleup Scoreboard, Report for Italy*, 2026.

BOX

Measuring Productivity. Prices, Quality, Levels and Dynamics in Economies with High Internal Heterogeneity| National Productivity Board, Working Paper No. 3, July 2026

Pasquale Lucio Scandizzo and Emanuele Canegrati

CNEL Working Paper No. 3, *Measuring Productivity. Prices, Quality, Levels and Dynamics in Economies with High Internal Heterogeneity*, provides the theoretical and methodological framework for this Report. Its central argument is that measuring productivity and measuring output are the same problem viewed from two different angles: the conventions that determine what counts as output simultaneously determine what enters the measurement of productivity. Alongside this is a distinction that is often overlooked in public debate, namely that between level and dynamics. Italy maintains a relatively high productivity level by international standards, but its productivity growth has stagnated for more than twenty years. Confusing these two dimensions leads to misguided diagnoses and ineffective policy responses.

Within this framework, total factor productivity (TFP) cannot be observed directly: it is calculated residually, as what remains of growth once the contribution of measurable factors has been deducted. It is therefore not a direct indicator of technological progress, but a residual—famously described as a "measure of our ignorance"—that brings together technology, measurement errors and market distortions. This residual nature gives rise to the productivity puzzles: the paradox whereby the computer age, and now the digital age, is visible everywhere except in the statistics, with a generalised slowdown that, after 2005, coincides precisely with the mass diffusion of new technologies. The same source of measurement also underlies several distinctive features of the Italian case: persistently negative TFP despite rising employment, delays in intangible investment, territorial dualism and fragmentation in firm size. A cross-cutting issue must also be considered: as employment shifts towards services whose output is measured at factor cost, such as healthcare and education, aggregate productivity slows partly for an accounting reason, and not only for a real one.

The Working Paper proposes therefore not to interpret productivity as a single number, but through six wedges: successive adjustments rather than competing theories, designed to bring measurement closer to what actually changes in the economy. The first wedge is standard growth accounting, which separates the contribution of capital per worker, labour quality and the residual. The second reclassifies as investment what the national accounts record as current expenditure—software, research, design, training, organisational capital and data. Part of what had been called technological progress was in fact the accumulation of unrecorded intangible capital. The third measures the amount of output trapped by poor resource allocation, distinguishing between two levels. Across sectors, Italy wastes relatively little, whereas the more significant gap is found between firms within the same sector, where highly productive frontier firms—comparable to the best-performing European firms—coexist with a long tail of much less productive firms that retain a large share of labour and capital. The fourth isolates the effects of market power. Where prices exceed costs, part of what is measured as output is actually rent. What matters is not the average level of mark-ups, but their dispersion, which identifies protected areas. The fifth replaces output with a measure closer to actual well-being, taking into account consumption, leisure time, income distribution and sustainability. This is a different metric, not an addition to the preceding measures, but one that can reveal

situations of high output and low well-being. The sixth treats artificial intelligence as a partly autonomous factor that substitutes for and complements labour and capital and, above all, generates ideas, thereby potentially changing not only the level but also the rate of growth. Its dual nature—concentrated infrastructure generating rents on the one hand, and technology diffused through products and processes generating productivity gains on the other—requires distinct governance regimes.

The application to the Italian case is conducted using three social accounting matrices for 2020, 2024 and 2025, harmonised within a common framework covering seventy-five sectors and households differentiated by income deciles, together with a general equilibrium model. The estimates derived from the matrices are systematically compared with those found in the literature. The resulting picture is not that of a country short of technology, but rather of a combination of three constraints: resources poorly distributed across firms; market power that varies excessively from one firm to another; and a productive structure shifting towards sectors such as services and tourism that appear less productive. Artificial intelligence can affect all three, but only if these frictions are addressed first. The framework is then tested against the recent European debate on productivity measurement, treated as an exemplary case of the central thesis, and translated into accessible language in a chapter showing where the Italian problem lies. The Working Paper concludes with a question-and-answer section tracing the concept of productivity through the history of economic thought, from its origins to the idea of creative destruction, explaining its measurement methods in accessible terms and discussing how reliable available measures are and the purposes for which they can appropriately be used.

Chapters 2 and 3 of this Report empirically develop the first wedge, namely growth accounting using OECD and Istat data; for the remaining wedges and for the applied framework, readers are referred to the Working Paper.

2 LABOUR PRODUCTIVITY DYNAMICS IN THE EUROPEAN CONTEXT[1]

EXECUTIVE SUMMARY

- Following the acceleration recorded during the recovery phase in real GDP, which lasted through the second quarter of 2022, the Italian economy returned to modest growth rates and slowed further in 2025. This reflects the weak contribution of productivity dynamics to GDP growth compared with most of the other major European economies, while the expansion of employment and hours worked has been the main driver of growth.
- Productivity dynamics in Italy have also been affected by the relatively limited weight and modest dynamism, compared with the other major European economies (EU27 and the United Kingdom), of knowledge-intensive sectors, both in manufacturing and in services. Between 2007 and 2025, the structural transformation of the Italian economy towards activities with greater technological and knowledge content was less pronounced than in the other major European economies. Moreover, employment growth was concentrated predominantly in lower-productivity sectors, further slowing aggregate productivity dynamics.
- Italian goods exports have continued to grow significantly in recent years despite considerable uncertainty and international shocks, demonstrating a high degree of resilience and a gradual reorientation of specialisation. The performance of goods exports is similar to that observed in France and Germany, but is characterised by a larger share of low- and medium-low-technology sectors, particularly in textiles and clothing and household goods. Nevertheless, the share of high-technology products, which had remained stable between 1995 and 2007, increased by more than 5 percentage points; a similar increase affected agri-food products.
- Services exports have grown less than in the other major European countries. This has also been influenced by the lower economic weight of highly knowledge-intensive activities, such as information and communication services, business services and services related to the exploitation of intellectual property.

1. The statistical sources and the main methodological assumptions used in the analyses in Chapter 2 are described in the *Statistical and Methodological Appendix to Chapters 2 and 3*.

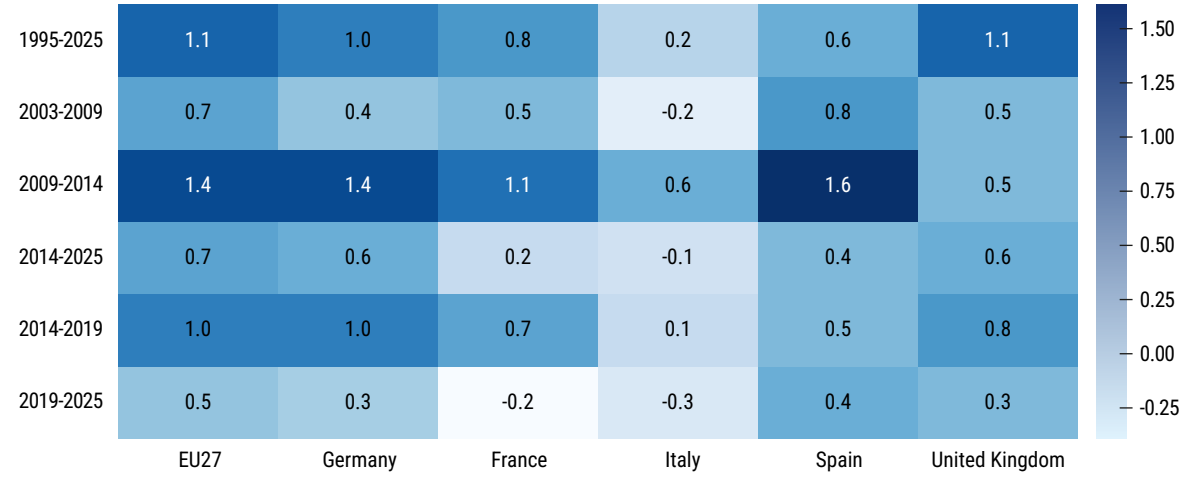
2.1. ECONOMIC GROWTH AND LABOUR PRODUCTIVITY[2]

Compared with the major European economies, Italy continues to stand out for its less favourable labour productivity dynamics[3]. In the most recent period (2019–2025), which encompasses the pandemic crisis and the subsequent recovery in GDP, labour productivity recorded an average annual decline of 0.3 per cent, compared with an average increase of 0.5 per cent in the EU27, particularly in Spain (+0.4 per cent) and Germany (+0.3 per cent), while growth remained positive in the United Kingdom (+0.3 per cent)[4]. France also recorded a decline in productivity (-0.2 per cent).

The labour productivity trend observed in Italy in the most recent period reflects a broader stagnation already evident in the pre-pandemic period. During the five-year period 2014–2019, characterised by greater macroeconomic stability, productivity growth in Italy had virtually come to a standstill (+0.1 per cent), unlike in the other major European economies, where it continued to increase, albeit at slower rates than in the past. During the five-year period of the Great Global Recession and the sovereign-debt crisis (2009–2014), productivity performance in Italy had been positive overall (+0.6 per cent), although significantly lower than in France (+1.1 per cent), Germany (+1.4 per cent) and, above all, Spain (+1.6 per cent). Only the United Kingdom had recorded a comparable performance over that period (+0.5 per cent)[5].

FIGURE 2.1.1

Labour productivity – Average annual growth rates, EU27 and major European countries



Source: OECD, Productivity Database.

2. By Carmine Fimiani and Antonio Regano, Istat, Directorate for National Accounts.

3. In this section, labour productivity is measured as real GDP per hour worked, in line with the OECD Productivity Database.

4. OECD data on labour productivity and hours worked for the United Kingdom are available up to 2024, while GDP data extend to 2025.

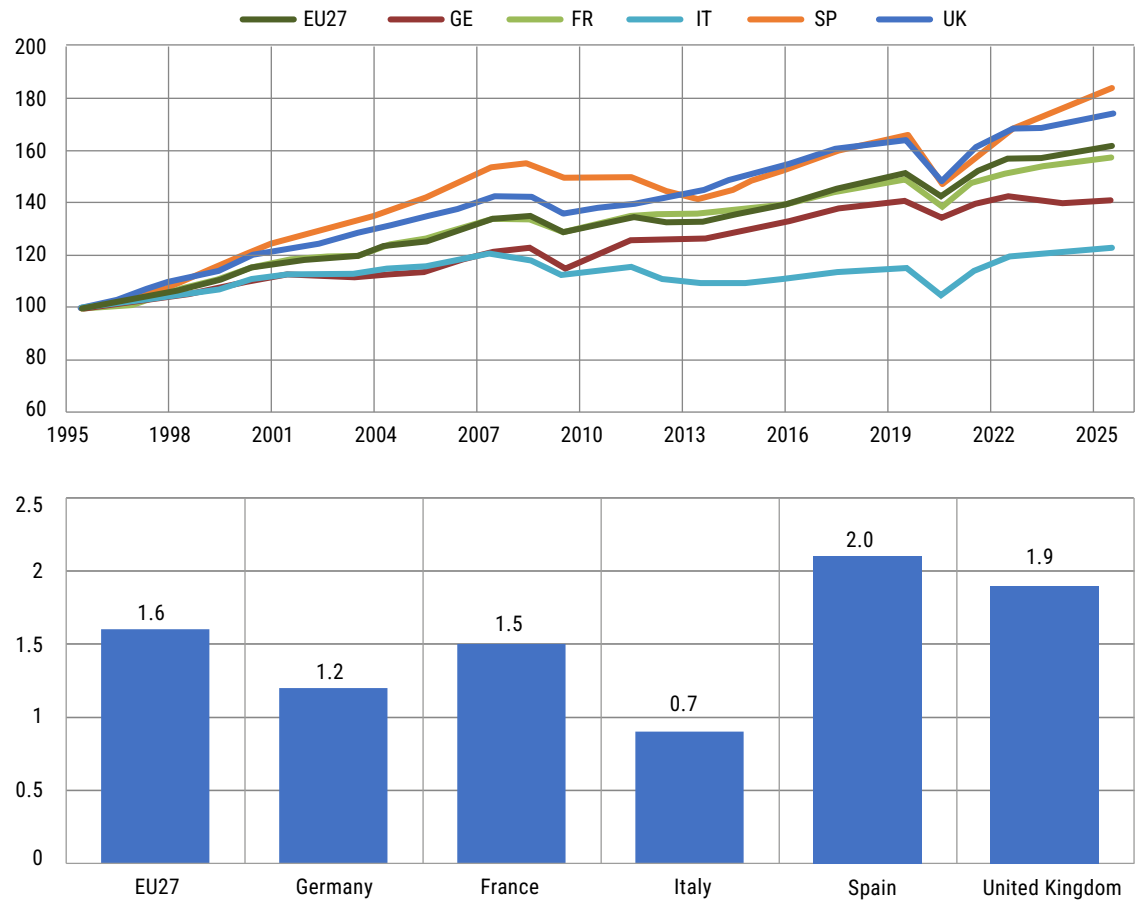
5. The favourable productivity dynamics also reflect the effects of the deep recession caused by the 2008–2009 financial crisis, which led to a marked contraction in labour input and the selection of firms.

Considering the entire 1995–2025 period, the weakness of Italian productivity dynamics takes on a structural dimension (Figure 2.1.1). Average annual labour productivity growth stood at around 0.2 per cent, compared with 1.1 per cent in the EU27, 1.0 per cent in Germany and 0.8 per cent in France. Spain, despite being characterised by greater cyclical volatility, also experienced stronger growth (+0.6 per cent). The comparison with the United Kingdom confirms this picture: over the same period, UK labour productivity increased by an average of 1.1 per cent per year.

The cumulative dynamics of GDP over the long term (Figure 2.1.2) provide a picture consistent with that observed for productivity, highlighting a progressive loss of relative momentum in the Italian economy. As discussed in greater detail below, growth has been driven predominantly by the expansion of labour input concentrated in sectors with relatively low value added and, consequently, modest productivity levels. According to OECD estimates, between 1995 and 2025 Italian GDP grew by an average of 0.7 per cent per year, a rate significantly below that of the EU27 (+1.6 per cent) and those recorded by Spain (+2.0 per cent), France (+1.5 per cent) and Germany (+1.2 per cent). The gap is also substantial when compared with the United Kingdom (+1.9 per cent).

FIGURE 2.1.2

GDP, 1995-2025 – Index numbers (2020=100) (top) and average annual growth rate (bottom)



Source: OECD, Productivity Database.

The evidence presented therefore confirms the persistence of Italy's productivity and economic growth gap in the European comparison. Against this backdrop, the analysis of the determinants of productivity undertaken in the following section is central to understanding, from a macroeconomic perspective, the factors shaping—and therefore also the medium- to long-term growth prospects of—the Italian economy.

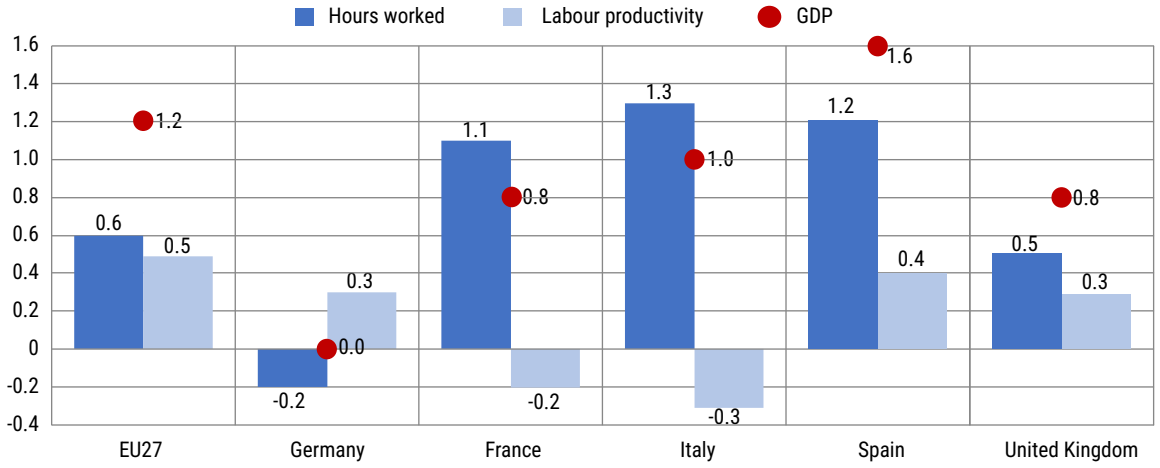
2.2. PRODUCTIVITY AND HOURS WORKED: CONTRIBUTIONS TO ECONOMIC GROWTH[6]

As anticipated in the previous section, the cumulative weakness of Italian GDP growth reflects a combination of factors: on the one hand, an increase in hours worked broadly in line with the European average (+0.5 per cent per year between 1995 and 2025); on the other, a consistently modest contribution from labour productivity, which increased by only 0.2 per cent per year over the same period, compared with 1.1 per cent in the EU27. The resulting growth pattern is weaker and dependent on the quantity of labour employed, with limited progress in terms of productivity[7].

In the most recent period, marked by a succession of shocks—from the COVID-19 pandemic to the energy and geopolitical crises—the Italian economy has shown, overall, relatively favourable growth dynamics in the European comparison (Figure 2.2.1). These six years nevertheless comprise both a period of stronger performance (2020–2022) and one of weaker performance (2022–2025), both in absolute terms and relative to the other European countries, with the exception of Germany.

FIGURE 2.2.1

GDP, labour productivity and hours worked – Average annual growth rates (2019-2025)



Source: OECD, Productivity Database.

6. By Carmine Fimiani and Antonio Regano, Istat, Directorate for National Accounts.

7. For a more detailed examination of developments across the various sub-periods, see the tables in the Appendix.

Between 2019 and 2025, GDP increased by an average of 1.0 per cent per year, a rate only slightly below that of the EU27 and above that of Germany, where growth averaged zero, and France (+0.8 per cent). Over the same period, GDP growth in the United Kingdom was also lower than Italy's, averaging +0.8 per cent per year. However, Italian growth was driven almost exclusively by the expansion of labour input (+1.3 per cent per year), while labour productivity recorded a negative change (-0.3 per cent per year). As shown by the detailed tables in the Appendix, the decline intensified in 2023–2024, with productivity falling by 2.2 per cent in 2023 and 1.4 per cent in 2024, against significant increases in hours worked (+3.1 per cent and +2.2 per cent, respectively). The 2025 figures confirm this trend: productivity continued to decline while hours worked increased further, albeit at slower rates than in the previous two-year period (+1.1 per cent). The post-COVID recovery, while temporarily supporting growth, was not accompanied by a structural strengthening of labour productivity dynamics. The predominant contribution of the increase in hours worked is partly attributable to the stronger expansion of traditional services, characterised by high labour intensity and low productivity levels, compared with more advanced services and manufacturing.

2.3. PRODUCTIVE SPECIALISATION AND STRUCTURAL TRANSFORMATIONS IN ITALY: A COMPARATIVE PERSPECTIVE ACROSS EUROPEAN COUNTRIES[8]

A significant part of the differences observed between Italy's modest productivity performance and that of the other major European economies can be attributed to the structural characteristics of the Italian productive system, which in turn reflect both persistent factors and pressures for change. To examine this aspect in greater depth, it is useful to analyse the evolution of productive specialisation, the composition of exports and processes of sectoral transformation in Italy in comparison with the rest of Europe.

The structural transformation of the Italian economy has been less intense than that observed in the other major European economies. Between 2007 and 2025, the reallocation of value added across economic activities was less pronounced than in the other E4 economies (France, Germany and Spain). The overall intensity of change[9] was 4.1 percentage points in Italy, compared with 5.3 in France, 6.4 in Germany and 8.6 in Spain. However, what matters is not only the intensity of structural transformation, but also its composition in terms of the technological and knowledge content of economic activities. The share of value added generated in Italy by sectors classified as more knowledge-intensive in production processes—high- and medium-high-technology manufacturing sectors and high-technology and knowledge-intensive services, according to the OECD definition, the so-called Knowledge-Intensive Business Services (KIBS)—increased between 1995 and 2007 but subsequently stagnated, whereas it continued to rise steadily

8. By Paola Bosso and Andrea De Panizza, Istat, Department for the Development of Methods and Technologies; Stefano De Santis, Istat, Department for Social and Demographic Statistics.

9. Calculated by comparing changes in the shares of different economic sectors: specifically, by summing the absolute changes in the shares of the 20 ATECO sectors and dividing the result by two.

in France, Germany and Spain (Figure 2.3.1, left). This difference in dynamics has also widened the already significant gap between Italy and France and Germany in the share of high-technology manufacturing, highlighting Italy's growing lag in specialisation towards higher-technology manufacturing activities.

The evolution of knowledge- and skill-intensive sectors in Italy also displays different patterns in manufacturing and services. In manufacturing, the 1.1 percentage-point decline in the sector's share of total value added concerned almost exclusively low- and medium-low-technology activities, whereas higher-technology production remained broadly stable. In services, by contrast, the increase in the share of total value added was concentrated predominantly in activities characterised by higher labour intensity and lower technological and knowledge content. Between 2007 and 2025, administrative and support activities increased their share by around one percentage point and accommodation and food services by 0.7 percentage points, while ICT services recorded a decline of 0.6 percentage points.

The reallocation of economic activity in employment terms was even more substantial, reaching approximately 7.3 percentage points when measured in full-time equivalent units of labour (FTEs). Between 2007 and 2024, manufacturing's share of total employment declined by 3.3 percentage points, to 14.1 per cent, accompanied by a 16.9 per cent decline in the sector's FTEs. This loss was concentrated primarily in textiles and clothing and in other traditional industries, including wood and furniture, non-metallic mineral products, and rubber and plastics.

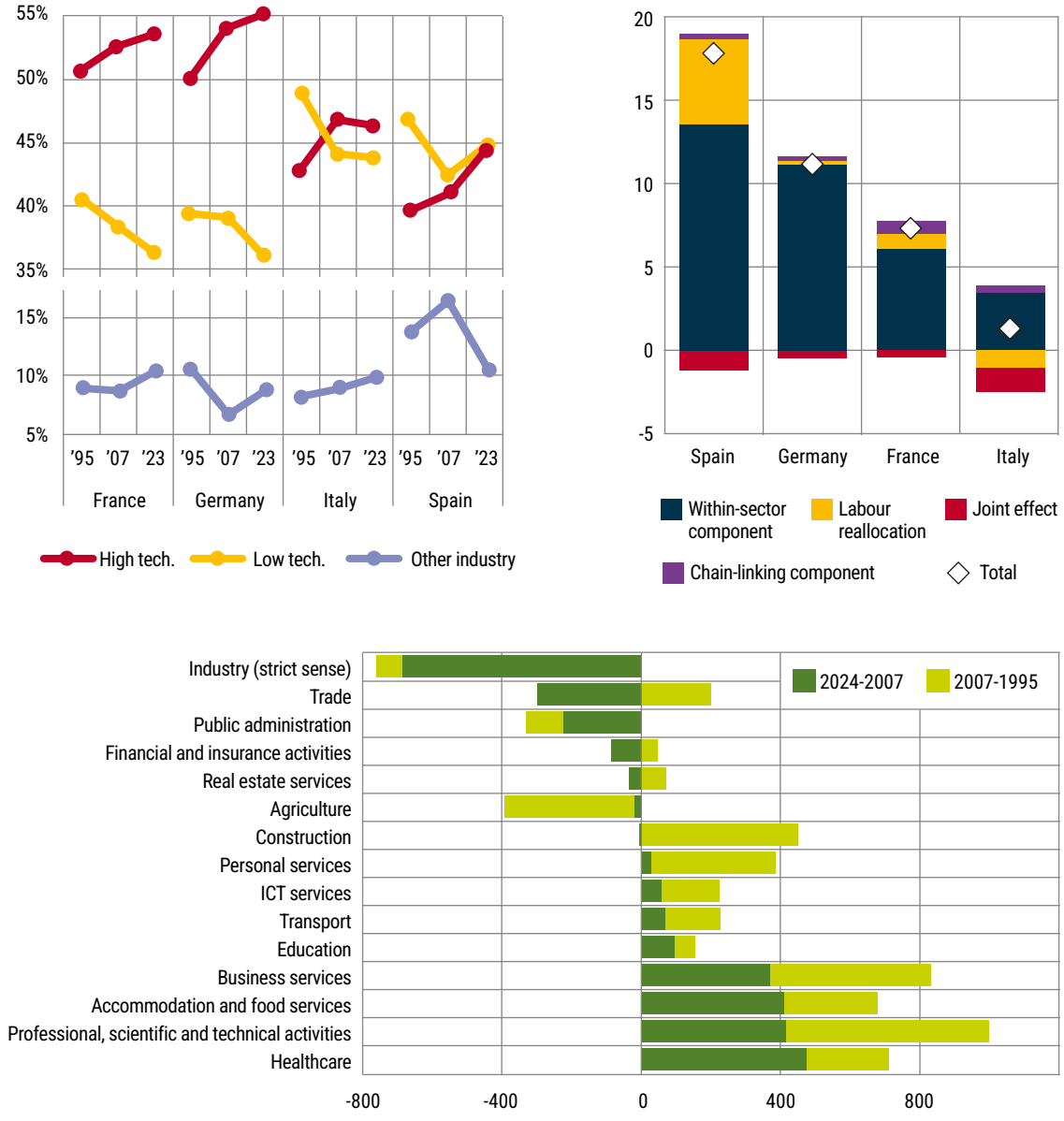
Over the same period, labour input in the economy as a whole increased by 1.4 million people (+5.6 per cent) and by approximately 600,000 FTEs (+2.4 per cent). This result reflects the loss of more than 1.3 million FTEs in manufacturing, trade and public administration, more than offset by growth of almost 2 million FTEs in certain service sectors: approximately half a million in healthcare and social assistance, and more than 400,000 each in professional, scientific and technical activities and in accommodation and food services (Figure 2.3.1, centre). This represented a substantially more intense reallocation than during the 1995–2008 period, when employment growth was more broadly distributed across manufacturing and services while significant employment losses were concentrated in agriculture.

The reallocation of employment from manufacturing towards less knowledge-intensive and therefore lower-productivity services contributed to the weak aggregate labour productivity dynamics observed at the economy-wide level. Compared with the other E4 economies, Italy has not only recorded weaker productivity growth within individual sectors, but has also experienced a structural composition effect favouring lower-productivity sectors. By contrast, this effect was virtually zero in Germany and positive in France and, above all, Spain, where the reallocation of employment across sectors contributed to higher aggregate productivity (Figure 2.3.1, right).

The negative effect of sectoral reallocation reflects the different employment dynamics observed across sectors. Between 2007 and 2024, employment increased most significantly in business services, accommodation and food services, and education and healthcare, while it declined in manufacturing, trade, ICT services and personal services (Figure 2.3.1, centre). As documented in Chapter 4 of the Istat Annual Report

FIGURE 2.3.1

Shares of value added of non-agricultural activities by technological level in the E4 countries (top left); changes in employment in Italy (below); sectoral contributions to productivity in the E4 countries (top right)(a). 1995–2023/24 and 2025 vs. 2007. Percentage shares, thousands of FTEs and percentage points



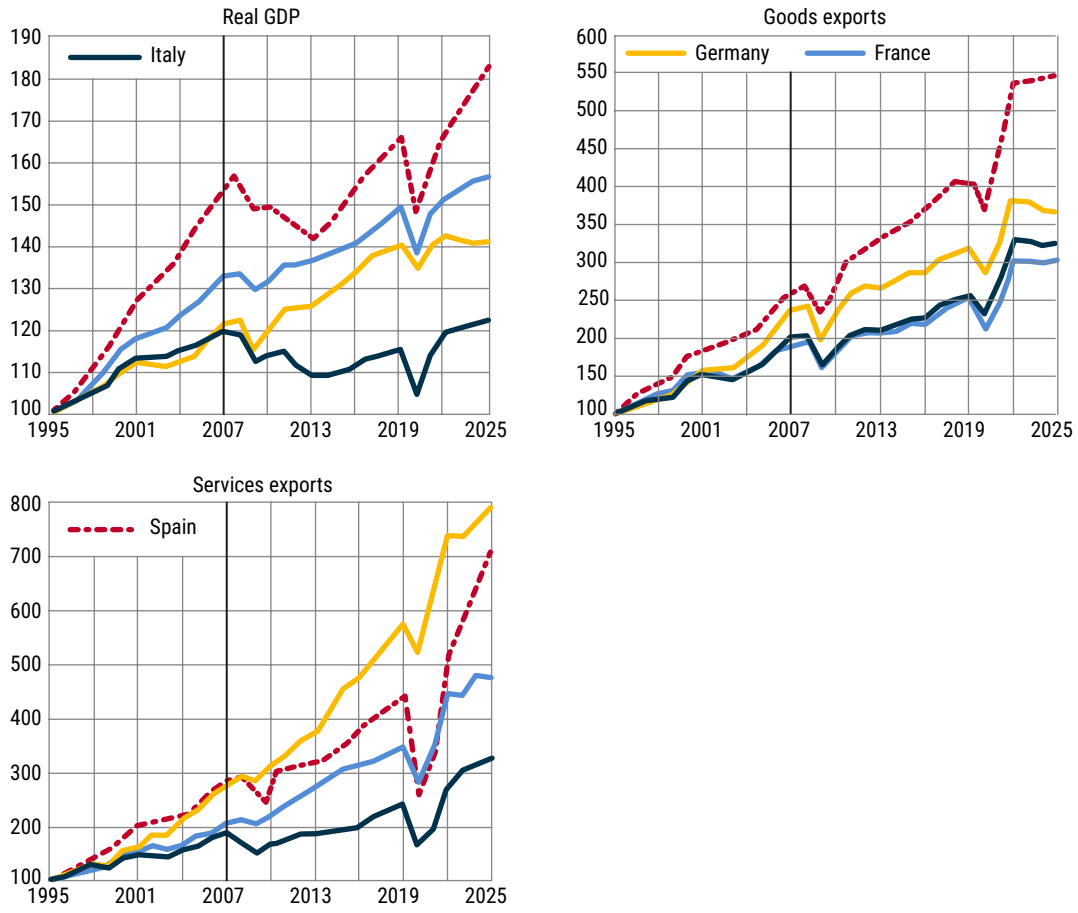
Source: Authors' calculations based on Eurostat, National Accounts, and Istat, National Accounts.
(a): The change in hourly productivity is decomposed into contributions arising from: (i) changes in productivity within sectors, holding employment shares (hours worked) constant; (ii) reallocation of employment across sectors, holding hourly productivity constant (the contribution is positive when initially more productive sectors increase their employment share); and (iii) the joint effect of changes in productivity and employment shares (the contribution is positive when employment shifts towards sectors experiencing productivity gains). The final chaining residual reflects the effects arising from the use of chain-linked indices in the National Accounts.

2026[10], this reallocation predominantly affected sectors characterised by relatively less favourable productivity dynamics, thereby weakening the efficiency gains achieved in the more dynamic sectors.

This evolution is also reflected in Italy's international specialisation. Between 1995 and 2025, Italian goods exports showed a performance broadly in line with that of France and Germany and stronger than GDP growth (Figure 2.3.2). Services exports, by contrast—a component that has driven the expansion of international trade in recent decades—increased at a significantly slower pace than in the other major European economies, starting already in the years preceding the 2008 crisis, even though they too grew faster than output.

FIGURE 2.3.2

Real GDP and exports of goods and services in the four largest economies of the European Union 1995-2025. Index numbers (1995=100)



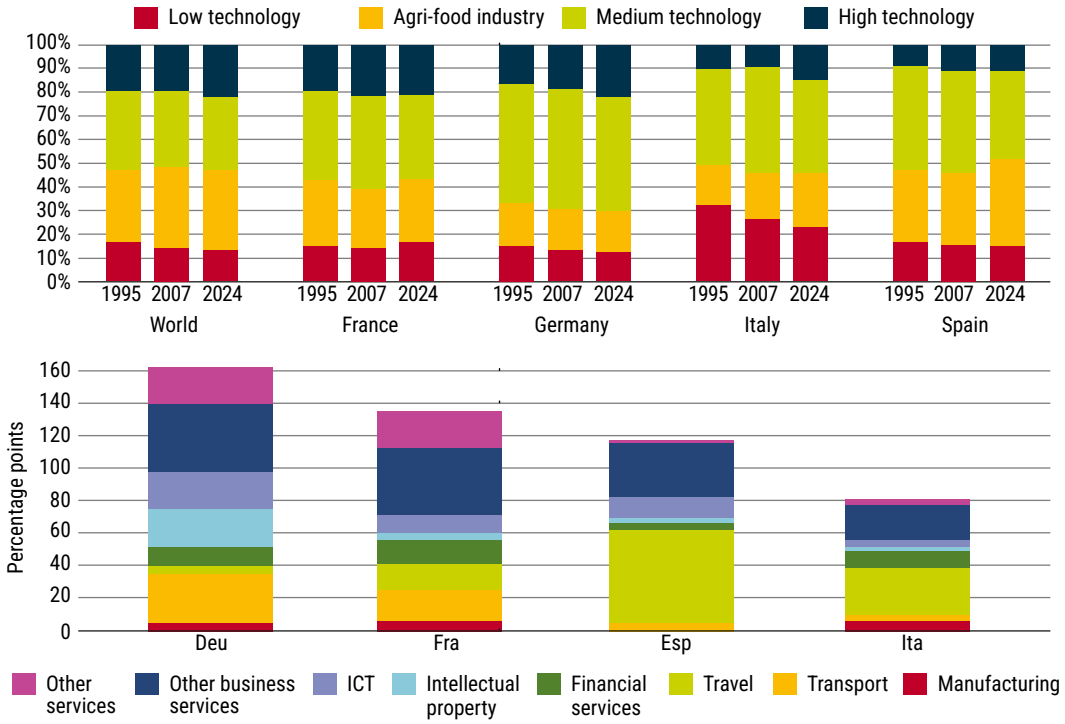
Source: Eurostat, National accounts.

10. For further details, see Section 4.1.2, *I cambiamenti strutturali dell'occupazione e della produttività del lavoro*, of the 2026 Istat *Annual Report*.

The performance of exports reflects specific features of Italy's productive specialisation. The strong performance of goods exports was achieved despite a productive structure still heavily oriented towards low- and medium-low-technology sectors, particularly textiles and clothing and household goods, which are more exposed to competition from emerging economies. The share of these sectors in Italian exports declined by approximately 9 percentage points between 1995 and 2025, reaching 23.4 per cent, while remaining the highest among the E4 economies (Figure 2.3.3). At the same time, the share of high-technology products increased by more than 5 percentage points—entirely after 2007—and a similar increase affected products belonging to the agri-food value chain[11]. The more limited growth of services exports, by contrast, reflects the limited contribution of activities with a higher knowledge intensity, such as information and communication services, business services and services related to the exploitation of intellectual property. The post-2007 shift in manufacturing exports towards high-technology sectors contrasts with the stability of those sectors' share in total value added over the same period, a contrast that suggests a shortfall in domestic demand.

FIGURE 2.3.3

Techno-economic composition of goods exports (left) and contribution of different categories to services exports (right). 1995–2024 and 2008–2024. Values and percentage points



Source: Authors' calculations based on WTO and UNCTAD (ITC) data.

11. As a result of changes in product composition and positioning towards higher-quality segments, the average unit value of Italian exports increased more rapidly than in the other economies in the group: measured in US dollars, it increased by 224 per cent between 2000 and 2024, compared with increases of between 155 and 170 per cent in France, Germany and Spain.

BOX

The Italian Tertiary Sector. Transformations, Productivity and Prospects | National Productivity Board, Working Paper No. 5, September 2026

by Paolo Feltrin, Sergio Maset, Mariano Bella and Luciano Mauro

The Working Paper No. 5 examines the role of market services in the transformation of Italy's productive structure and in labour productivity dynamics, challenging the interpretation of tertiarisation as a simple shift of employment from manufacturing towards structurally less productive activities and highlighting instead the high degree of heterogeneity within services and the importance of the conditions under which firms operate. Between 2015 and 2023, employment in local units increased overall by approximately 14 per cent, with growth of 16.1 per cent in services and 6.9 per cent in manufacturing; within the services sector, knowledge-intensive services (KIS) recorded an increase of 25.6 per cent.

The measurement and interpretation of productivity in services are among the central themes of the Working Paper. The comparison between value added and labour input shows highly differentiated trajectories across sectors: in market services, labour productivity has displayed positive long-term dynamics in some sectors and weaker or negative dynamics in others. For example, between 1995 and 2025, information and communication activities recorded an 81 per cent increase in value added per employee, while accommodation and food services experienced a decline in value added per employee; over the same period, however, employment in accommodation and food services increased significantly. This highlights the need to interpret changes in labour productivity taking into account employment dynamics and the composition of inputs.

Italy's productive structure is also characterised by a strong presence of micro and small firms, particularly in professional and managerial services: within the PROM scope, approximately seven out of ten employees work in the smaller size classes. The European comparison nevertheless suggests that productivity differences do not depend exclusively on firm size. The simulations and comparisons presented in the Working Paper show that, for the same size class, Italian service firms have lower productivity levels than comparable French firms and, more generally, that there is scope to increase productivity even without a radical transformation of the size structure. Productivity therefore depends, alongside firm size, on the quality of the organisational and economic environment, managerial functions, technologies, access to markets and the conditions that support investment.

The relationship between education, demand for skilled labour and productivity represents another important area. Italy has a lower proportion of people with tertiary education qualifications than the European average, while the productive system's capacity to absorb and make effective use of these skills remains uneven. The supply of human capital and the demand for qualified professionals must therefore be considered jointly: a limited supply of skills may hinder technology adoption, while insufficient demand for skilled labour reduces the return on investment in education and training and may encourage mobility towards other countries.

The transformation of the services sector also has a significant territorial dimension. Knowledge-intensive services are more highly concentrated in major urban centres and in territories characterised by greater endowments of human capital, universities and

complementary services, whereas manufacturing production systems retain a different geographical distribution.

A further issue concerns the internationalisation and measurement of trade in services. The Working Paper examines the methods used to measure and represent services trade, highlighting, particularly in relation to tourism, the limitations of statistical classifications in allocating activities directed towards foreign customers to individual sectors. This distortion may lead, at the microeconomic level, to an underestimate of the contribution of service firms to international markets.

Finally, the Working Paper examines the role of digital technologies and artificial intelligence in the transformation of services, including those characterised by greater labour intensity. Automation and the adoption of new technologies are presented as potential levers for increasing productivity, but their effectiveness also depends on the availability of skills and on firms' organisational capacity.

3 DETERMINANTS OF LABOUR PRODUCTIVITY IN ITALY

EXECUTIVE SUMMARY

- The dynamics of labour productivity examined in Chapter 2 are decomposed here into two determinants: total factor productivity (TFP), which measures the degree of technological and organisational innovation, and capital intensity in production processes. The modest improvements in labour productivity observed between 1995 and 2025 are entirely attributable to TFP, while capital intensity (capital per hour worked) made a negligible contribution. The positive contribution of TFP has progressively weakened in recent years, becoming negative over the last two years.
- The dynamics of capital intensity reflect both the increase in labour input and the weak growth of the capital stock itself, which declined overall for more than a decade following the sovereign-debt crisis. The capital stock began to grow again in 2021, but at lower rates than labour input, resulting in a further decline in capital intensity that was interrupted only in 2025.
- Capital accumulation has nevertheless followed markedly different trajectories across asset categories: growth has been stronger for ICT tangible assets and intangible assets, whereas non-ICT tangible capital has remained broadly stable.
- Skills and human capital formation are two key elements in labour productivity growth. The share of workers with tertiary education has increased across all productive sectors, particularly those already characterised by a higher prevalence of highly educated workers. The share of skilled employment in Italy rose from just over one fifth to approximately one third of total employment between 1992 and 2024. Most of this increase occurred during the 1990s and 2000s, while the growth in the share of skilled occupations has slowed considerably since 2011.
- The Italian labour market has experienced a progressive ageing of the workforce. The average age of employed people rose to 45.6 years in 2025, almost five years more than in 2007. This development reflects both demographic trends—which have narrowed the base of the age pyramid and increased the share of older age groups—and changes in working and retirement patterns, including the progressive increase in the retirement age and the resulting extension of working lives. Job tenure with the same employer has also increased, reflecting lower labour-market dynamism.

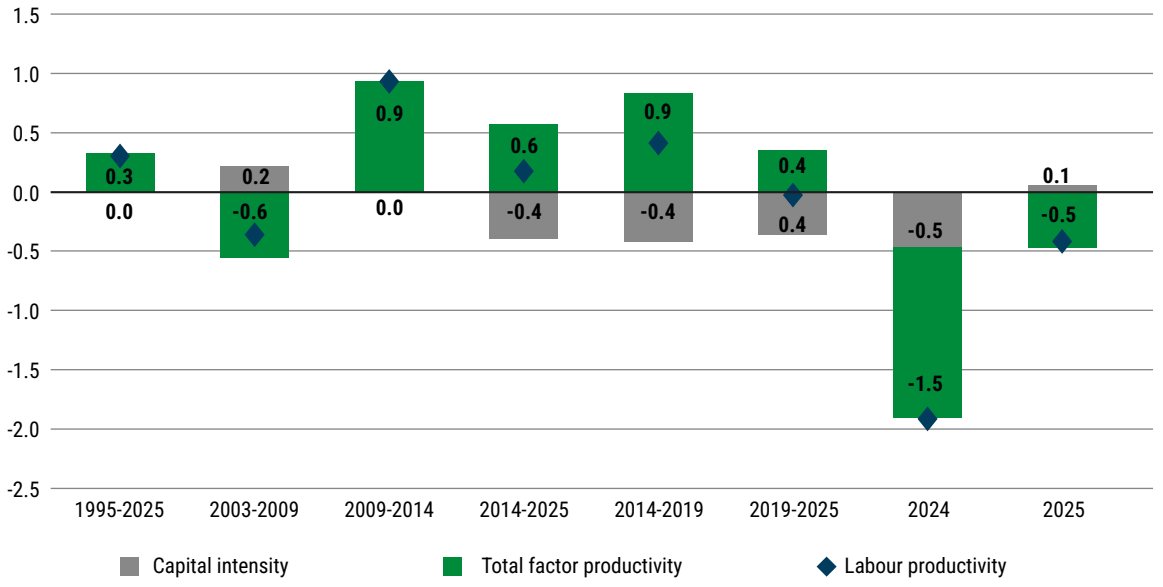
3.1 CAPITAL, EFFICIENCY AND PRODUCTIVITY[1]

Growth accounting makes it possible to decompose labour productivity dynamics into the contributions arising from changes in capital per hour worked (capital intensity or capital deepening) and total factor productivity (TFP). Increases in labour productivity may therefore result either from a greater capital endowment per unit of labour or from improvements in the efficiency with which capital and labour are combined in the production process.

Macroeconomic data confirm the existence of structural weaknesses that translate into weak growth both in TFP and, above all, in capital intensity. Between 1995 and 2025, the modest growth in Italian labour productivity was entirely attributable to the positive contribution of TFP (+0.3 percentage points), while the contribution of capital per hour worked was zero overall (Figure 3.1.1). Even during periods when labour productivity recorded higher growth rates, such as the 2009–2014 five-year period, its dynamics remained driven almost entirely by TFP. In 2024, both contributions—TFP and capital per hour worked—were negative, resulting in a marked contraction in labour productivity. In 2025, the decline in labour productivity moderated (-0.4 per cent), thanks to a slight positive contribution from capital intensity (+0.1 percentage points), which only partially offset the persistent negative contribution of TFP (-0.5 percentage points).

FIGURE 3.1.1

Contributions of capital intensity and TFP to labour productivity growth
Average annual growth rates and percentage points



1. By Carmine Fimiani and Antonio Regano, Istat, Directorate for National Accounts.

The analysis of capital input dynamics shows that, between 1995 and 2025, it increased by an average of 0.5 per cent per year. Following the twin crises—the financial crisis and the sovereign-debt crisis—the overall capital stock nevertheless declined for more than a decade, owing to a sharp contraction in investment and its insufficient recovery in subsequent years, unlike the pattern observed in the other major European countries. Only from 2021 onwards was there a gradual recovery in the growth of the capital stock employed in production processes.

In the most recent period, hours worked increased faster than capital input. As a result, capital intensity progressively declined. Between 2014 and 2025, capital per hour worked decreased by an average of 1.1 per cent per year, while capital input increased by 0.2 per cent.

Weak overall accumulation has nevertheless been accompanied by significant changes in the composition of capital input. Growth was driven by ICT components (+2.6 per cent per year on average over the long term and +2.9 per cent over 2014–2025) and non-ICT intangible capital (+2.2 and +2.8 per cent, respectively), while non-ICT tangible capital remained almost stagnant over the long term (+0.1 per cent) and declined over the last decade (-0.5 per cent).

Figure 3.1.1 highlights the overall contribution of capital per hour worked to labour productivity growth. To understand the reasons for the limited contribution of capital to labour productivity growth, it is useful to examine the evolution of capital stocks jointly with these developments (Table 3.1.2).

Overall, capital dynamics made only a limited contribution to labour productivity growth over the long term. Weak capital accumulation, the decline in capital intensity over the last decade and the progressive weakening of the contribution of TFP paint a picture in which productivity growth has been constrained both by insufficient expansion of productive capital and by the weak dynamics of overall efficiency in the economic system. From this perspective, the following section examines more closely the role of the qualitative characteristics of the workforce and of human capital among the factors potentially underlying labour productivity dynamics.

TABLE 3.1.2

Capital input by type of asset and capital per hour worked. Average annual growth rates

	Capital input				Capital intensity
	Capital input	ICT capital input	Non-ICT tangible capital input	Non-ICT intangible capital input	Capital per hour worked
1995-2025	0.5	2.6	0.1	2.2	0.0
2003-2009	0.7	0.1	0.8	1.5	0.6
2009-2014	-1.2	0.5	-1.6	1.0	0.1
2014-2025	0.2	2.9	-0.5	2.8	-1.1
2014-2019	-0.2	3.6	-1.2	3.6	-1.4
2019-2025	0.5	2.3	0.0	2.1	-1.0
2024	0.9	2.4	0.6	1.5	-1.3
2025	1.1	2.1	0.9	2.2	0.2

Source: Istat.

3.2 HUMAN CAPITAL AND WORKFORCE CHARACTERISTICS[2]

The weak dynamics of labour productivity have been accompanied, particularly in recent years, by strong employment growth. In this context, particular importance attaches to the analysis of the qualitative characteristics of the workforce. Human capital is an important determinant of productivity because it affects the ability to adopt innovations, use more advanced technologies and improve the efficiency of production processes. However, the availability of more highly educated workers does not automatically translate into higher levels of productivity; it also depends on the capacity of the economic system to make effective use of their skills and qualifications.

Over recent decades, the characteristics of the employed population have changed substantially, with the growing diffusion of tertiary education and higher-level professional qualifications, but also with a progressive and rapid ageing of workers. The most significant transformation has been the rise in educational attainment, to which generational replacement has contributed. In 1992, approximately 60 per cent of employed people had, at most, lower-secondary education, while fewer than 9 per cent held a university degree; today, the two groups are of broadly equal size, at 26 per cent[3].

In particular, between 2007 and 2025, according to the *Labour Force Survey*, the number of employed people with tertiary qualifications increased by 2.6 million, or approximately 70 per cent, across economic activities, although not uniformly. The largest increase—almost 800,000 workers—occurred in education and healthcare, where graduates account for 60 per cent of the total, followed by professional activities, with half a million additional workers, and industry excluding construction, with 370,000. In the latter case, as also in public administrations, the share of workers with tertiary qualifications doubled—from 7.2 to 15.5 per cent and from 19.7 to 37.3 per cent, respectively—in a context of declining sectoral employment (Figure 3.2.1).

Skilled employment, measured as the share of professionals and technicians (Groups 2 and 3 of the ISCO classification), increased in Italy from just over one fifth to approximately one third of total employment between 1992 and 2024. However, most of this increase occurred during the 1990s and 2000s, while since 2011 the share of skilled occupations has increased by only two percentage points, much less than in France and Germany, where it stands at around 43 per cent, and in Spain, which has nearly reached the Italian level (Figure 3.2.2).

Moreover, the increase in skilled employment primarily reflects the dynamics of sectors already characterised by a higher concentration of professionals and technicians. More than half of the increase occurred in education, healthcare and professional activities. In the sectors that have driven employment growth in recent years—including accommodation and food services, administrative and support activities and trade—the share of professionals and technicians has instead remained relatively low or increased

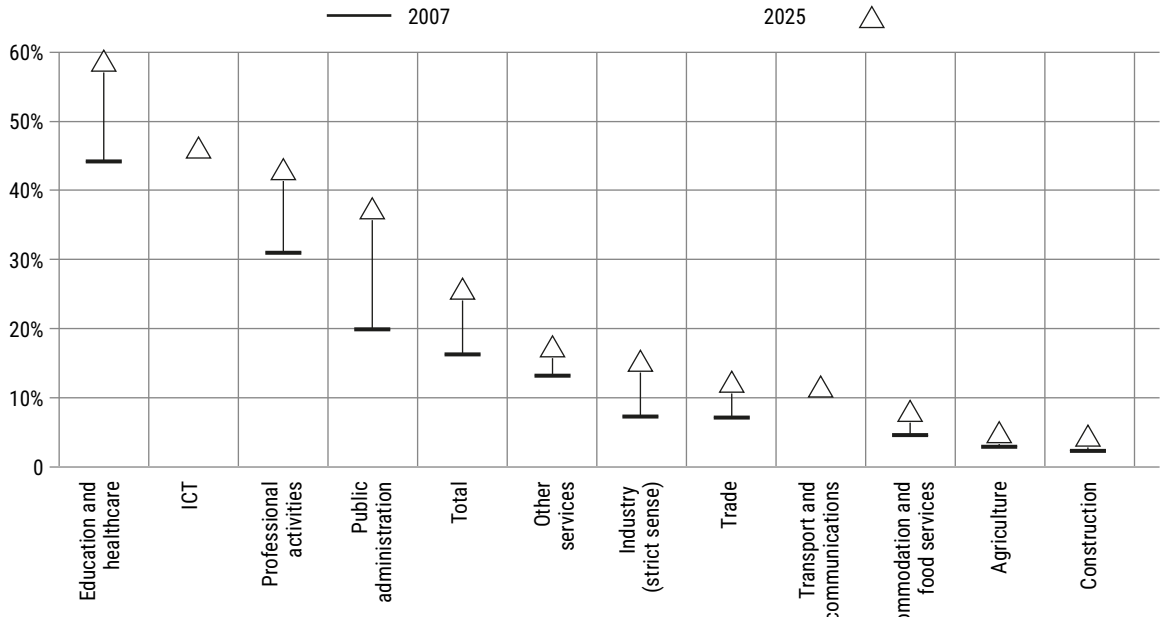
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2. By Paola Bosso and Andrea De Panizza, Istat, Department for the Development of Methods and Technologies; Stefano De Santis, Istat, Department for Social and Demographic Statistics.

3. On the other hand, despite this progress, the share of graduates in Italy remains lower and is increasing more slowly than in France and Spain, where growth is also supported by the spread of short-cycle tertiary education programmes (ISCED 5), generally lasting two years, which remain relatively uncommon in Italy and Germany. Italy and Spain nonetheless continue to have a high share of workers with low levels of education. The progressive exit of older cohorts from the labour market will narrow part of this gap.

FIGURE 3.2.1

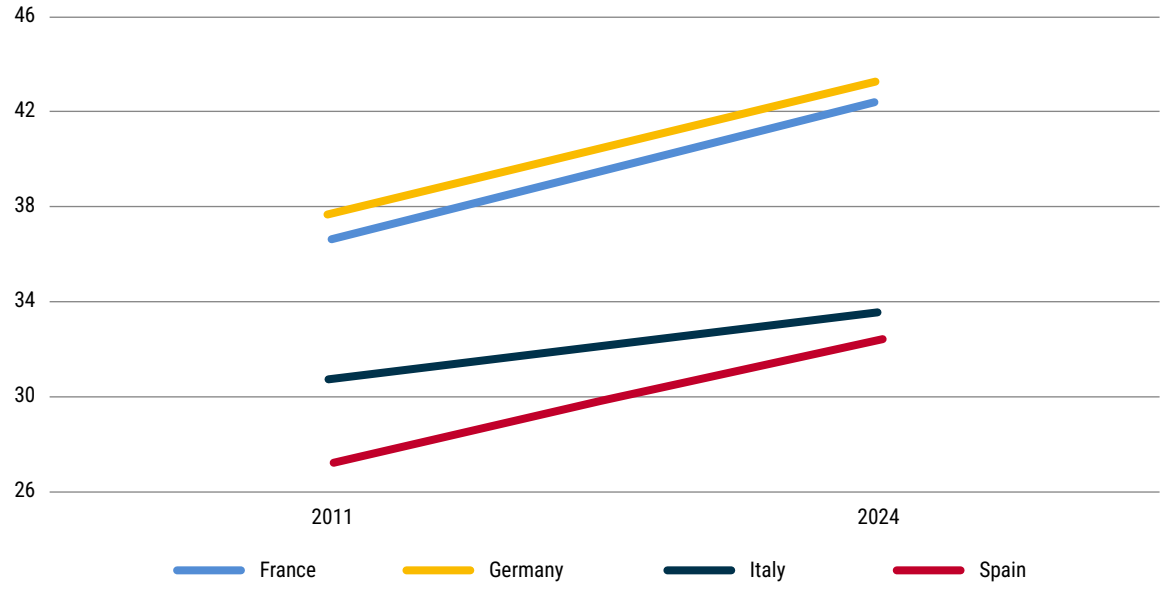
Employed People with tertiary education, by sector. 2007 and 2025 (percentages)



Source: Istat, Labour force survey.

FIGURE 3.2.2

Specialists and technicians in the E4 countries. 2011 and 2024 (as a percentage of total employment)



Source: Istat, Labour force survey.

only marginally. The share of workers with tertiary education has also increased in manufacturing, although to a lesser extent than in the more knowledge-intensive sectors. However, the sectors that drove employment growth also absorbed a significant share of workers with levels of education higher than those normally associated with the jobs they perform, pointing to a growing mismatch between educational attainment and the occupational content of employment.

Alongside rising educational attainment, the Italian labour market has also experienced a progressive ageing of the workforce. Between 2007 and 2025, the average age of employed people increased by 4.6 years, reaching 45.6 years. This development reflects both demographic trends and changes in working and retirement patterns.

Ageing has affected all economic sectors, albeit with varying intensity. In 2025, the highest average ages were recorded in public administration and agriculture, while lower values were found in ICT services and accommodation and food services. At the same time, job tenure with the same employer also increased, reaching an average of 13.5 years.

Overall, the evidence points to a significant improvement in the educational attainment of the Italian workforce, accompanied by a progressive ageing of employed people. These two trends may have opposite effects on productivity dynamics. Firm-level analyses presented in Chapter 5 show that a higher level of education among the workforce employed by firms is associated with a greater propensity to innovate and higher productivity, whereas a higher average age of the workforce, holding other characteristics constant, is negatively associated with innovative propensity. At the same time, the evidence presented here indicates that the growth in highly qualified occupations has been more limited than the increase in educational attainment, particularly over the last decade, and has been concentrated in specific sectors. At the aggregate level, the different sectoral composition of employment growth has also played a role.

BOX

Tax Incentives, Industry 4.0 and Capital Intensity in Manufacturing Firms[4]

Introduction

The weak dynamics of capital intensity represent one of the main factors underlying the modest growth of labour productivity observed in Italy. In this context, investment in productive capital constitutes one of the main channels through which firms can increase productivity and strengthen competitiveness. In particular, the adoption of advanced digital technologies and capital goods associated with the Industry 4.0 paradigm can enhance the efficiency of production processes and support the diffusion of innovation throughout the productive system. The descriptive evidence reported in the Appendix also shows that the use of public incentives represents only one of

4. By Eleonora Bartoloni and Antonella Caiumi, Istat, Department for Economic, Environmental and National Accounts Statistics; Andrea Ugo Marino, Istat, Directorate for National Statistical System and Territory.

the ways in which firms invest in digital technologies, highlighting the heterogeneity of investment behaviour. In this context, tax incentive policies for investment play an important role in fostering the technological transformation of firms. Within this set of measures[5], the present analysis focuses on tax measures supporting investment in capital goods aimed at the technological and digital transformation of production processes. In particular, the analysis considers the two instruments introduced successively over time: the increase in depreciation allowances for investments in tangible Industry 4.0 capital goods (*Iper-ammortamento*), in force from 2017 to 2019, and the tax credit for investments in Industry 4.0 capital goods (*Credito Transizione 4.0*), introduced by the 2020 Budget Law and subsequently extended through 2025. The evolution of the main tax parameters of the two measures is summarised in the table below.

Table 3.2.3.

Overview of the evolution of the main characteristics of Industry 4.0 investment incentives

Period		2017	2018	2019	2020	2021	2022	2023	2024	2025
		Depreciation allowance increase			Tax credit					
Tangible Industry 4.0 goods	rate	150%	150%	170%	40%	50%	40%	20%	20%	20%
	threshold(*)			*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*	*2.5*
	rate			100%	20%	30%	20%	10%	10%	10%
	threshold(*)			*10*	*10*	*10*	*10*	*10*	*10*	*10*
	rate			50%		10%	10%	5%	5%	5%
	threshold(*)			*20*		*20*	*20*	*20*	*20*	*20*
Multi-year allocation		Depreciation period			5 annual quotas	3 annual quotas				

Note: (*) Investment classes (EUR million) for the increase in depreciation allowances; investment brackets (EUR million) for tax credits.

To understand the extent to which these measures have contributed to supporting the accumulation of innovative capital by firms, this analysis addresses two distinct aspects. The first concerns the determinants of incentive take-up, namely which firm characteristics, economic and financial conditions, tax position and previous history of incentive

5. The *Piano Industria 4.0*, introduced at the end of 2016 and subsequently updated on several occasions, aims to create a favourable environment for the competitiveness and productivity growth of Italian firms by supporting their ability to seize the opportunities offered by the fourth industrial revolution, namely the use of technologies based on the increasing integration of physical systems, digital tools and advanced data analytics (e.g. the Internet of Things, cloud computing, big data analytics, collaborative robotics, virtual/augmented reality and 3D printing). The Industry 4.0 paradigm introduces a systemic approach to innovation, moving beyond the logic of a single innovative investment or individual piece of machinery through the adoption of fully automated and interconnected production and business-management systems ("smart" infrastructures and facilities). To this end, the Plan provides for complementary measures covering the entire business life cycle: from promoting investment in new capital goods (*Super-ammortamento*) and the digitalisation of production processes (*Iper-ammortamento*), to supporting access to bank credit (*Nuova Sabatini*, *Fondo di Garanzia*), and incentivising private expenditure on research and development (R&D tax credit), with the aim of strengthening process and product innovation and consolidating productivity over the long term. The measures also include ACE (*Aiuto alla Crescita Economica*), aimed at strengthening the capital structure of Italian firms by encouraging the use of equity and promoting a better balance between risk capital and debt.

use affect the probability of resorting to Industry 4.0 measures. The second concerns the incentive effect of the measure, namely the quantification of its impact on firms' investment intensity among those that benefited from the tax incentive.

Data and methodology

Industry 4.0 incentives have a number of specific features that make it more difficult to identify their effects than those of other economic policy measures. The first concerns the design of the measure itself. The incentives are potentially available to all firms undertaking eligible investments; consequently, there is no natural control group consisting of firms excluded *ex lege* from the measure. A second issue concerns the availability of information: eligible goods cannot be directly identified from firms' financial statements, but can only be observed ex post through the tax returns in which the benefit is claimed. Consequently, in administrative data, the decision to claim the incentive cannot be distinguished from the decision to invest in Industry 4.0 goods[6].

To address the issue of self-selection, a two-stage empirical strategy was adopted. The first stage analyses the incentive adoption process, estimating the probability that a firm uses Industry 4.0 measures as a function of its structural, economic, financial and tax characteristics. The second stage assesses whether and to what extent the incentives actually stimulated investment by beneficiary firms, correcting for the potential self-selection effect arising from the fact that participation in the programme is not random[7]. A distinctive feature of the analysis consists in measuring incentive intensity through the reduction in the user cost of capital[8] induced by the tax benefit, rather than through a simple dummy variable indicating use of the incentive. This approach makes it possible to measure the effective intensity of the tax benefit for each firm, taking into account heterogeneity in the use of incentives and isolating the effect of the measure from the other components of the user cost of capital, which are determined by the tax system and the firm's economic and financial characteristics.

The use of the user cost of capital also makes it possible to assess possible investment-anticipation effects, since it incorporates changes in the tax benefit resulting from legislative amendments and the temporary nature of the measure. Finally, the dynamic structure of the model makes it possible to account for the inertia characterising capital accumulation, which is relevant for correctly identifying the effect of the incentive. The

6. Failure to make use of the incentive does not necessarily imply the absence of investment in Industry 4.0 assets. Evidence from the Permanent Census of Enterprises shows that a non-negligible share of firms invests in digital technologies, including technologies more closely associated with the Industry 4.0 paradigm, without benefiting from public incentives (see the Appendix). Such investments cannot be identified in administrative tax data, which make it possible to observe only Industry 4.0 investments for which the incentive was claimed. The analysis therefore refers to subsidised investments and does not capture the full set of Industry 4.0 investments undertaken by firms.

7. The methodology draws on Heckman-type selection models (Heckman, 1978; 2001) and the subsequent literature on selection-control models (Rivers and Vuong, 1988; Terza et al., 2008; Wooldridge, 2010).

8. The user cost of capital is the actual cost incurred by a firm to use a capital asset (such as machinery or equipment) for a given period, generally one year. It takes into account not only the wear and obsolescence of the asset, but also the cost of the financial resources required to purchase it and the effects of taxation, which may increase or reduce the attractiveness of the investment. The user cost of capital represents for capital what the wage represents for labour: the price paid to use a productive factor. In the analysis, the user cost of capital is constructed following the approach of Hall and Jorgenson (1967) and subsequent empirical literature (Mairesse and Mulkay, 2003). The dynamic structure of the model follows Capron and Van Pottelsberghe (1997) and Lach (2000).

empirical strategy requires integrated information on firms' economic, financial and tax characteristics. To this end, the analysis is based on an unbalanced panel of Italian manufacturing corporations, constructed by integrating several firm-level sources—including tax returns and company financial statements—covering the entire population of firms. The analytical sample includes firms with at least one employee observed over the period 2013–2022, for a total of more than 177,000 firms and over 860,000 observations. For these firms, a long pre-policy period is also available, starting in 2007, making it possible to observe their characteristics before the introduction of the incentives and to take these into account in the empirical analysis. The dataset contains information on tangible and intangible capital stocks, investment flows, profitability, productivity, sales, financial structure, the composition of the workforce by educational attainment, and the use of various tax incentives, including *Iper-ammortamento*, *Super-ammortamento*, *Aiuto alla Crescita Economica (ACE)* and the R&D tax credit.

Recent scientific literature on the evaluation of industrial policies reaches broadly consistent conclusions in finding positive effects of Industry 4.0 incentives on investment and, more generally, on firm performance, although different model specification and estimation strategies are adopted. Bratta et al. (2023)[9] use a propensity-score matching approach combined with difference-in-differences; the Scientific Committee for the Evaluation of the *Piano Transizione 4.0* (2026)[10] adopts a synthetic difference-in-differences estimator, while the Parliamentary Budget Office (2025)[11] proposes a comparison between the two incentive regimes using nearest-neighbour matching. This contribution falls within this strand of analysis by proposing a complementary strategy. Its distinctive contribution consists in explicitly modelling the incentive adoption process, separating the determinants of access to the measure from the estimation of the effect of the intensity of the tax benefit on investment decisions, measured through the change in the user cost of capital.

Main findings

The main characteristics of beneficiary firms

The analysis first identifies the characteristics of firms that use Industry 4.0 incentives. Descriptive evidence shows that the use of Industry 4.0 incentives concerns a relatively limited share of the productive system. Approximately 82% of the firms in the sample never use the measure and, among those that do, use is generally limited to a single year. Only a small proportion of firms benefit repeatedly from the incentive over time.

Econometric analysis nevertheless makes it possible to understand which characteristics distinguish beneficiary firms and which factors affect the probability of using the incentives again. The results of the adoption model show that access to the measure is not

9. Bratta, B., Romano, L., Acciari, P., & Mazzolari, F. (2023). *Assessing the impact of digital technology diffusion policies: Evidence from Italy*. *Economics of Innovation and New Technology*, 32(8), 1114–1137.

10. Scientific Committee for the Evaluation of the *Piano Transizione 4.0* (2026). *Piano Transizione 4.0: una valutazione degli effetti su investimenti, occupazione e produttività*. Final Report. Ministry of Economy and Finance, Ministry of Enterprises and Made in Italy, and Bank of Italy.

11. Parliamentary Budget Office (2025). *L'efficacia degli incentivi Industria/Transizione 4.0 alle imprese: evidenze empiriche e questioni aperte*. In *Rapporto sulla politica di bilancio 2025*. Rome: Parliamentary Budget Office.

random, but is significantly associated with specific structural characteristics of firms. Holding the other conditions considered constant, the probability of using the incentives increases with firm size, capital intensity and firm productivity. It is also higher among firms with stronger economic and financial conditions and a larger stock of human capital. The model also shows significant state dependence: holding the other characteristics considered constant, firms that have already benefited from the measure have a significantly higher probability of using it again in subsequent years. This result is consistent with the descriptive evidence, which shows that previous participation substantially increases the probability of reusing the incentive—approximately 30%, compared with 5% among firms that did not benefit in the previous year—even though use of the measure remains predominantly episodic. Repeated participation is in fact concentrated among a relatively small core of firms.

Firms that use Industry 4.0 incentives also show a greater propensity to make use of other industrial policy instruments. In particular, a significant complementarity with ACE emerges, consistent with the role played by stronger capitalisation in supporting innovative investment. By contrast, the use of ordinary incentives for investment in capital goods is negatively associated with the adoption of Industry 4.0 measures once other firm characteristics are controlled for. This result is consistent with a partial substitution in the composition of investment between ordinary goods and Industry 4.0 goods[12].

A particularly relevant result concerns the change introduced in 2020, when the *Iper-ammortamento* regime was replaced by a tax credit. Estimates show that, under the new regime, access to the incentives became less dependent on firms' tax positions, consistently with the different mechanism through which a tax credit is used compared with an increase in depreciation allowances. Indeed, *Iper-ammortamento*, by reducing the taxable base, generates a benefit for the firm only where taxable income is positive, that is, when the firm reports a tax profit. By contrast, the tax credit can also be used by firms making tax losses, since it can be offset against other corporate liabilities (e.g. VAT or social security contributions).

Do incentives actually increase investment?

Once the determinants of access to the measure have been analysed, the second objective is to assess whether the incentives actually stimulated new investment.

The behavioural investment-demand model is specified in reduced form, consistently with the literature on investment demand, taking as the dependent variable the investment rate in tangible goods, defined as the ratio between gross investment in tangible goods and the stock of tangible capital at the beginning of the period. The specification relates this measure to the user cost of capital, expressed in logarithmic terms, and to a set of control variables designed to capture the main economic and financial determinants of investment decisions[13].

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12. The two measures could be used jointly by the same firm for different types of investment. Descriptive statistics show that approximately 15% of the firms in the sample used both measures, whereas only 3.5% used Industry 4.0 incentives exclusively. The negative relationship emerges instead from the multivariate analysis, once the other observed characteristics of firms are controlled for, and is consistent with a partial substitution in the composition of investment between ordinary goods and Industry 4.0 goods.

13. The specification adopts a dynamic partial-adjustment model, including the lagged investment rate to capture the

The structure of the model makes it possible to interpret the response of investment to the user cost of capital as an indicator of the effect of fiscal policy on incentives for capital accumulation. The user cost represents the central policy variable in the specification, since it explicitly incorporates the elements of the tax system that affect the effective price of capital: the corporate income tax rate, the present value of tax depreciation allowances, any tax credits, the cost of financing, economic depreciation and inflation[14].

The estimates produced for the period 2017–2022 make it possible to assess both the role of the main determinants of investment decisions and the specific effect of the tax incentive. Overall, the investment rate displays persistent dynamics, indicating that firms gradually adjust investment towards the desired level rather than changing it instantaneously. The estimates nevertheless suggest that this adjustment process takes place relatively rapidly.

The availability of internal financial resources supports investment, particularly among smaller firms, signalling the presence of financial constraints, while the ratio of turnover to invested capital confirms the role of demand conditions and capacity utilisation in supporting investment decisions. The estimates also confirm that firms using incentives are also those that, owing to characteristics that are not directly observed, are more inclined to invest. The model accounts for this self-selection through the control term derived from the first stage, making it possible to estimate the effect of the tax incentive net of this component.

To assess the effect of fiscal policy, the user cost of capital is decomposed into two components[15]: the user cost calculated in the absence of the incentive and the reduction in the user cost attributable to the tax benefit. This decomposition makes it possible to identify separately the effect of the reduction in the cost of capital induced by the tax measure, distinguishing it from the level of the user cost that firms would have faced in the absence of the incentive.

The estimates show that the reduction in the user cost of capital attributable to the tax incentive is statistically significant, whereas the user cost calculated in the absence of the incentive does not display a statistically significant effect. The coefficient associated with the incentive component is negative, consistently with the definition of the variable, which measures the reduction in the user cost of capital: a greater reduction in the cost of capital generated by the incentive therefore translates into an increase in firms' overall investment rate.

The result suggests that, over the period considered, investment decisions were more responsive to the change in the cost of capital induced by the tax incentive than to the level of the user cost in the absence of the incentive. One possible interpretation is that

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persistence of investment decisions over time. To correct for firms' potential self-selection into the incentive programme and obtain consistent estimates of the parameters of interest, the model also incorporates a control term (*control function*) derived from the adoption model estimated in the first stage, which captures the unobserved component associated with the decision to participate in the programme. The specification also includes sectoral and time effects, as well as firm-specific individual effects capturing unobserved firm-level heterogeneity.

14. A further methodological issue concerns the measurement of the tax benefit associated with investment. Since this benefit depends not only on the statutory tax rate but also on the firm's tax position—for example, in the presence of tax losses carried forward or other elements of the tax system that may defer or reduce the effective use of tax incentives—the analysis uses a proxy for the effective marginal tax rate. In particular, the variable takes the value of the statutory tax rate when taxable income is positive and zero otherwise. This approximation makes it possible to represent more realistically the effective tax benefit associated with investment.

15. The decomposition of the user cost of capital follows the methodology proposed by Mairesse and Mulkay (2003).

the incentive component, being associated with a temporary and discretionary measure, provided a sufficiently strong economic signal to alter the timing of investment, whereas changes in the user cost determined by the ordinary economic and tax environment had a less evident effect.

The estimates indicate an economically significant elasticity of the investment rate in tangible goods with respect to the user cost of capital[16]. In particular, a 10% reduction in the user cost of capital is associated, in the long run, with an increase of approximately 9% in the investment rate.

The average elasticity nevertheless masks substantial heterogeneity across firm-size classes. The response is particularly strong among micro-enterprises, for which a 10% reduction in the user cost of capital is associated with an increase in investment of almost 18%. For small firms, the increase is approximately 5%, whereas for medium-sized and large firms the effect is negligible, at less than 1%.

Distinguishing between the two incentive regimes, investment elasticity was higher during the period in which *Iper-ammortamento* was in force (2017–2019) than during the subsequent tax-credit period (2020–2022). This difference should not, however, be interpreted as an effect attributable to the different nature of the instrument. It is instead consistent with the changes introduced into the design of the incentive from 2019 onwards, characterised by the introduction of declining rates by investment class and a ceiling on eligible expenditure, a configuration that was largely maintained under the subsequent tax credit. The differences observed between the two sub-periods therefore appear to reflect primarily changes in the intensity of the incentive, rather than the transition from increased depreciation allowances to a tax credit.

Overall, the results show that the reduction in the user cost of capital induced by Industry 4.0 incentives contributed to supporting innovative investment through a reduction in the user cost of capital, with particularly strong effects among smaller firms. These results should nevertheless be interpreted in the light of the evidence emerging from the first part of the analysis, which shows that the use of incentives concerns a relatively limited share of firms. This limited diffusion is consistent with the fact that the positive effects observed at the microeconomic level are only partially reflected in the aggregate dynamics of tangible capital intensity discussed in the chapter. The evidence therefore suggests that strengthening productivity requires not only effective investment incentives, but also a broader diffusion of technological transformation processes throughout the productive system.

Appendix. Digital investment and use of incentives: census evidence

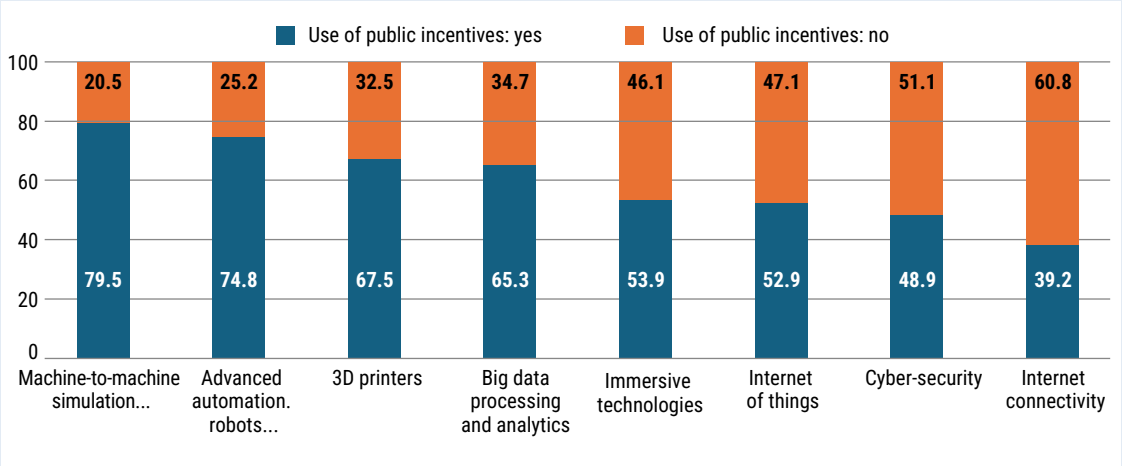
This Appendix presents descriptive evidence drawn from the qualitative multi-purpose survey conducted by Istat in 2022 as part of the Permanent Census of Enterprises. The aim is to provide complementary information on the diffusion of digital investment and the use of public incentives, helping to contextualise the results of the econometric analysis presented in the main text. In particular, the evidence makes it possible to assess the extent to which investment in digital technologies is associated with the use of public

16. Elasticities measure the percentage change in the investment rate associated with a percentage change in the user cost of capital. The results therefore describe the relative intensity of the response to incentives rather than the absolute increase in investment.

support measures rather than exclusively with Industry 4.0 incentives. According to the survey results, in 2021–2022 almost 45% of Italian manufacturing firms with 3 or more employees made at least one type of investment in digital technologies, including the most widespread investments aimed at improving Internet connectivity. However, more than 57% of investing firms did not make use of public incentives. The share of firms that invested in digital technologies without using public incentives varies substantially by firm-size class, reaching almost 70% among micro-enterprises with 3–9 employees, while remaining non-negligible—more than one third of the total—even among firms with more than 50 employees. The use of the different forms of public incentive identified by the survey also varies depending on the type of digital investment undertaken. In general, investments characterised by greater technological complexity or involving the acquisition of more costly capital goods tend to be more frequently associated with the use of public support measures. In this regard, Figure A1 shows the percentage distribution of manufacturing firms that, in 2021–2022, did or did not use public incentives by type of digital technology. As can be seen, the lowest share of firms making use of public support is recorded for investment in connectivity—fewer than 40 out of every 100 firms that invested in improving Internet connectivity—whereas the highest values are recorded for investment in two of the enabling technologies characterising the Industry 4.0 definition, namely advanced automation and simulation between interconnected machines. However, even for these two types of investment, the share of firms that did not make use of public incentives remains significant, ranging from approximately one quarter to one fifth of the total.

FIGURE A1

Share of firms using public incentives by type of digital investment



Source: Authors' elaboration based on Istat, Qualitative multi-purpose survey on enterprises, 2022.

Overall, the census evidence shows marked heterogeneity in investment behaviour and in the use of public incentives. A significant share of firms undertakes digital investment without making use of public support measures, suggesting that technological transformation processes can follow different paths across firms.

Statistical and Methodological Appendix to Chapters 2 and 3[17]

STATISTICAL SOURCES

The international comparative analyses presented in Chapter 2 are based on the OECD Productivity Database (PDB), the new productivity database developed as part of the revision of international productivity indicators[18].

The new PDB replaces and integrates the previous **Productivity Levels Database**, **Productivity Growth Database** and **Productivity by Industry Database**, bringing together in a single platform harmonised information on productivity levels and dynamics, disaggregated by economic activity sector and type of capital asset.

Compared with previous versions, the database offers broader coverage and more detailed information. In particular, it includes estimates of capital services by type of asset and economic activity sector that are fully consistent with the National Accounts of individual countries. The data are updated continuously as new statistical information becomes available from national statistical institutes.

The database includes annual indicators of labour productivity (calculated both per employed person and per hour worked), capital services, labour and capital inputs, and total factor productivity.

The statistical tables used for the international comparative analyses presented in Chapter 2 are provided below.

17. Carmine Fimiani e Antonio Regano, Istat, Direzione centrale per la contabilità nazionale.

18. The database, made available in 2025, can be accessed through the following link: https://data-explorer.oecd.org/vis?lc=en&fs[0]=Topic,1%7CEconomy%23ECO%23%7CProductivity%23ECO_PRO%23&pg=0&fc=Topic&bp=true&snb=7&df[ds]=dsDisseminateFinalDMZ&df[id]=DSD_PDB%40DF_PDB&df[ag]=OECD.SDD.TPS&df[vs]=2.0&dq=.A.GVAHRS._T.....&lom=LASTNPERIODS&lo=5&to[TIME_PERIOD]=false.

TABLE A

Labour Productivity, GDP and Hours Worked (1995–2025) – European Comparisons
Average annual growth rates

Labour productivity	EU27	Germany	France	Italy	Spain	UK
1995-2025	1.1	1.0	0.8	0.2	0.6	1.1
2003-2009	0.7	0.4	0.5	-0.2	0.8	0.5
2009-2014	1.4	1.4	1.1	0.6	1.6	0.5
2014-2025	0.7	0.6	0.2	-0.1	0.4	0.6
2014-2019	1.0	1.0	0.7	0.1	0.5	0.8
2019-2025	0.5	0.3	-0.2	-0.3	0.4	0.3
2023	-0.8	-1.2	0.0	-2.2	-0.2	-0.3
2024	0.2	-0.3	0.0	-1.4	1.2	-0.7
2025	1.4	0.4	1.5	-0.6	0.7	-
GDP	**EU27**	**Germany**	**France**	**Italy**	**Spain**	**UK**
1995-2025	1.6	1.2	1.5	0.7	2.0	1.9
2003-2009	1.2	0.6	1.2	-0.2	1.8	0.9
2009-2014	1.0	2.2	1.3	-0.6	-0.7	1.9
2014-2025	1.6	0.8	1.2	1.0	2.2	1.4
2014-2019	2.2	1.8	1.5	1.0	2.8	2.0
2019-2025	1.2	0.0	0.8	1.0	1.6	0.8
2023	0.4	-0.9	1.4	0.9	2.4	0.3
2024	1.1	-0.5	1.2	0.8	3.4	1.1
2025	1.5	0.2	0.8	0.5	2.8	1.4
Hours worked	**EU27**	**Germany**	**France**	**Italy**	**Spain**	**UK**
1995-2025	0.5	0.2	0.7	0.5	1.4	0.7
2003-2009	0.5	0.3	0.8	0.1	1.1	0.4
2009-2014	-0.4	0.8	0.2	-1.1	-2.2	1.4
2014-2025	0.9	0.2	1.0	1.1	1.7	0.9
2014-2019	1.2	0.8	0.9	0.9	2.4	1.3
2019-2025	0.6	-0.2	1.1	1.3	1.2	0.5
2023	1.3	0.3	1.4	3.1	2.6	0.6
2024	0.9	-0.2	1.2	2.2	2.2	1.8
2025	0.2	-0.2	-0.6	1.1	2.0	-

Source: OECD.

METHODOLOGICAL NOTE ON THE MEASUREMENT OF CAPITAL INPUT

This methodological note describes the main criteria used to estimate the capital stock and capital services, which provide the basis for calculating total factor productivity indicators and for the growth decomposition presented in Chapter 3.

The Perpetual Inventory Method (PIM) is the standard approach used to measure the capital stock. It is based on the idea that the capital stock at a given point in time is determined by the accumulation of past investment, adjusted for losses in value due to economic obsolescence and the ageing of capital assets.

The application of the method requires a number of fundamental assumptions concerning:

the economic service life of capital assets and therefore the duration of the depreciation process;

the availability of sufficiently long historical investment series or, where these are unavailable, an initial capital-stock value;

the specification of the retirement function, which determines when a capital asset reaches the end of its economic life and exits the production process;

the definition of the depreciation profile, which represents the decline in the economic value of the asset over its useful life.

Istat uses the PIM to estimate the capital stock, drawing on particularly extensive historical series of gross fixed capital formation by type of capital asset and economic activity sector. For construction assets—residential buildings, non-residential buildings and civil engineering works—the historical series begin in 1870; for other capital assets, they begin in 1950, with the exception of investment in research and development and weapons systems, which are available from 1995.

The service lives of capital assets differ across 26 asset types and 38 branches of economic activity, corresponding to the highest level of detail used in estimating the capital stock. As part of the 2024 comprehensive revision of the National Accounts, these assumptions were updated to reflect the recommendations formulated by the Eurostat Task Force on investment and the estimation of depreciation under ESA 2010 (TF FIXCAP 2020–2022). The main innovations concerned the introduction, for certain categories of capital assets, of variable service lives over the historical series—particularly for construction, motor vehicles and other plant and machinery—and the updating of the service lives of other assets on the basis of the most recent information sources and available technical documentation[19].

The service life represents the average number of years for which a capital asset participates in the production process. Since an asset may be retired before or after its average service life, it is necessary to specify a retirement function. Istat uses a truncated normal distribution, in which the probability of retirement is initially very low, increases progressively until reaching its maximum at the average service life, and subsequently declines.

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19. The average service lives of other machinery and equipment, furniture, hardware and communications equipment were revised on the basis of the results of the *Survey of Industrial and Service Firms* (INVIND) conducted by the Bank of Italy in 2024. As part of this exercise, a specific section was prepared in cooperation with Istat to collect information on the average service lives of capital goods in machinery and equipment purchased and produced by firms.

The assumption of a truncated distribution reflects the fact that, once a capital asset has entered the production process, it will necessarily be retired within a finite time horizon.

With regard to depreciation, Istat uses a linear depreciation function for almost all capital assets, while a geometric function is used for research and development and weapons systems. In the former case, it is assumed that the productive capacity of the asset declines by the same amount in each period; in the latter, the remaining value of the stock decreases each year at a constant percentage rate.

One of the main innovations introduced by the new OECD Productivity Database (PDB) concerns precisely the measurement of capital input. In previous versions of the database, capital services and multifactor productivity indicators were estimated on the basis of gross fixed capital formation series by economic activity sector, applying a set of assumptions harmonised across countries with regard to depreciation profiles and capital-asset retirement functions. The new methodology instead makes direct use of the **net capital stocks** produced by national statistical institutes within the framework of the National Accounts, together with the methodological profiles relating to service lives, depreciation and retirements supplied by those institutes as part of the international data collection coordinated by the OECD and launched in 2023.

This approach eliminates the need for a harmonised PIM constructed centrally by the OECD and provides greater consistency between international productivity indicators and national estimates based on capital input[20].

It should finally be noted that the OECD indicators used for international comparisons are not directly comparable with those produced by Istat. OECD measures refer to the economy as a whole, including public administration, and use GDP as the measure of output, whereas the indicators disseminated by Istat as part of the National Accounts refer to the market economy and use value added as the measure of output.

20. For further details on the innovations introduced compared with the previous version of the database, see OECD (2025), *The Revamp of the OECD Productivity Database*, Technical Report, OECD Publishing, Paris.

4 THE TERRITORIAL DIMENSIONS OF GROWTH AND PRODUCTIVITY

EXECUTIVE SUMMARY

- In the period following the pandemic, differences in GDP per capita growth rates across Italy's macro-areas narrowed, while significant differences remain in both levels and determinants of growth.
- The North-West and North-East have reached overall GDP levels that are consistently above those recorded before the 2008 crisis, whereas the Centre has experienced a more limited recovery. Southern Italy has only recently returned to real output levels close to those observed at the beginning of the 2000s, thanks to GDP growth over the most recent five-year period that was above the national average.
- Between 2000 and 2024, GDP per capita growth was modest across all macro-areas. The decline in the resident population in Southern Italy has contributed to supporting the dynamics of GDP per capita in the area.
- In the post-pandemic period, differences in GDP per capita growth rates across macro-areas narrowed, while differences in the determinants of growth remained pronounced. The contribution of labour productivity is greater in the North-West, whereas growth in output per capita is driven predominantly by employment expansion in the other areas.
- Most of the growth in GDP per capita across the macro-areas can be attributed to increases in output per capita within the individual regions making up each macro-area, rather than to changes in their relative weight within the corresponding geographical area. Nevertheless, considerable heterogeneity exists among regions even within the same macro-area in terms of the determinants of growth. In particular, it is possible to distinguish between regions in which economic growth is productivity-led and regions in which it is employment-led.
- There is a positive long-term relationship between the dynamics of the working-age population and productivity, consistent with the idea that the availability of labour, human capital and agglomeration economies can foster growth in the productive efficiency of local economies. In Southern Italy, GDP per capita growth is constrained by demographic trends.
- Between 2004 and 2025, all regions recorded a significant increase in the share of tertiary-educated people among employed persons, signalling a broad-based strengthening of human capital as an important precondition for productivity growth. A more

detailed territorial analysis explores the relationship between the availability of human capital and the productive specialisation of local economies, including in terms of their medium- to long-term economic growth potential.

4.1. TERRITORIAL DYNAMICS OF ECONOMIC GROWTH[1]

The period following the pandemic has highlighted differentiated territorial patterns of economic growth, modifying, at least in part, the relative positions observed over the previous decade. In the five-year period 2019–2024, all of Italy's macro-areas recorded GDP growth, with particularly favourable developments in Southern Italy, which recorded expansion rates above the national average. Territorial differences nevertheless remain significant and concern not only the intensity of growth, but also its determinants.

To place the most recent developments in a broader perspective, it is useful to consider the evolution of the Italian economy over the entire 2000–2024 period. During these years, Italy recorded average annual GDP growth of 0.4%, reflecting an expansionary phase up to 2007, followed by the sharp contraction associated with the global financial crisis and the sovereign debt crisis, and subsequently by a gradual recovery in the following years. Within this framework, significant differences can be observed among the macro-areas both in their ability to absorb the effects of the crises and in the time required to recover the levels of economic activity prevailing before the shocks (Figure 4.1.1).

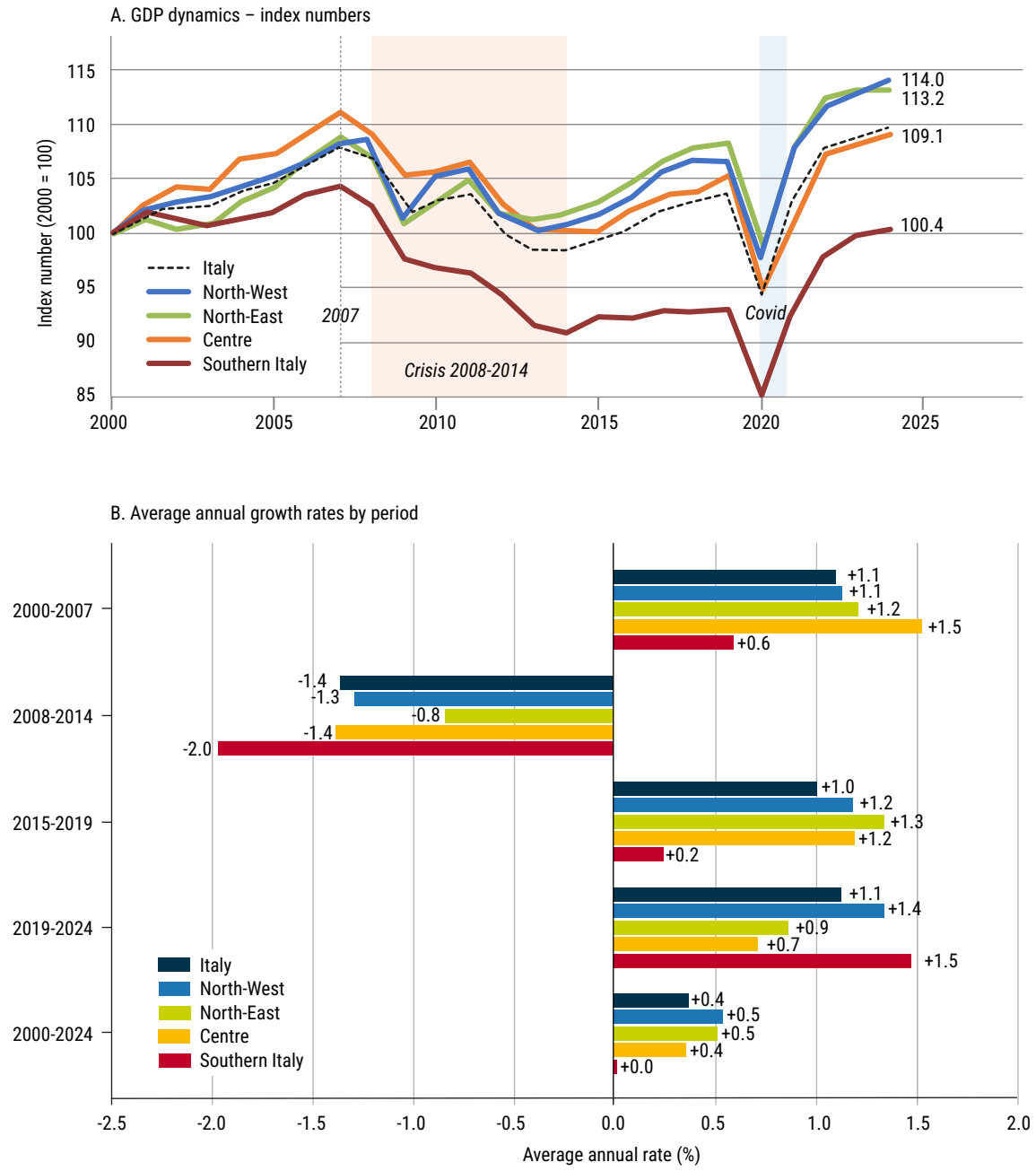
Overall, the North-West and North-East have reached GDP levels consistently above those recorded before the 2008 crisis, while the Centre has experienced a more limited recovery. Despite the strong growth recorded over the most recent five-year period (+1.5% on an average annual basis), Southern Italy has instead experienced broadly stagnant real output over the period as a whole, only recently returning to levels close to those at the beginning of the 2000s, also as a result of the slower growth recorded in 2000–2008.

1. By Massimo Armenise, Istat, Directorate for Environmental and Territorial Statistics.

FIGURE 4.1.1

GDP dynamics by macro-area

Chain-linked values (reference year 2020), index numbers (2000=100) and average annual growth rates, 2000–2024



Source: Authors' calculations based on Istat data.

The analysis of GDP per capita provides further insight into these findings by taking account of demographic developments across territories. Economic growth observed in the different macro-areas reflects not only changes in output, but also changes in the resident population and in the working-age population. Demographic changes affect GDP per capita both directly, through the denominator, and indirectly, through the numerator, by, among other factors, changing the composition of consumption and progressively reducing and ageing the available labour force.

Overall, between 2000 and 2024, GDP per capita growth was modest across all macro-areas. Territorial differences become more apparent over the different economic cycles. During the recovery preceding the pandemic, Central and Northern Italy recorded significantly higher increases than Southern Italy. In the five-year period 2019–2024, by contrast, the southern regions experienced a relative recovery, recording the highest GDP per capita growth rate among the macro-areas (Figure 4.1.2).

Territorial differences emerge even more clearly when the two-year period of the pandemic shock (2020–2021) is distinguished from the subsequent three-year period (2022–2024), which includes both the completion of the rebound and the subsequent consolidation phase. Across all macro-areas, growth in the second sub-period was driven primarily by the strong recovery recorded in 2022, followed by a slowdown in the subsequent years. In Italy, the average annual growth rate increased from +0.1% between 2019 and 2021 to +2.2% between 2021 and 2024; the differential was even wider in the Mezzogiorno (+0.4% compared with +3.0%) and particularly pronounced in the Centre, where the contraction recorded during the pandemic (-1.3% on an average annual basis) was followed by a robust recovery (+2.5% on an average annual basis).

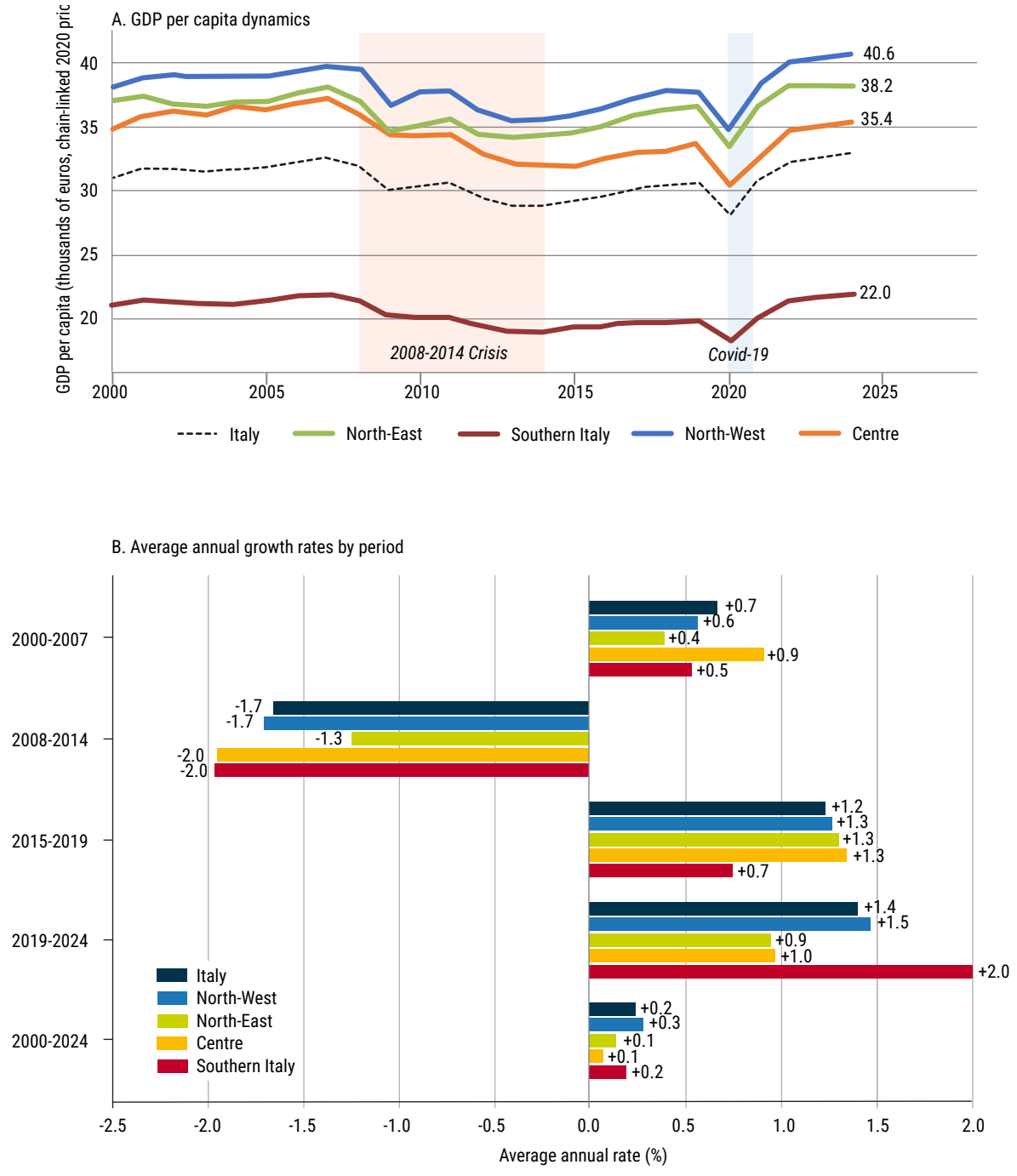
These developments must nevertheless be interpreted in light of demographic trends. The Mezzogiorno is in fact the area that has experienced the most pronounced population decline in recent years. The decline in the number of residents affects the dynamics of GDP per capita, making it necessary to consider economic and demographic indicators jointly (Figure 4.1.3)[2].

2. Between 2019 and 2024, the population of Southern Italy declined by approximately 2.5%, resulting in an increase in GDP per capita of the same magnitude and therefore contributing significantly to the overall performance of the region.

FIGURE 4.1.2.

GDP per capita dynamics per macro-area

Chain-linked values (reference year 2020), average annual growth rates, 2000–2024

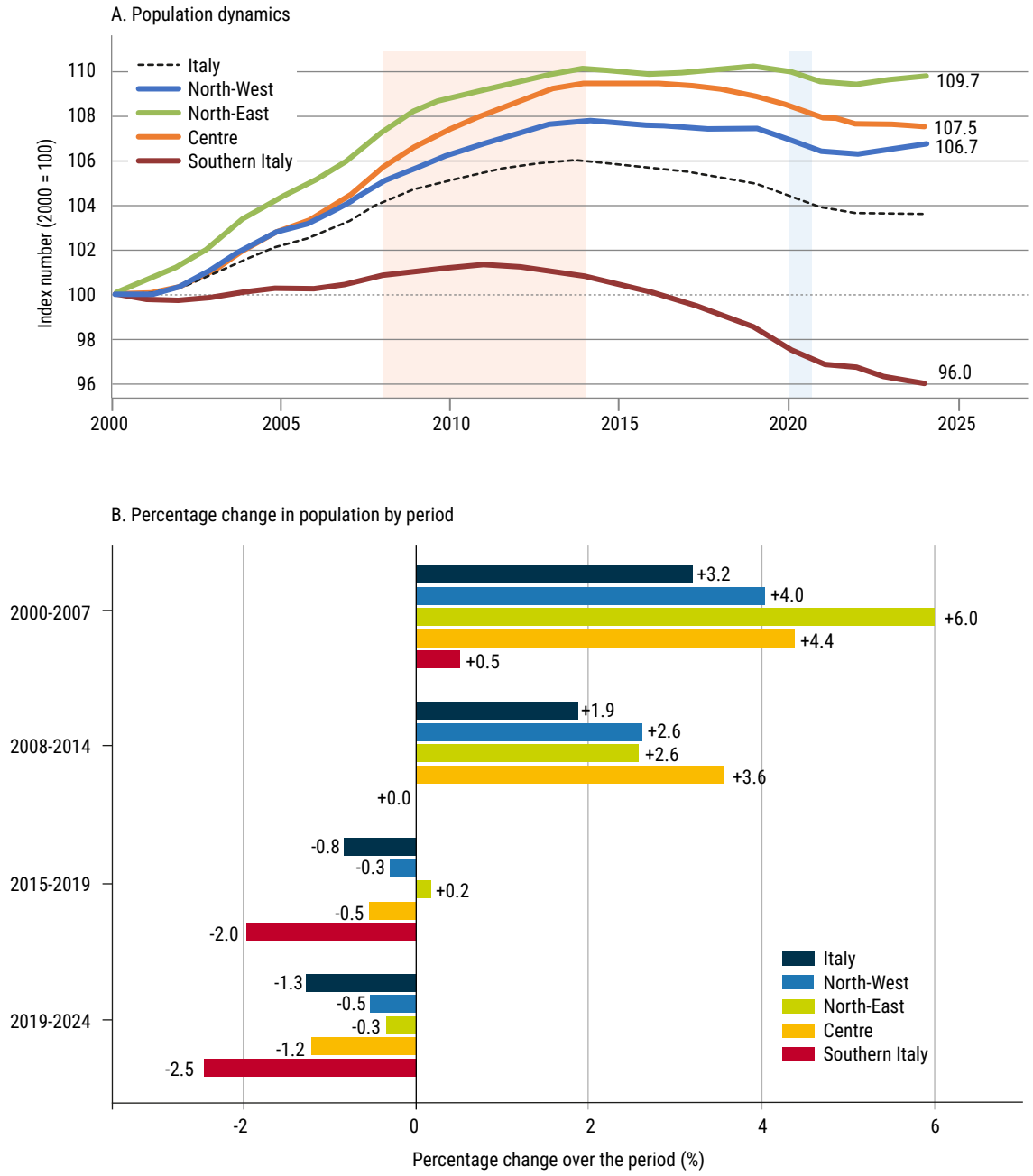


Source: Authors' calculations based on Istat data.

FIGURE 4.1.3

Population dynamics by macro-area

Index numbers (2000=100) and percentage changes by period (2000–2024)



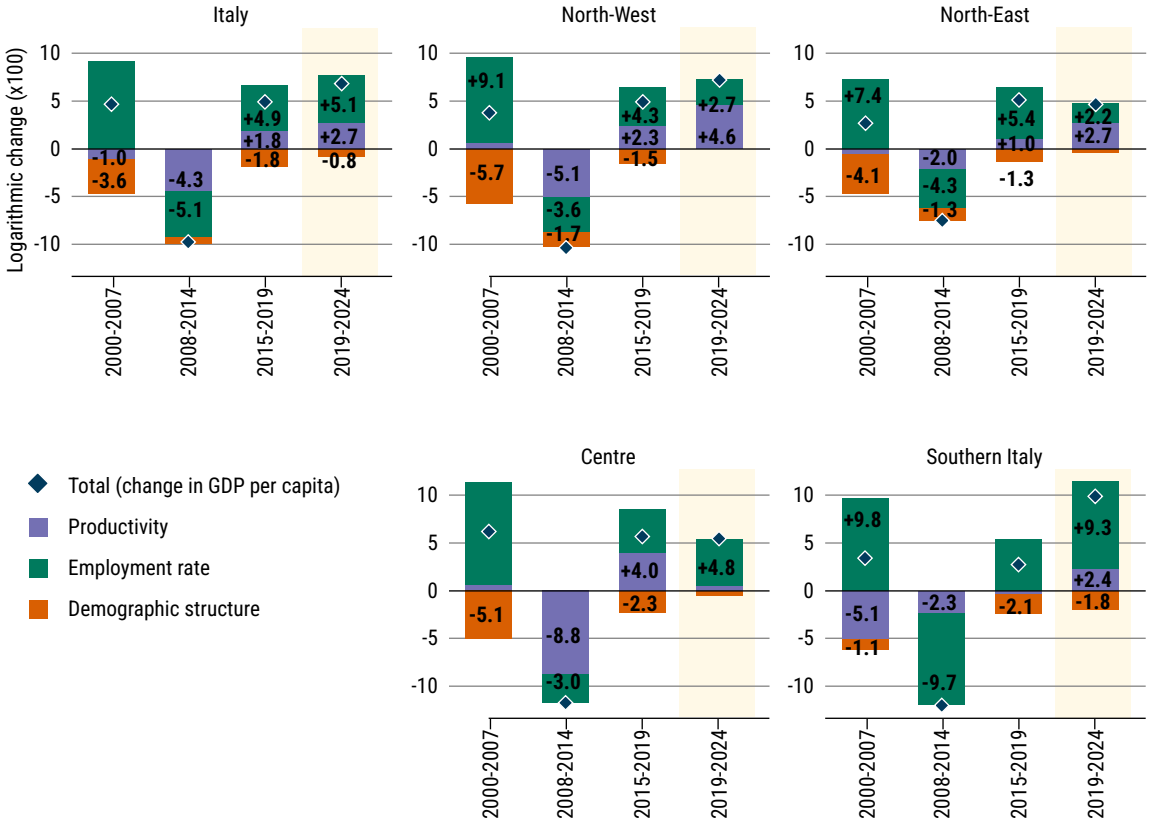
Source: Authors' calculations based on Istat data.

To understand the differences observed in GDP per capita growth rates, it is useful to decompose the dynamics into their main determinants: labour productivity (measured as real GDP per employed person)[3], the employment rate (the ratio of employed persons aged 15–64 to the working-age population), and demographic structure (the share of the working-age population in the total population)[4]. This decomposition makes it possible to distinguish the contribution of productive efficiency from that of labour utilisation and changes in the working-age population (Figure 4.1.4).

FIGURE 4.1.4

Decomposition of GDP per capita dynamics

Logarithmic changes × 100 and contributions of the three components, by macro-area and period



Source: Authors' calculations based on Istat data. The yellow band highlights the years 2019-2024.

3. Territorial economic accounts apply national sectoral deflators, implicitly assuming uniform prices across territories. Istat's experimental statistics on spatial consumer price indices (2023 and 2024 editions, 2021 data) nevertheless identify regional differentials of up to approximately 15 percentage points, with northern regions being more expensive on average; L. Cannari and G. Iuzzolino (*Le differenze nei livelli dei prezzi al consumo tra Nord e Sud*, Questioni di Economia e Finanza No. 49, Banca d'Italia, 2009) had already estimated similar gaps. A share of the territorial gaps measured in real terms therefore reflects differences in relative prices rather than quantities, and comparisons of levels should be interpreted with this caveat.

4. Territorial data do not make it possible to attribute productivity dynamics to the three components: labour, capital and TFP.

The decomposition of GDP per capita highlights how the contribution of its main determinants has changed significantly over time (Figure 4.1.4). In the period preceding the global financial crisis (2000–2007), growth was supported primarily by an increase in the employment rate, while demographic dynamics exerted a restraining effect, particularly in the regions of Central and Northern Italy. In Southern Italy, labour productivity (GDP per employed person) also made a negative contribution.

Between 2008 and 2014, the effects of the Great Recession and the subsequent sovereign debt crisis were reflected in a negative contribution from all components of growth. The decline in productivity played a particularly significant role in the North-West and Centre, while in Southern Italy the main factor behind the contraction during this period was the fall in the employment rate.

During the pre-pandemic recovery phase (2015–2019), GDP per capita growth again came to be driven predominantly by employment across all macro-areas. Productivity made a positive contribution, particularly in the North-West and Centre, while demographic dynamics continued to exert a negative effect due to the gradual decline in the working-age population.

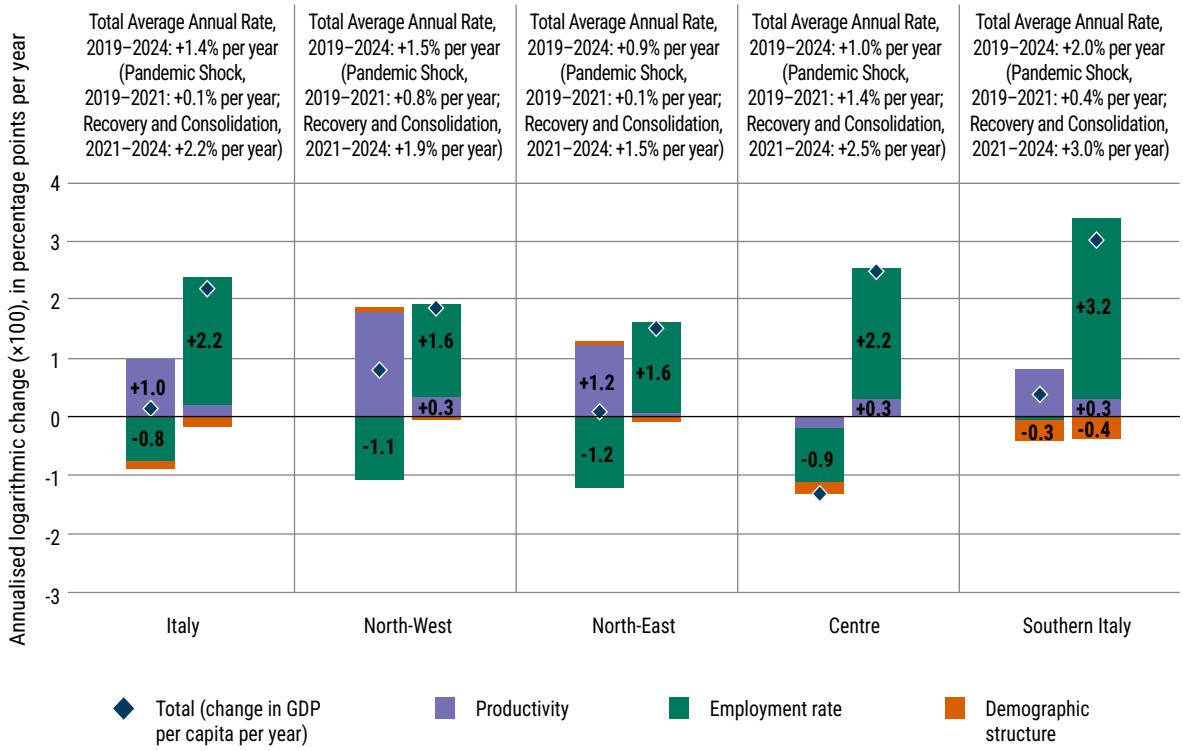
In the most recent five-year period (2019–2024), GDP per capita growth was driven by different combinations of its determinants across the various macro-areas. The employment rate was the main driver of growth in Southern Italy and the Centre, while in the North-West the contribution of labour productivity became more significant, returning to positive territory after a prolonged period of zero growth. In all areas of the country, the decline in the share of the working-age population in the total population continued to constrain GDP per capita growth, with particularly pronounced effects in Southern Italy. Moreover, across all macro-areas, during the two-year period of the pandemic crisis, labour productivity (per person employed) made a positive contribution in almost all macro-areas, while the employment rate made a negative contribution. In the subsequent three-year period, however, the picture changed significantly: the contribution of productivity declined, while the employment rate became the main driver of growth across all macro-areas, particularly in Southern Italy, where there is greater scope for employment growth (Figure 4.1.5).

The picture emerging from the analysis of the components suggests the following overall interpretation: over the five-year period beginning with the pandemic, differences in GDP per capita growth rates across the macro-areas narrowed, while significant differences remained in the determinants of growth. Growth in the North-West appears to have been more strongly supported by labour productivity, whereas in Southern Italy the contribution of employment expansion prevailed, despite the drag from the decline in the share of the working-age population. The Centre and North-East display more heterogeneous situations internally, reflecting the presence of differentiated regional trajectories (see Box 4.1).

FIGURE 4.1.5

The two phases of growth during the pandemic: pandemic shock (2019–2021) and three-year recovery and consolidation period (2021–2024)

Decomposition of GDP per capita growth by macro-area and Italy, annualised contributions of the three components (logarithmic change × 100 / number of years in the sub-period)



Source: Authors' calculations based on Istat data. "Shock" refers to the 2019–2021 period, while "Consolidation" refers to the 2021–2024 period. Values are expressed as average annual contributions (log change × 100 / number of years), so as to allow comparison in terms of annual intensity while controlling for the different length of the two sub-periods.

The evidence thus shows that a narrowing of differences in growth rates may reflect very different combinations of productivity, employment and demographic dynamics. The sustainability of territorial trajectories will therefore depend, to varying degrees across the macro-areas, on their ability to strengthen labour productivity in a context of a progressive decline and ageing of the working-age population[5].

5. Among the microeconomic factors contributing to both the level and dynamics of productivity is firm heterogeneity, including within the same productive sector, with firms differing in size, technology, innovation capacity, financial constraints, governance, organisation and so on. Its role, however, has not been specifically analysed either in this chapter or in the following one.

BOX

Growth within Regions or Composition Effects? A Shift-Share Analysis of GDP per capita across Italian Regions

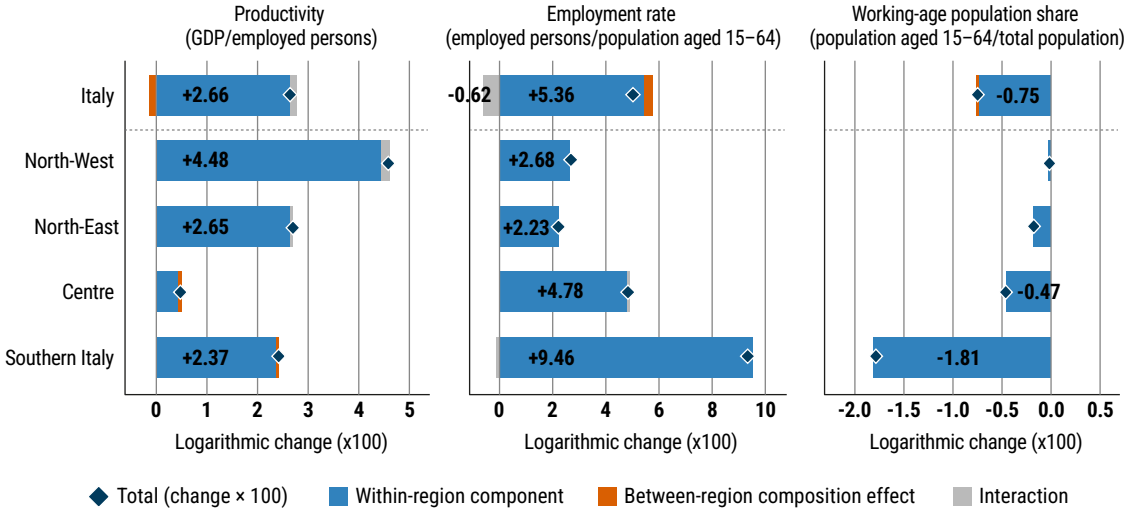
The dynamics observed at the macro-area level reflect regional developments that often differ substantially from one another. Regional analysis makes it possible to identify the territories that have contributed most to the growth of the different geographical areas and to show how relatively similar aggregate outcomes across macro-areas can derive from very different territorial trajectories. A shift-share analysis[6] makes it possible to decompose the economic growth rate of each macro-area into two distinct components: the within component, which measures the growth observed within individual regions while holding their relative weights constant, and the between component, which instead measures the contribution to growth stemming from changes over time in the relative weight of individual regions (Figure B4.1.1).

The key finding emerging from the decomposition is that the dynamics of GDP per capita in the macro-areas and in Italy during the five-year post-pandemic period can be attributed almost entirely to the within component, that is, to growth occurring within individual regions, rather than to changes in the relative weight of different territories. In none of the twelve macro-area-component combinations does the between component exceed 0.05 percentage points in absolute value, compared with within components ranging from 0.4 to 9.5 points. For the employment rate, the between component rises to +0.33 percentage points at the national level, compared with a total of +5.07 points, reflecting the increased employment weight of Southern Italy over the five-year period.

6. The shift-share decomposition is calculated using weights at the initial point in time (2019). The 21 NUTS 2 units considered correspond to Italy's 19 regions plus the two Autonomous Provinces of Trento and Bolzano, consistently with the new 2021 NUTS 2 coding used in Eurostat data. GDP is expressed in chain-linked values with reference year 2020 (Istat Territorial Economic Accounts). Employment and population aged 15–64 are drawn from Eurostat's Labour Force Survey (lfst_r_lfsd2pwn); total population is the average annual population used to calculate GDP per capita (nama_10r_3popgdp). It should be noted that the dominance of the within component over the between component is also partly related to the relatively short time horizon (five years), over which regional weights—population shares, employment shares and working-age population shares—change only to a limited extent. Over longer horizons, when territorial reallocations are more substantial, the contribution of the between component may become quantitatively more significant.

FIGURE B4.1.1

Shift-share decomposition of within/between components of GDP per capita
Italian macro-areas (NUTS 2) and Italy, log changes × 100, 2019–2024



Source: Authors' calculations based on Istat data. "Within" refers to average internal growth; "between" refers to the reallocation component (diamond).

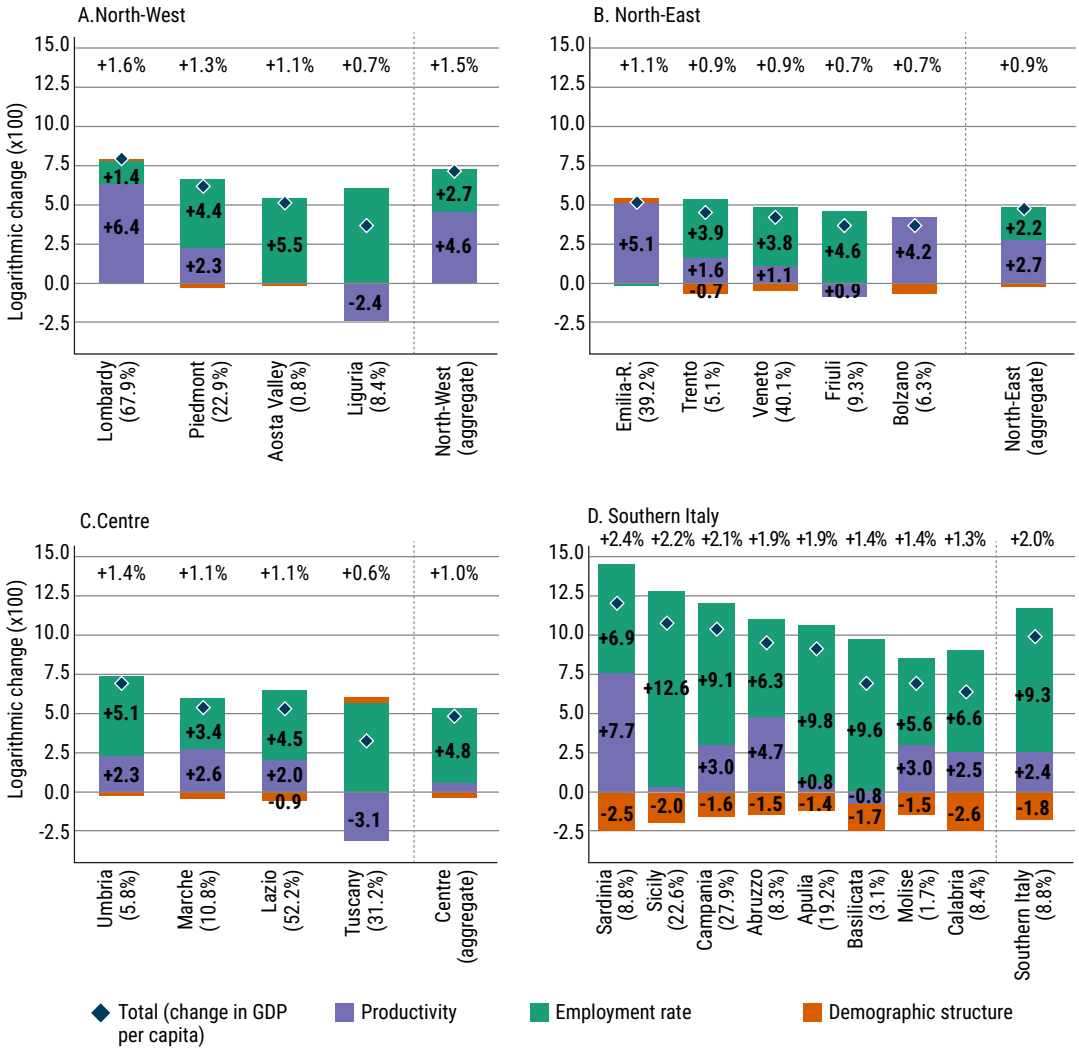
Italian regions display highly differentiated trajectories within the same macro-area. Four cases are particularly illustrative of the possible patterns. Lombardy (67.9% of the North-West's GDP) represents the closest example of *productivity-led* growth: over the five-year period, GDP per capita increased by +1.6% per year on average, with a cumulative contribution from productivity of +6.4 percentage points, compared with only +1.4 points from the employment rate. Veneto and Emilia-Romagna in the North-East display contrasting profiles. Veneto (40.1% of the macro-area's GDP) is an *employment-led* case, with GDP per capita driven by the employment rate (+3.8 points), compared with productivity growth of only +1.1 cumulative points. Emilia-Romagna (39.2%) displays a pattern more similar to Lombardy, with productivity (+5.1 points) acting as the main driver (see Figure B4.1.2).

In Southern Italy, Sardinia (average annual increase in GDP per capita of +2.5%) and Abruzzo (+1.9%) stand out as examples of more balanced growth between productivity and employment compared with the other regions of the macro-area. Aggregate dynamics in these regions are underpinned by a robust increase in productivity (+7.7 and +4.7 points, respectively), accompanied by a significant expansion of the employment rate (+6.9 and +6.3 points). They differ markedly from Sicily (average annual increase of +2.2%) and Apulia (+1.9%), which together account for more than 40% of the GDP of all Southern Italy: in these regions, GDP per capita dynamics were almost entirely *employment-led*, with a very large contribution from the employment rate (+12.6 and +9.8 points, respectively), against virtually no increase in productivity.

The coexistence of such differentiated trajectories within the same macro-area, and across macro-areas, suggests that relatively similar aggregate outcomes may reflect very different growth dynamics. Some regions are growing primarily through productivity gains, while others are expanding almost exclusively through employment growth. The medium-term sustainability of GDP per capita dynamics—especially in a context of structurally declining working-age population—will therefore also depend on the ability to accompany employment growth with stronger productivity dynamics.

FIGURE B4.1.2

Decomposition of GDP per capita by region, 2019–2024



The 21 NUTS 2 regions are ordered by macro-area and by descending average annual GDP per capita growth rate. The weight of each region in the macro-area's GDP in 2019 is shown in parentheses. The values at the top of each bar indicate the average annual GDP per capita growth rate.

Source: Authors' calculations based on Istat data. The "aggregate" bar in each panel, separated by a dashed line, reports the macro-area figure for comparison.

4.2 HUMAN CAPITAL AND TERRITORIAL GROWTH DIFFERENTIALS[7]

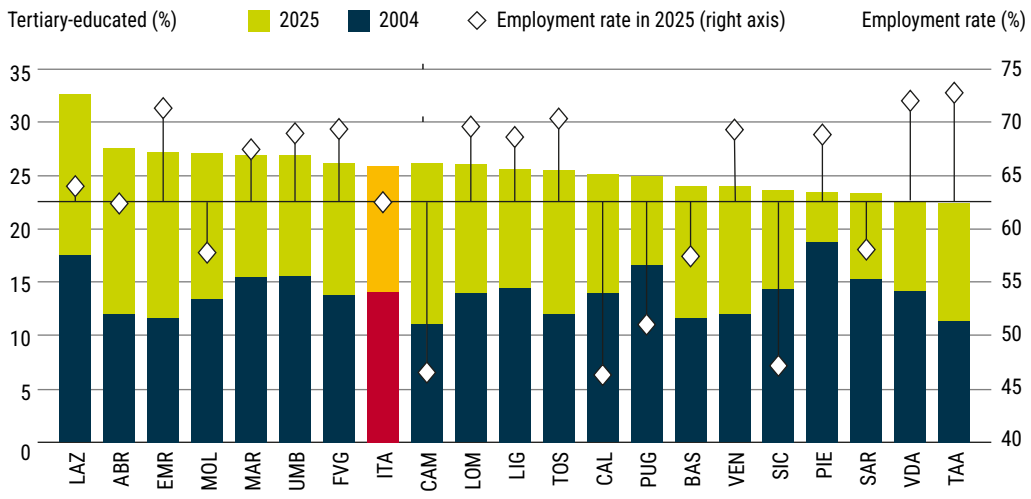
Alongside labour productivity, employment and demographic dynamics, the ability of local economic systems to attract, employ and make effective use of skilled labour is an important factor in explaining differences in territorial economic performance. Differences across territories also emerge in the qualitative composition of employment, both in terms of the intensity of employment of tertiary-educated workers and of the ability of local economic systems to absorb and make effective use of human capital (Figure 4.2.1).

Between 2004 and 2025, all regions recorded a significant increase in the share of tertiary-educated people among employed persons, accompanied by a reduction in territorial disparities. Lazio continues to record the highest value (32.5%), clearly above that of the other regions; Piedmont, which led the ranking in 2004, now ranks lower, while Campania is now aligned with the national average and Abruzzo and Emilia-Romagna rank second and third, respectively.

This evolution does not, however, exhaust the differences across territories. A joint analysis of the share of tertiary-educated people among employed persons and employment rates makes it possible to distinguish two complementary dimensions: on the one hand, the diffusion of skilled work within employment and, on the other, the capacity of local economic systems to absorb labour.

FIGURE 4.2.1

Share of tertiary-educated people among employed persons, by region in 2004 and 2025, and employment rates in 2025. Percentage values



Source: Istat, Labour Force Survey.

7. By Massimo Armenise, Istat, Directorate for Environmental and Territorial Statistics. Stefano De Santis, Istat, Department for Social and Demographic Statistics; Andrea De Panizza, Istat, Department for the Development of Methods and Technologies; Paola Bosso, Istat, Department for the Development of Methods and Technologies.

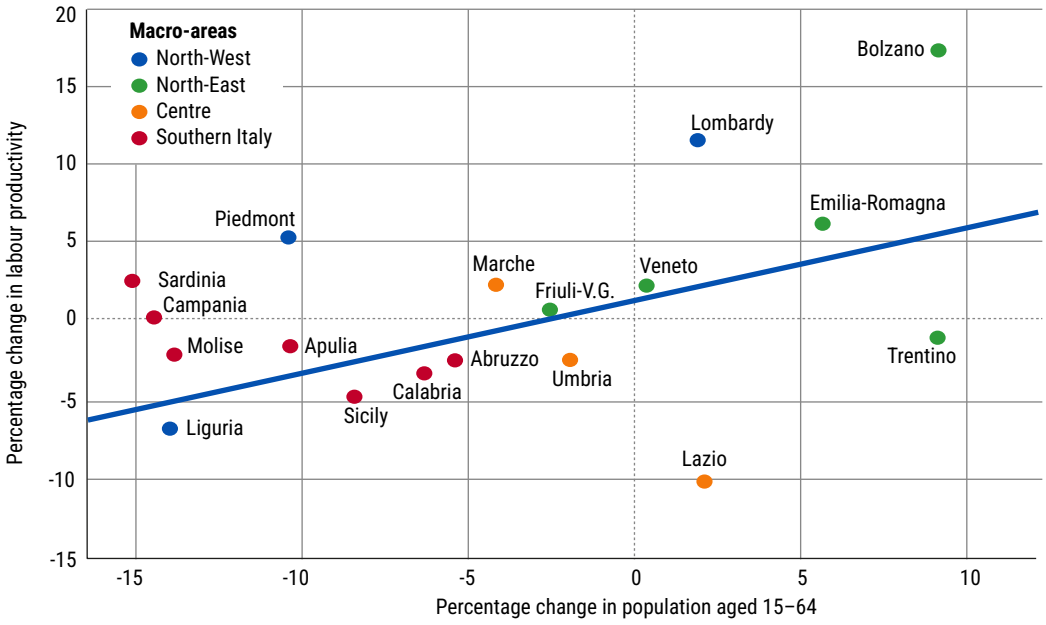
In approximately one third of the regions (Lombardy, Veneto, Piemonte, Liguria, Valle d'Aosta and Trentino-Alto Adige in the North, and Tuscany in the Centre), the share of tertiary-educated people is in line with or below the national average, while the employment rate is above average, signalling substantial employment opportunities also in occupations that do not necessarily require a tertiary qualification.

In Emilia-Romagna, Friuli-Venezia Giulia, Lazio, Marche, Umbria and Abruzzo, both indicators are in line with or above the national average, pointing to contexts characterised by a greater capacity to create employment and absorb skilled labour. In the remaining regions of Southern Italy, with the exception of Abruzzo and Molise, both indicators are below the national average, highlighting a lower capacity to absorb and make effective use of skilled labour.

Regional evidence shows that territories with similar levels of education may display very different capacities to absorb and make effective use of human capital. Changes in the working-age population are one of the factors through which the economic attractiveness of territories can be described, together with other factors. From this perspective, analysis of the 2000–2024 period shows a positive correlation between changes in the working-age population and changes in labour productivity (Figure 4.2.2). Regions that have recorded relatively more favourable working-age population dynamics also tend to display stronger growth in labour productivity. The distribution of observations reveals a contrast between a group of regions characterised by a joint decline in the working-age population and productivity—including all regions of Southern Italy and several regions of Central and Northern Italy—and a group of regions recording growth in both variables (Lombardy, Emilia-Romagna and the Autonomous Province of Bolzano).

FIGURE 4.2.2

Change in the working-age population and labour productivity in Italian regions (2000–2024)



Source: Authors' calculations based on Istat (Territorial Economic Accounts, 2020 base year) and Eurostat (LFS, average annual population). Productivity is measured as real GDP per employed person.

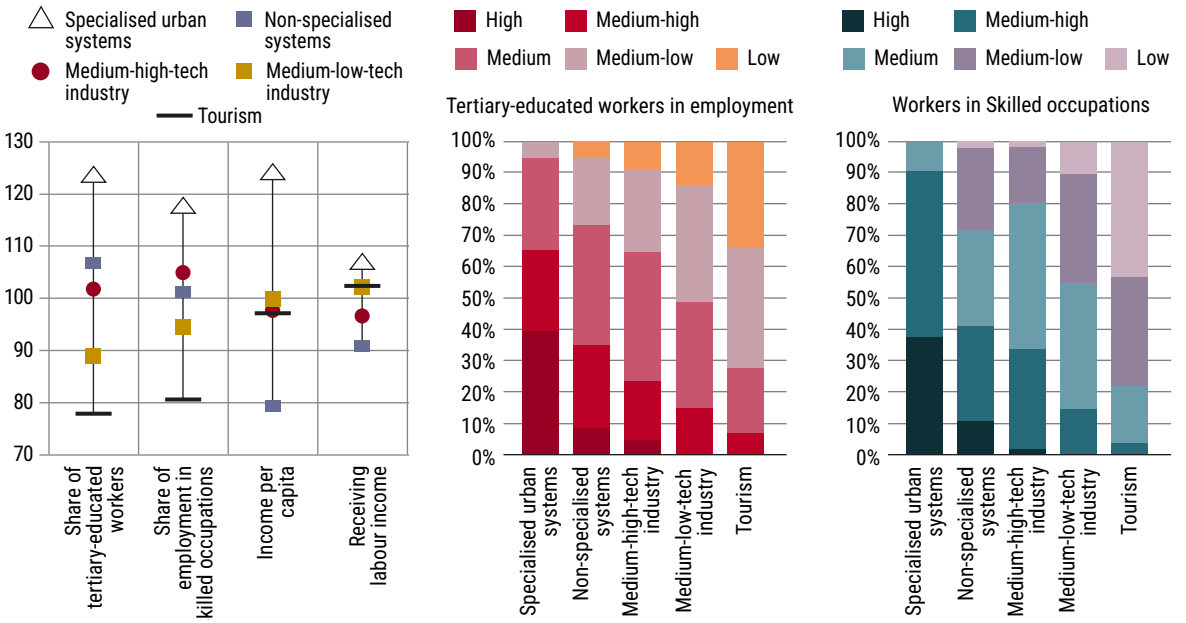
The observed relationship is consistent with the hypothesis that more economically dynamic territories are also better able to attract and retain a larger share of the working-age population. However, to better understand which characteristics of local economic systems may be associated with this capacity to attract and make effective use of human capital, it is necessary to look beyond demographic dynamics alone.

Employment opportunities for more highly skilled workers also depend on the productive structure, the composition of labour demand and the economic functions performed by territories. These aspects can be analysed in greater detail at the level of Local Labour Systems (LLSs), which represent more homogeneous territorial units than regions in terms of economic relations and labour-market characteristics.

The analysis of the 515 LLSs, classified according to their predominant productive specialisation into industrial, tourism-oriented, specialised urban and non-specialised urban systems[8], reveals even greater variability than that observed at the regional level. In particular, specialised urban systems show, with only a few exceptions, higher levels and stronger dynamics of skilled employment than surrounding territories, suggesting that the effective use of human capital depends not only on the availability of skilled workers but also on the characteristics of the local productive fabric.

FIGURE 4.2.3

Groups of LLSs by human capital, income per capita and labour income (left), employment of tertiary-educated workers (centre), and employment in skilled occupations (right). Data for 2023; levels relative to the LLS average (= 100) and percentage composition



Source: Authors' calculations based on Istat statistical registers and administrative sources.
(a) Levels refer to the entire population of the group; classes are defined using the Jenks natural breaks method. Ind MHT and Ind MLT denote, respectively, industrial LLSs specialised in high and medium-high technology activities and in low and medium-low technology activities. "Per capita income" is calculated on the basis of per capita taxable income. The indicator "With labour income" instead represents the share of the resident population declaring labour income for tax purposes.

8. The classification of Local Labour Systems is the one developed by Istat on the basis of the predominant productive specialisation of LLSs (see Istat (2026), *La specializzazione produttiva prevalente dei Sistemi locali del lavoro. Anno 2021*, *Statistiche Focus*, 12 February 2026, Methodological Note).

In particular, specialised urban systems—where more than one quarter of the Italian population resides[9] —show a share of tertiary-educated workers, shares of skilled workers and levels of per capita income (taxable income) approximately 20% above the average for LLSs (Figure 4.2.3, left). Non-specialised urban systems (with around 15% of residents), while displaying above-average shares of tertiary-educated workers and skilled occupations, show a lower share of the population with labour income and, consistently, lower levels of per capita income (taxable income). Tourism systems (where less than 5% of the population resides), by contrast, employ relatively few skilled workers but maintain relatively high average income levels, associated with a larger share of the population receiving labour income.

Among the two groups of industrial systems distinguished according to the technological content of their activities (each accounting for approximately one quarter of residents), those specialised in higher-technology activities have a higher share of skilled employment than the others, without, however, displaying a corresponding advantage in terms of per capita income. The distribution of LLSs by the share of tertiary-educated people and skilled workers confirms these differences (Figure 4.2.3, centre and right): more than 90% of specialised urban systems fall within the "high" or "medium-high" classes for the share of skilled workers, compared with approximately 10% of tourism systems. Similarly, almost two thirds of specialised urban systems fall within the "high" or "medium-high" classes for the share of tertiary-educated workers.

Overall, the territorial evidence suggests that, despite a broad-based improvement in educational attainment, significant differences persist across territories in their capacity to absorb and make effective use of human capital. The findings observed across Local Labour Systems show that this capacity also depends on the characteristics of the productive structure and on the demand for skilled labour expressed by local economic systems. In particular, the stronger performance of specialised urban systems is consistent with the presence of contexts in which agglomeration economies facilitate the matching of skills, productive activities and employment opportunities.

9. Specialised urban systems are characterised by a strong orientation towards advanced and knowledge-intensive service activities.

5 DYNAMICS AND DETERMINANTS OF PRODUCTIVITY AT THE FIRM LEVEL

EXECUTIVE SUMMARY

- Moving from the macro to the micro level, educational attainment emerges as the variable most systematically associated with innovation, research and development, and digitalisation activities and, at the same time, with productivity. The association between education and productivity is predominantly direct, but part of the positive relationship between human capital and productivity can be attributed to the fact that firms with a more highly educated workforce also display a greater propensity to innovate, conduct research and development, and adopt digital technologies: higher levels of human capital and the performance of innovative activities are in fact more likely to be found in more productive firms within their respective sectors.
- Controlling for structural characteristics, firms that are initially further away from the productivity frontier record higher average productivity growth rates, suggesting the existence of a process of conditional convergence. This process is also associated with the composition of the workforce: a greater presence of workers with tertiary education and of managerial staff is accompanied by stronger productivity growth. Moreover, a positive relationship emerges between moving into a higher size class and productivity growth: firms that manage to move into larger size classes display more favourable productivity dynamics and are less dependent on their initial gap from the productivity frontier.
- Innovative start-ups remain a marginal component of national economic aggregates, but they make a significant contribution to innovation activity. They face more stringent selection than non-innovative start-ups, which is reflected in their ability to achieve their economic objectives: innovative start-ups are, on average, smaller than other start-ups when they are established, but close the gap within the first decade.
- Academic research in STEM disciplines is a strength of the country. The encouraging results recorded in basic research are not matched by equally satisfactory outcomes in patenting, despite recent progress. Patent applications are fewer than in the main European countries and are concentrated in traditional sectors. The lag in patenting activity also reflects the low level of R&D expenditure, the limited effectiveness of initiatives aimed at technology transfer, and the fragmentation of incentive policies, which display substantial overlap among instruments and across the responsibilities of different levels of government.

– Recent energy shocks have represented an important test of the resilience of the Italian production system. Firms' demand for energy is inelastic in the short term, especially among energy-intensive firms, which account for a large share of overall energy consumption. The impact of higher prices on firms was nevertheless mitigated not only by public support measures, but also by the presence of fixed-price contracts and the low average incidence of energy costs on total costs. Firms, particularly energy-intensive ones, demonstrated an ability to pass a substantial share of the higher costs on to final prices, thereby preserving profitability.

5.1 HUMAN CAPITAL, INNOVATION AND PRODUCTIVITY[1]

The educational attainment of the Italian workforce has increased significantly over recent decades. This progress has not, however, translated—at least at the aggregate level—into stronger productivity. To better understand this apparent contradiction, it is useful to shift the analysis from the macro to the micro level, examining how the different dimensions of human capital[2] contribute to labour productivity, both directly and indirectly, through firms' propensity to innovate. The latter is analysed along three dimensions: digitalisation, innovation (of products and processes), and research and development (R&D). Each dimension is represented by a synthetic indicator constructed from a set of elementary pieces of information derived from Istat surveys on firms' digital technologies, innovation and R&D, integrated with the multi-purpose survey associated with the Permanent Census of Enterprises[3].

The results show that human capital, particularly the component related to formal education, is one of the main factors associated with both firms' propensity to innovate and their productivity (Figure 5.1.1). Firms whose workers are, on average, more highly educated, or where tasks require a higher level of professional skills, are more advanced in the digitalisation process, more capable of generating product and/or process innovation, and record greater R&D spending intensity; these firms also display higher average levels of productivity. A 1% increase in the firm's education indicator is associated with an increase of more than 0.2% in the synthetic innovation indicator, approximately 0.14% in the R&D indicator, more than 0.12% in the digitalisation indicator, and approximately 0.75% in labour productivity.

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1. The evidence reported in this section is based on microeconometric analyses of Istat data on Italian firms. Paola Bosso and Andrea De Panizza, Istat, Department for the Development of Methods and Technologies; Stefano De Santis, Istat, Department for Social and Demographic Statistics.

2. Human capital is defined as the stock of knowledge, skills and experience accumulated by workers. To capture its multidimensional nature, three complementary components are considered: educational attainment, the professional skills required by the tasks performed, and work experience, distinguishing between general experience (age) and firm-specific experience (tenure). The education indicator is constructed as the weighted average of the years of education of the firm's workers and represents a measure of the general skills acquired through formal education. Professional skills are measured through a synthetic indicator derived from the International Labour Organization (ILO) ISCO occupational classification, which classifies occupations according to the complexity of the tasks and the level of skills required. The firm-level indicator is obtained as the weighted average of the skill levels associated with the occupations of its employees. Work experience is considered both in its general component, approximated by the average age of employees, and in its firm-specific component, measured through tenure (average length of service within the firm), which represents the firm-specific human capital accumulated within the organisation.

3. For a detailed description of the methodology used to construct the indicators and for further analysis of the findings summarised here, see Chapter 4 of Istat's 2026 Annual Report.

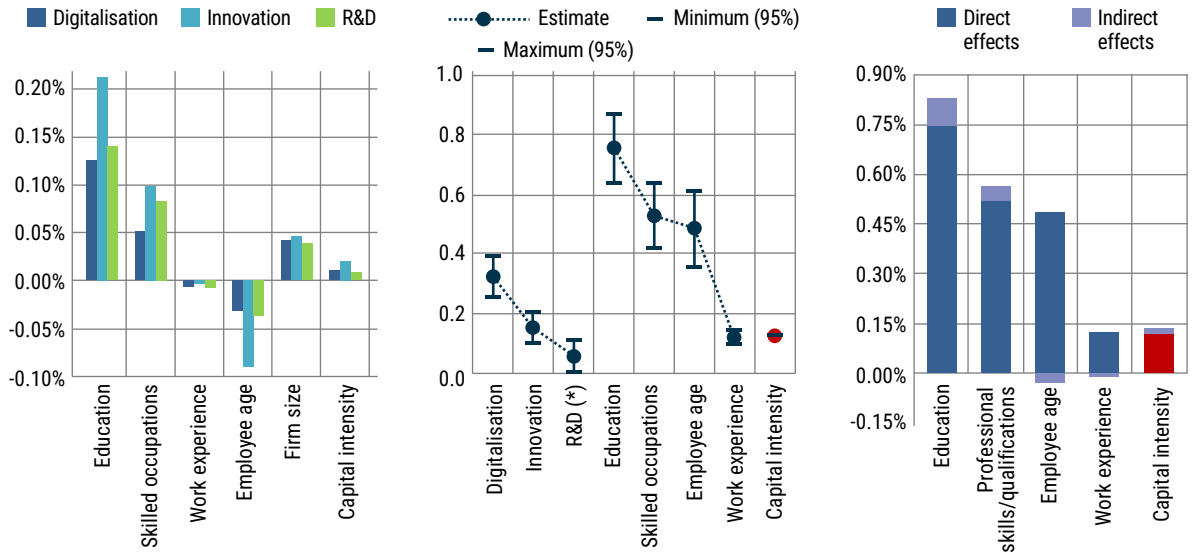
Other aspects of human capital display weaker associations with innovative propensity and productivity. Tenure within the same firm has limited effects on both dimensions, while the average age of the workforce is negatively associated with innovative propensity but positively associated with productivity levels.

The positive association between the average age of the workforce and productivity may reflect, at least in part, the firm life cycle. More mature firms have, on average, older workforces, larger size[4] and higher productivity levels, while they tend to display a lower propensity to invest than younger firms[5]. From this perspective, the different relationship observed between workforce age, innovation and productivity may reflect different structural characteristics of firms at different stages of their life cycle.

The relationship between education and productivity operates predominantly through a direct effect, but also through an indirect channel associated precisely with firms' greater propensity to innovate, that is, their greater capacity to adopt digital technologies, introduce product and process innovations, and invest in research and development.

FIGURE 5.1.1

Associations between human capital, other firm structural characteristics, innovative propensity and productivity, and decomposition of the direct and indirect effects on productivity. 2022 (elasticities) (a)



Source: Istat calculations based on the multi-purpose survey on enterprises, statistical registers and administrative data
(a) Cross-elasticity measures the percentage change in the dependent variable associated with a 1% increase in the corresponding explanatory variable. The model jointly considers the dimensions of human capital (education, professional skills, age and work experience), other structural characteristics of the firm (size and capital intensity), and indicators of innovative propensity (digitalisation, innovation and R&D). The graph on the right distinguishes the direct effects of structural characteristics on productivity from the indirect effects mediated through innovative propensity.

4. S. Garbin, A. Linarello, A. Locatelli, B. Mottironi, G. Papini, P. Recchia, A. Sechi and G. Viggiano, *Dimensione, dinamica e crescita delle imprese italiane: evidenze dai microdati*, Banca d'Italia, *Questioni di economia e finanza*, forthcoming.

5. L. Gazzano, F. Manaresi, M. Mariani, L. Mirenda, G. Rodano, F. Scoccianti and P. Zoi, *Firm aging and the aggregate investment rate*, Banca d'Italia, *Questioni di economia e finanza*, forthcoming.

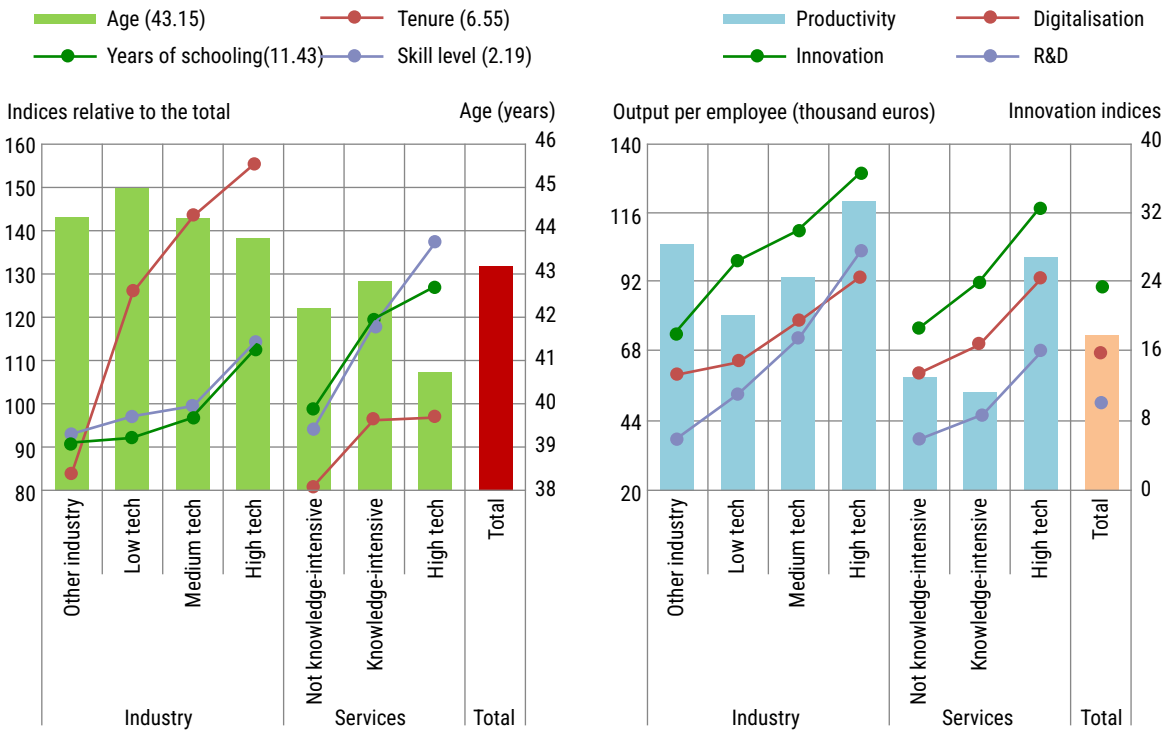
The relationships identified by the microeconomic analysis are also reflected in the productive specialisation of the Italian economic system, which is still characterised by a significant weight of low-technology *Made in Italy* sectors, particularly in household and personal goods. These sectors have a higher average age of employees and relatively lower levels of education and skills than sectors with greater technological and knowledge intensity (Figure 5.1.2).

Systematic differences also emerge across productive sectors. In manufacturing, high-technology sectors display higher levels of education and skills and, at the same time, higher values for indicators of innovation, research and development, digitalisation and productivity per employee. A similar pattern is observed in services, where knowledge-intensive activities show higher levels of human capital, innovative propensity and productivity than other sectors.

Overall, the evidence suggests that strengthening productivity requires not only higher levels of educational attainment, but also productive environments capable of making effective use of qualified human capital and providing employment opportunities consistent with higher skill levels.

FIGURE 5.1.2

Normalised human capital characteristics (left), productivity and innovative behaviour (right) of firms, by techno-economic groupings. Years, indexed levels and synthetic indices (a)



Source: Statistical Register of Active Enterprises (ASIA) and calculations based on data from the multi-purpose survey on enterprises, statistical registers and administrative data.
(a) Years of education, tenure and skill levels are expressed as levels relative to the total system = 100 (average values shown in parentheses in the legend); Digitalisation, Innovation and R&D are expressed as average sectoral values of synthetic indices (from 0 to 100) based on factor analyses for each dimension). The group "Other industry" includes construction activities and utilities (electricity, water and environmental services).

Even within the same techno-economic grouping[6], a higher level of human capital and innovative propensity is associated with a greater probability of belonging to the group of high-productivity firms[7] (Figure 5.1.3). Among the variables considered, educational attainment is confirmed as the factor most systematically associated with high productivity across the different techno-economic groupings, while professional skills display a positive association particularly in less knowledge-intensive services and in the "other industry" sectors (construction and utilities). In sectors characterised by greater technological and knowledge intensity, however, this association tends to weaken, consistently with the broader diffusion of skilled workers, for whom possessing high levels of skills is becoming an increasingly structural feature and therefore less of a distinguishing characteristic across firms.

This finding is related to what was highlighted in Chapter 2, where the increase in the educational attainment of the workforce was not accompanied by a corresponding increase in highly skilled occupations. Although the evidence does not make it possible to directly identify phenomena of overqualification or skill mismatch, it is consistent with the hypothesis that part of the increase in human capital is not being fully utilised in production processes, as suggested by a broad body of literature on mismatches between skills supplied and skills required.

The relationship between work experience and productivity also varies across the different techno-economic groupings. Firm-specific experience (tenure) is more strongly associated with productivity in manufacturing sectors and in less knowledge-intensive services, while in highly knowledge-intensive services the average age of employees appears to play the more prominent role. These differences suggest that the different components of work experience may carry different weight depending on the technological and organisational characteristics of the different production environments.

With regard to the three dimensions of innovative propensity, the analysis confirms the particularly important role of digitalisation[8], which is associated with a greater probability of belonging to the group of high-productivity firms in most techno-economic groupings. The adoption of digital technologies displays generally positive associations, although their intensity varies across sectors (Figure 5.1.3, right). In high-technology sectors and highly knowledge-intensive services, this association is weaker, consistently with the wider diffusion of innovative behaviour, which tends to constitute a structural characteristic of the business model and therefore becomes less able to distinguish high-productivity firms[9].

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6. Defined on the basis of the Eurostat classification of the technological and knowledge intensity of individual economic activities.

7. High-productivity firms are identified within each techno-economic grouping through a statistical clustering procedure and represent, on average, approximately 20% of firms with at least 10 employees. Estimates are obtained through a logistic model. Odds ratios measure the change in the relative probability of belonging to this group associated with a one-unit increase in human-capital indicators (one year of age, tenure, education and the share of professional skills) and a 1% increase in innovative-propensity indicators (digitalisation, innovation and R&D), holding the other characteristics included in the model constant.

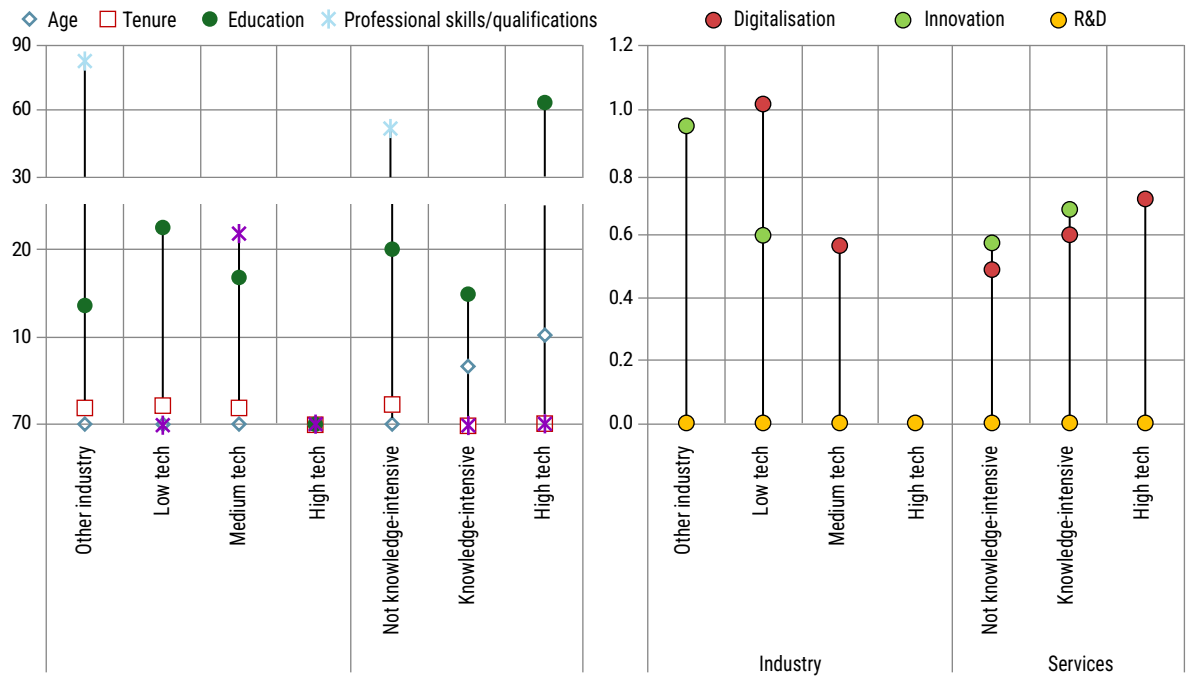
8. Innovative propensity is defined as comprising three dimensions: digitalisation, product/process innovation and R&D. A high level of digitalisation therefore indicates a high propensity to innovate.

9. At the same time, it appears difficult to operate in high-technology and/or highly knowledge-intensive sectors with-

Research and development activities, by contrast, do not display a systematic association with the probability of belonging to the group of high-productivity firms. This result is consistent with the characteristics of the Italian production system, in which R&D activities have a low overall intensity and are highly concentrated in a limited number of firms, reducing their ability to discriminate productivity across most of the business population.

FIGURE 5.1.3

Impact of human-capital variables (left) and innovation variables (right) on firms' productivity, by techno-economic grouping. *Odds ratios* (a)



Source: Istat calculations based on the multi-purpose survey on enterprises, statistical registers and administrative data.
(a) Increase in the probability of belonging to the high-productivity group associated with a one-point increase in human-capital indicators (one year of age, tenure, education, skills share) and a 1% increase in innovation indicators. *The "Other" group includes construction activities and utilities (electricity, water and environmental services*).

Overall, the evidence suggests that human capital and innovative propensity are closely complementary dimensions associated with firms' productivity. The differences observed across techno-economic groupings and among firms indicate that a greater endowment of human capital tends to be accompanied by a greater propensity to innovate and, jointly, by higher productivity levels. The overall picture is therefore one in which productivity depends on firms' ability to combine skills, innovation and organisation effectively within their production processes, albeit in different ways across sectoral contexts.

out having fully adopted digital technologies, both in hardware and software equipment and in business organisation and, consequently, in the internal circulation of information. High digitalisation is therefore no longer a distinctive characteristic of some firms.

BOX

Corporate Academies: a Strategic Driver of National Productivity | National Productivity Board, Working Paper No. 4, September 2026[10]

The Working Paper No. 4 explores the role of Corporate Academies as instruments for the accumulation and enhancement of human and organisational capital and as a potential lever for productivity in the economic system. The analysis starts from the observation that training should not be interpreted merely as an activity aimed at updating individual skills, but should be regarded as an investment in intangible capital capable of generating effects on the quality of work, the organisation of firms, the dissemination of knowledge and, more generally, the ability of the productive system to innovate and reallocate resources efficiently. The volume combines a theoretical discussion of the role of Academies and industrial relations with a review of concrete experiences developed by major industrial groups, collected as part of Assoknowledge's activities.

Corporate Academies and Human Capital

Pasquale Lucio Scandizzo

Academies fit within a conception of human capital as a stock of knowledge and skills that accumulates over time and generates returns through its interaction with the productive organisation. The quality of work depends not only on formally acquired skills, but also on the ability to learn, adapt to complex environments, deal with non-codified situations, and participate in collective processes of knowledge production and sharing. From this perspective, individual human capital is intertwined with organisational capital, embodied in the routines, processes, languages and shared mental models of the firm. Academies represent one of the main mechanisms through which this capital can be produced and consolidated, through the codification of tacit knowledge, the dissemination of common practices and the development of shared competency frameworks.

Training therefore takes on significance that extends beyond individual job performance and is directly linked to long-term productivity. A particularly important issue concerns the lack of recognition of training as a fully capitalised investment. Unlike research and development, which has progressively been incorporated into systems of economic accounting as a form of investment in the production of a stock of knowledge, training largely remains in a "statistical-economic limbo". This lack of capitalisation may result in an underestimate of the value added generated by the knowledge economy and, at the same time, in a distorted representation of TFP, in which the effects of investment in training may be absorbed into the productivity residual.

The discussion therefore focuses on organisational misallocation, understood as the inefficient allocation of skills and resources within organisations. Academies can help reduce such inefficiencies by developing broad-based managerial capabilities, standardising and disseminating operational practices, and sharing knowledge. Their role is not necessarily positive in aggregate terms, however: if Academies remain confined to firms that are already more productive and operate primarily for the benefit of or-

10. This summary box was prepared by the Technical Secretariat of CNEL and should therefore be considered provisional pending updating by the authors.

ganisations at the technological frontier, they may contribute to widening productivity gaps and increasing the concentration of skills. Their ability to reduce misallocation therefore depends on their degree of openness to universities, ITS institutions, territorial bodies, production chains and smaller firms, as well as on the governance arrangements adopted.

A further aspect concerns the polarisation of skills and the distribution of the benefits of training. The dissemination of knowledge from the technological frontier to the rest of the productive system is essential to prevent the accumulation of human capital from remaining concentrated in the most advanced firms. In this respect, the Academies of major corporate groups can perform a knowledge-transfer function along production chains and across territories, helping to reduce productivity differentials between firms. The key issue is therefore not only how much is invested in training, but also how skills are produced, distributed and used within the economic system.

Particular attention is finally devoted to artificial intelligence and the training required to transform its technological potential into actual productivity gains. The integration of human capabilities and AI systems requires specific skills and new organisational arrangements. This gives rise to a form of hybrid capital, generated by the interaction between workers and technologies and not fully attributable either to human capital or to the firm's technological endowment. Academies can play a central role in building this capital by supporting upskilling and reskilling processes and promoting the integration of AI into production processes.

Corporate Academies and Industrial Relations: Extended Collective Bargaining, Stakeholding, Rights and Hybrid Capital in the Age of Artificial Intelligence

Pasquale Lucio Scandizzo

The relationship between Academies and industrial relations challenges the traditional separation between corporate training, human resources management and collective bargaining. Academies are primarily private infrastructures for skills governance, closely linked to corporate strategies, employer branding and productivity, but only rarely integrated with collective bargaining, job classification and grading systems, bilateral arrangements or public certification of skills. The growing centrality of training nevertheless makes this separation increasingly difficult to sustain.

Training can therefore be reinterpreted as a form of "extended bargaining", in which the worker is not merely the recipient of an investment decided unilaterally by the firm, but participates in the creation of an asset that generates value for multiple stakeholders. From this perspective, acquired skills constitute a form of worker entitlement and raise questions concerning participation in the definition of training pathways, certification, and the possibility of transferring and making effective use of acquired skills outside the firm as well. Some European experiences referred to in the contribution already show forms of worker participation in training or individual recognition of training rights.

The advent of AI makes this perspective even more relevant. The training required to use artificial intelligence effectively produces hybrid capital resulting from the complementarity between workers and technology. Its governance raises new questions concerning governance arrangements and the allocation of rights, making greater involve-

ment of industrial relations necessary in technological transformation processes and in defining training entitlements. From this perspective, Academies can become a meeting point between corporate strategy, skills development, worker participation and the management of technological transformation.

Corporate Academies of Major Industrial Groups

Laura Deitinger and Alessandro Sciolari

The empirical section of the Working Paper brings together the experiences of fourteen firms operating in different sectors—from industry to energy, from services to technology, and from manufacturing to automotive and consulting—with the aim of showing concretely how Academies are evolving and what functions they perform within organisations. The contributions were developed as part of Academy Circle, an initiative promoted by Assoknowledge as a forum for exchange among Academy managers and senior executives, aimed at sharing experiences and identifying common challenges and trajectories.

The contributions focus primarily on two areas: AI and new technologies, and upskilling/reskilling, alongside a reflection on the strategic and reputational value of Academies. Corporate experiences show that Academies can no longer be reduced to the organisation of training courses alone, but are increasingly integrated into corporate transformation processes: they anticipate new professional requirements, accompany the introduction of emerging technologies, support the redeployment and upgrading of skills, and contribute to building a shared organisational culture.

A common feature is the shift from a conception of training as an intervention limited to the individual worker to a systemic and ecosystem-based perspective. Academies increasingly operate in cooperation with universities, ITS institutions, training providers, schools, local communities and production chains, helping to connect firms' skill requirements with training provision and skills-development processes. This function is particularly important in a context characterised by the rapid pace of technological change and the difficulty of traditional education systems in adapting at the same speed to the evolution of professional requirements.

The experiences collected also highlight a growing identity and reputational dimension of Academies. Investment in training is not only a means of increasing productivity, but also a way in which firms communicate their orientation towards the future of work, enhance their people, strengthen their ability to attract talent, and build relationships with stakeholders and local communities. The reputational dimension therefore complements the technical-organisational and strategic dimensions, helping to shape the firm's positioning and its ability to generate value over the medium to long term.

Overall, the experiences show that Academies can represent strategic infrastructures for productivity, provided that training is regarded as an investment in intangible capital rather than simply as a corporate cost. Their potential concerns both the development of internal skills and the ability to disseminate knowledge, innovation and organisational practices along production chains and across territories. From this perspective, the challenge is to transform Academies from instruments operating predominantly within individual firms into nodes of broader training ecosystems capable of contributing to reducing skills and productivity gaps.

In conclusion, the analysis highlights an increasingly close relationship between human capital, organisational capital, training and productivity. The ability to generate growth does not depend solely on the introduction of new technologies, but on the ability to translate them into skills, behaviours, processes and organisational culture. Academies are precisely at the intersection of these dimensions and can contribute to making the diffusion of innovation more effective, reducing inefficiencies in the allocation of skills and supporting the transformation of work in the age of artificial intelligence. Their role, however, depends on their ability to ensure openness, knowledge dissemination and appropriate forms of participation and governance, so that the benefits of investment in training can extend from the individual firm to the productive system as a whole.

5.2 PRODUCTIVITY, CONVERGENCE AND FIRM SIZE GROWTH[11]

While the preceding analyses make it possible to identify some of the characteristics associated with higher productivity levels, it remains necessary to understand which factors are also associated with productivity growth over time. To this end, the relationship between labour productivity growth and firms' characteristics was analysed using a panel of Italian firms covering the period 2012–2020, encompassing both the period following the global financial crisis and the initial effects of the COVID-19 pandemic.

The estimates are derived from a conditional productivity growth model[12], in which the role of firm and employment characteristics is assessed while taking account of the firm's initial productivity level. Even after controlling for the main structural characteristics of the firm—including size, capital intensity, export orientation, sector of activity and geographical location—the composition of employment[13] emerges as one of the main factors associated with productivity growth (Figure 5.2.1).

Among observable employee characteristics, average educational attainment and occupational composition—measured through the shares of blue-collar workers, white-collar employees and managers—are the characteristics most strongly associated with productivity growth. In particular, a 10-percentage-point increase in the share of employees with tertiary education is associated with an increase in productivity growth of approximately 1.6 percentage points in manufacturing and almost 3 percentage points in services. The effect is even more pronounced in the case of managerial and executive positions, whose greater presence is associated with the largest productivity increases.

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11. The evidence presented in this section is taken from Bartoloni, E. (2026), *Pitfalls of productivity convergence tests using firms' microdata*, *Journal of Industrial and Business Economics* (DOI: 10.1007/s40812-026-00410-6). The analyses are based on an integrated panel database constructed from Istat's FRAME-SBS and ASIA Employment archives.

12. This is a conditional productivity convergence model in which the productivity growth rate is explained, among other factors, by the firm's initial productivity level. This approach makes it possible to assess whether firms with lower initial productivity levels display, all else being equal, different growth dynamics from firms that are initially more productive. The approach builds on the traditional literature on economic convergence and adapts it to firm-level analysis.

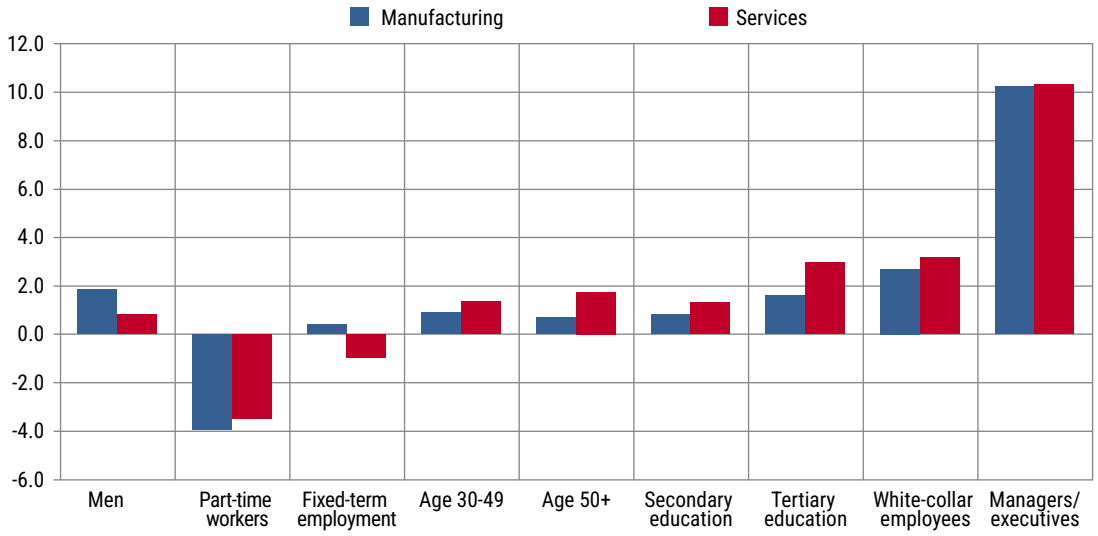
13. Unlike the preceding paragraph, which uses synthetic indicators of human capital, this section considers firms' employee characteristics directly through the information available in the ASIA Employment archive.

Differences also emerge in relation to other employment characteristics. In both sectors, a higher incidence of part-time work is associated with weaker productivity growth, while workers' age is generally positively associated with productivity dynamics, with a stronger relationship in services. This finding is consistent with the role of accumulated work experience.

Overall, the evidence indicates that observable characteristics of both employees and firms, related to human capital and the organisation of work, are significantly associated with firms' productivity growth. The model also makes it possible to explore a further aspect, namely whether firms starting from lower initial productivity levels tend, over time, to reduce their gap relative to those initially more productive.

FIGURE 5.2.1

Effect of employment characteristics on productivity growth (%) (a)



Source: calculations based on Istat statistical registers and administrative data. The explanatory variables are expressed as shares of employees in the total firm workforce. The reference categories are women, full-time workers, permanent workers, workers under 30 years of age, workers with primary education and blue-collar workers.
(a) The reported effects are obtained from coefficients estimated through dynamic panel models (System-GMM) and represent the change in productivity growth associated with a 10-percentage-point increase in the share of the corresponding category of workers.

The evidence confirms that firms that are initially less productive tend, over time, to record higher productivity growth rates, progressively reducing the gap relative to more productive firms. This finding points to the existence of a process of convergence in productivity levels, consistent with the diffusion of knowledge, technologies and organisational practices among firms.

To further examine the productivity recovery process, the analysis considers the distance from the productivity frontier[14], that is, the productivity gap relative to the most efficient firms operating in the same sector. The evidence confirms that firms initially further away from the frontier tend, on average, to record higher productivity growth rates. Table 5.2.1 also shows that the process of productivity convergence differs depending on firms' paths of size growth, that is, according to whether they remain in the same size class or manage, during the period considered, to move into a higher size class.

Among firms remaining in the same size class, those furthest from the frontier record the highest productivity growth rates, confirming the recovery process described above. Firms that manage to cross the threshold of their original size class also continue to display a process of convergence; however, they record systematically higher productivity growth rates and their dynamics are less dependent on their distance from the frontier. This is consistent with the hypothesis that firms able to move into a higher size class—in terms of employment—possess organisational and productive characteristics that enable them to sustain higher productivity growth rates, making their dynamics less dependent on their initial distance from the frontier.

Overall, the evidence suggests that productivity improvement and movement into a higher size class are closely interconnected processes. However, such transitions concern a very limited share of firms[15]. This suggests that, although they are associated with stronger productivity growth, these pathways, because they concern only a small number of firms, make a limited contribution to aggregate productivity growth. From this perspective, if productivity gains are not accompanied by growth trajectories that enable firms to move into higher size classes, those gains tend to remain confined to the level of individual firms. Their limited diffusion therefore contributes to constraining the transmission of productivity gains from the microeconomic to the aggregate level.

14. The distance from the productivity frontier is defined as the productivity gap relative to the 5% most productive firms belonging to the same sector (two-digit NACE) and the same year.

15. Over the period considered, only 1.4% of small manufacturing firms and 0.5% of small service firms in the observed sample move into a higher size class.

TABLE 5.2.1

Productivity Growth and Firm Size-Growth Paths

Firm size trajectory	Productivity growth	Role of distance from the frontier	Main message
Firms remaining in the same size class	Lower	Growth depends more strongly on the initial distance from the frontier (manufacturing and services).	Firms initially furthest from the frontier achieve the largest productivity gains.
Small firms moving into a higher size class	Higher	Growth depends less strongly on the initial distance from the frontier (manufacturing and services).	Moving into a higher size class is accompanied by stronger productivity growth and makes the initial gap relative to the frontier less relevant.
Medium-sized firms that grow and large firms that remain in the highest size class	Higher	Growth depends only to a limited extent on the initial distance from the frontier (significant in services).	Productivity growth remains high even among firms that are initially closer to the frontier.

Note: The results reported are based on dynamic panel estimates obtained using the System-GMM method. The productivity frontier is defined as the 5% of firms with the highest levels of labour productivity within each sector and year. Small firms that move up to a higher size class are defined as firms with fewer than 50 employees at the beginning of the observation period that subsequently move into higher size classes; medium-sized firms that move up to a higher size class are firms with 50–249 employees that move into higher size classes; large firms that remain in the same size class are firms with at least 250 employees that remain in the largest size class throughout the observation period.

BOX

Innovative Start-ups in the Italian Productive System: Economic Characteristics and Recent Regulatory Developments[16]

Francesco D'Amuri, Rosalia Greco and Giacomo Caserta

Newly established firms (*start-ups*) play a central role in job creation and innovation, particularly disruptive innovation[17]. However, not all start-ups have high growth potential: during the first three years of a cohort of firms, 10% of them generate more than two thirds of employment growth and more than three quarters of the increase in revenues[18].

16. By Francesco D'Amuri, Rosalia Greco and Giacomo Caserta, Firms and Regional Analysis Division, Economic Structure Service, Economics and Statistics Department of the Bank of Italy.

17. J. Haltiwanger, R. Jarmin and J. Miranda, *Who Creates Jobs? Small Versus Large Versus Young*, The Review of Economics and Statistics, vol. 95, no. 2, 2013; D. Acemoglu, U. Akcigit, H. Alp, N. Bloom and W. Kerr, *Innovation, Reallocation, and Growth*, American Economic Review, vol. 108, no. 11, 2018.

18. A. Cintolesi, E. Frattola, R. Greco, F. Leombroni, A. Linarello, A. Locatelli, S. Nesi and S. Zuccolalà, *High-Growth Young Firms in Italy*, Banca d'Italia, Questioni di economia e finanza, 889, 2024.

Likewise, not all newly established firms are innovative. A recent study[19] identifies two types of innovative start-ups: those defined on the basis of registration in the special section of the Business Register established by the Start-up Act[20] (SU-INN) and those that have received at least one venture capital funding round (SU-VC). The two groups partly overlap: 80% of SU-VCs are also SU-INNs, whereas only 7% of SU-INNs have received at least one venture capital round and are therefore also SU-VCs.

Innovative start-ups account for a relatively small share of the Italian productive system[21]: SU-INNs represent 2.3% of the companies with share capital established between 2012 and 2024, while SU-VCs account for only 0.2%.

The activity of both groups of firms is concentrated primarily in sectors with high technological and knowledge intensity, consistently with their innovative nature: ICT services, professional and scientific activities, and medium-high-technology manufacturing. In terms of innovation, they contribute to patenting activity more than proportionally to their numbers. Around half of the start-ups[22] founded between 2012 and 2019 that filed at least one patent application with the European Patent Office (EPO) during the same period were SU-INNs; these firms were also responsible for 44% of the patents filed[23]. The financial structure of both groups of firms is consistent with their innovative nature: compared with other young firms, innovative start-ups have a significantly higher share of intangible assets and a lower dependence on bank debt, which may partly reflect the greater difficulty faced by firms with predominantly intangible assets in accessing credit, given that such assets are difficult to use as collateral.

Growth Dynamics, Productivity and Selection

The economic significance of this segment does not lie in its contribution to aggregate indicators—in 2019, innovative start-ups accounted for around 1.1% of value added and 1.2% of employment among companies with share capital—but rather in their growth profiles and selection mechanisms. Innovative start-ups face more stringent selection

19. M. G. Cassinis, A. Cintolesi, S. Formai, A. Locatelli, F. Manaresi, E. Manzoli, G. Papini, F. Parlapiano, P. Recchia and S. Zuccolalà, I*nnovative Firms Unveiled: Economic and Financial Insights from Italian Start-Ups*, Banca d'Italia, Questioni di economia e finanza, 967, 2025.

20. The Start-up Act (Decree-Law No. 179 of 18 October 2012, as subsequently amended; see note 13 of Chapter 1) provides that a newly established firm whose corporate purpose is the production and marketing of innovative products or services with a high technological content may register in the special section for innovative start-ups of the Business Register if it meets requirements concerning age, size and legal form and at least one of a series of criteria relating to innovative capacity: the scale of expenditure on research and development, workforce education, and ownership or licensing of patents or registered software. Registration in the special section gives the firm access to a broad range of support measures: tax incentives for venture capital investors; free, simplified and direct access to the SME Guarantee Fund for bank financing; simplified incorporation and corporate crisis procedures; flexibility in employment conditions (use of fixed-term contracts without the ordinary quantitative limits) and the possibility of remunerating employees and collaborators through stock options or equity stakes (*work-for-equity*), instruments excluded from the taxable employment-income base; more flexible corporate governance arrangements than under the ordinary rules; and access to equity crowdfunding; as well as support for internationalisation through the ICE Agency.

21. In this box, unless otherwise specified, the expression "innovative start-ups" refers to the combined group of SU-INNs and SU-VCs.

22. Only companies with share capital are considered.

23. The shares for SU-VCs are 11.7% and 11.8%, respectively. For SU-INNs, the figure may partly reflect the statutory definition itself, under which ownership of a patent is one of the alternative eligibility requirements for registration in the special section of the Business Register.

than non-innovative start-ups: in the short term, SU-INNs show survival rates in line with those of other start-ups, but over time selection intensifies, and from the fourth year onwards their rates of exit from the market exceed those of other young firms[24]. SU-VCs initially display higher survival rates than SU-INNs, probably as a result of investor support. Once the typical investment horizon of venture capital has expired, however, their survival rates also fall below those of other young firms.

This more stringent selection is reflected in their ability to achieve economic objectives. At the time of establishment, innovative start-ups are, on average, smaller than other start-ups in the same economic sector, both in terms of employment and turnover, but these gaps disappear within the first decade of activity[25]. Initial total factor productivity is also, on average, lower than that of other newly established firms; this gap, however, narrows during the first years of activity but does not disappear. SU-VCs display more favourable dynamics than SU-INNs: ten years after establishment, they have, on average, six more employees and generate approximately twice the revenues of SU-INNs and, unlike the latter, the initial productivity gap relative to non-innovative start-ups tends to close over the period observed. Average indicators conceal substantial heterogeneity: across all variables considered, relative gains compared with other young firms are concentrated in the upper percentiles of the distribution, indicating that even among innovative start-ups it is the most dynamic firms that drive the aggregate performance of the segment.

Concluding Remarks and Recent Regulatory Changes

Innovative start-ups remain a marginal component of aggregate indicators, but make a significant contribution to innovation activity. The Start-up Act is based on identifying firms with high innovation potential on the basis of ex ante characteristics and aims to provide these firms with support during the early years of their existence in order to facilitate their development and survival. Part of the differences observed in the economic performance of innovative start-ups compared with non-innovative ones may therefore be attributable to the effect of the policy itself: an impact assessment[26] of the Start-up Act documents positive effects on firms' capital endowment—especially in terms of intangible assets—and on value added, with weaker effects on revenues and employment, but no causal effect on survival[27]. The evaluation demonstrated the effectiveness of the policy in easing financial frictions affecting a class of firms generally characterised by difficulties in accessing external finance, through two channels. On the one hand, it improved access to bank credit by simplifying procedures for obtaining guarantees from the Central Guarantee Fund; on the other, it increased the prob-

24. The business activity of innovative start-ups is riskier than that of other firms because it involves activities aimed at creating innovation, whose outcome and economic return are uncertain. Their lower probability of survival therefore reflects the higher business risk faced by innovative start-ups.

25. Ten years after establishment, SU-INNs have, on average, more than three employees more than non-innovative start-ups and the same level of revenues.

26. F. Manaresi, C. Menon and P. Santoleri, *Supporting Innovative Entrepreneurship: An Evaluation of the Italian "Start-up Act"*, Industrial and Corporate Change, vol. 30, no. 6, 2021.

27. The specific selection profile observed for these firms would therefore derive from their intrinsic characteristics and would not be driven by the benefits associated with SU-INN status.

ability of obtaining equity capital through tax incentives for equity investors. Recent legislative measures have further strengthened incentives for investors[28]. The 2023 Annual Law on the Market and Competition tightened the requirements for registration in the special section of the Business Register and those governing the maintenance of the status over time, linking it to firms' actual growth trajectories[29]. Greater selectivity in the definition of an innovative start-up—particularly if based on an assessment of growth trajectories over longer time horizons and on indicators closely related to firms' ability to expand in markets and advance technologically—could help ensure that access to public incentives and administrative simplifications is limited to firms that actually continue to develop, excluding those that are inactive or remain at very low levels of activity[30].

The legislation governing support for start-ups is likely to undergo further changes in the near future. The first Annual Law for SMEs (Law No. 34/2026) delegated to the Government the task of drafting a consolidated act to reorganise the entire regulatory framework governing innovative start-ups and SMEs, spin-offs, incubators and start-up accelerators, with the aim of rationalising administrative requirements and reducing the regulatory fragmentation that has accumulated since 2012. In March 2026, moreover, alongside the EU Inc. proposal, the European Commission adopted Recommendation (EU) 2026/720, which for the first time establishes EU-harmonised definitions of innovative enterprise, innovative start-up and innovative scale-up. These definitions, which provide the reference framework for access to European incentives, differ in part from the national definitions; the Recommendation will therefore guide future revisions of national legislation and the consolidated act delegated by the 2026 SME Law.

BOX

Research and Innovation in Italy[31]

Technological progress is the main determinant of productivity growth over the long term. Innovation and the adoption of advanced technologies are therefore crucial factors for the competitiveness of the productive system.

28. The main measures in this area are contained in Law No. 193/2024 (Annual Law on the Market and Competition 2023), Law No. 162/2024 (Provisions for the promotion and development of innovative start-ups and small and medium-sized enterprises through tax benefits and investment incentives), and Law No. 207/2024 (2025 Budget Law).

29. The law restricted registration in the special section of the Business Register to innovative firms that qualify as micro, small or medium-sized enterprises under Recommendation 2003/361/EC and excluded those whose main activity is agency or consultancy services. The basic period of residence in the special section was reduced from five to three years and may be extended to five years upon achievement of at least one of a set of objectives concerning growth in turnover or employment, innovation (the scale of R&D expenditure, the conclusion of an experimentation agreement with a public administration or the acquisition of a patent), or an increase in share capital involving the entry of professional investors. Two-year extensions are also provided for during the scale-up phase, subject to meeting conditions relating to an increase in capital by collective investment undertakings or revenue growth.

30. Banca d'Italia, *Memoria preliminare all'esame del disegno di legge "Legge annuale per il mercato e la concorrenza 2023"*, Camera dei Deputati, 17 October 2024.

31. By Francesco D'Amuri, Rosalia Greco and Giacomo Caserta, Firms and Regional Analysis Division, Economic Structure Service, Economics and Statistics Department of the Bank of Italy.

Italy ranks thirteenth among the 27 Member States of the European Union according to the European Commission's *European Innovation Scoreboard 2026*, and 28th among 139 countries according to the World Intellectual Property Organization's *Global Innovation Index 2025* (WIPO). Italy's persistent lag behind the leading innovating countries and its intermediate position in international rankings primarily reflect a low level of investment in the inputs underlying innovation processes[32]. The intensity of investment in research and development (R&D) is limited by European standards: according to Eurostat data, in 2024 aggregate R&D expenditure amounted to approximately 1.4% of GDP, around 0.9 percentage points below the European Union average. The gap is attributable primarily to business R&D expenditure, which in Italy amounts to approximately half the European average[33], but is also significant for the component attributable to public institutions, including public research organisations (PROs), and to public and private universities.

The Innovation Value Chain: STEM Research, Patenting and Technology Transfer

A recent study[34] provides a systematic overview of the entire innovation value chain in Italy, with particular attention to the link between public research and the innovative capacity of the productive system.

Academic research in the science, technology, engineering and mathematics (STEM) disciplines[35] represents a strength of the country. According to OECD bibliometric indicators, between 2009 and 2023 the number of high-quality publications increased by 60%[36], reaching a level just below that of Germany and clearly above those of France and Spain; Italy's share of the global total remained broadly stable at 3%[37]. Growth affected all fields of study and was particularly pronounced in the medical sciences, which alone accounted for more than 40% of the overall increase. These results were achieved in a context of limited resources. In 2023, expenditure on tertiary education amounted to 1% of GDP, compared with 1.3% in the EU and 1.5% in the OECD average; the gap relative to the European average is entirely attributable to lower public investment[38].

The encouraging results recorded in basic research are not matched by equally satisfactory outcomes in patenting, a crucial step in the economic valorisation of scientific

32. According to the *Global Innovation Index 2025*, Italy produces a level of innovative output that is more than proportional to the broad range of innovative inputs employed. For the definition of innovative inputs and outputs, see World Intellectual Property Organization, *Global Innovation Index 2025: Innovation at a Crossroads*, 2025.

33. Business expenditure is also highly concentrated: in 2023, 73% of this expenditure was incurred by large firms, while expenditure by small firms declined (Istat, Statistical Survey on Research and Development in Enterprises).

34. M. Andini, F. Bertolotti, L. Citino, F. D'Amuri, A. Linarello and G. Mattei, *Ricerca, innovazione e trasferimento tecnologico in* Italia, Banca d'Italia, Questioni di economia e finanza, 954, 2025.

35. There is no single definition of STEM disciplines. The definition used here is broad and includes agricultural and biological sciences, biochemistry, chemistry, energy, pharmacology, physics, genetics, geology, computer science, immunology, engineering, mathematics, medicine, microbiology, neuroscience, environmental sciences, materials science, decision sciences, nursing sciences and veterinary science.

36. High-quality publications are defined as those falling within the top decile of the citation distribution.

37. Over the same period, the share declined in the United States, to 17.2% from 34.1%, and increased substantially in China, to 35.8% from 7.8%.

38. Public expenditure on universities amounted to 0.6% of GDP, little more than half that of France and Germany.

research. Despite recent progress—the number of patent applications filed with the European Patent Office (EPO) by applicants resident in Italy increased by more than 20% between 2015 and 2024—the gap relative to the main European countries remains large: in 2024, the number of patent applications filed by applicants from Germany and France was respectively five and two times that of Italian applicants[39]. Patent activity is concentrated in traditional technological fields and is markedly underrepresented in digital and frontier technologies[40]. Within this framework, the public patenting component, which accounts for just under 9% of patent applications to the EPO, displays a relatively more favourable profile: patents held by universities and public research organisations are more specialised in certain frontier technologies, such as medical technologies and biotechnology. At the global level, university innovation activity tends to be concentrated in a small number of centres of excellence[41]; Italy has only one such centre, Politecnico di Milano, compared with 12 in Germany, 15 in France and 4 in the United Kingdom[42]. The lag in patenting also reflects low levels of expenditure on research and development, both public and, above all, private. In the business-financed component, the gap relative to other countries is also evident within individual productive sectors and for firms of the same size, reflecting a specialisation in medium- and low-technology production.

A further lag can be observed in measures aimed at promoting technology transfer. University Technology Transfer Offices (TTOs**)** are responsible for protecting and managing intellectual property, licensing and assigning patents, concluding research contracts with firms, and promoting start-ups and spin-offs, thereby facilitating the transfer of innovations generated in academia. Despite recent improvements[43], TTOs in Italian universities remain smaller than the European average: for an equivalent number of patent families managed, they employ approximately 20% fewer staff and generate lower revenues from patent licensing and assignment and from research contracts[44].

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39. As in other major European countries, in 2025 the number of patent applications filed by Italian applicants decreased (-2.0%), while applicants from China and South Korea recorded high growth rates. Italy ranked tenth globally in the European Patent Office (EPO) ranking, with a 2.4% share of total applications, well below Germany (12.1%) and France (5.4%). European Patent Office (EPO), *Technology Dashboard 2025*. See Banca d'Italia, *Annual Report 2025*, Chapter 6.

40. In addition to the quantitative and specialisation gap, there is also a qualitative gap: for patent applications filed by Italian applicants in 2014–2019, the average number of citations received five years after filing was approximately 3, compared with a global average of 8. The average economic value of patents was also lower. See F. Bertolotti, G.B. Carnevali, A. Linarello and M. Sartori, *Analisi della qualità dei brevetti italiani nel confronto internazionale*, Banca d'Italia, *Questioni di economia e finanza*, forthcoming.

41. A university centre of excellence in patenting activity is defined as a university that directly filed at least 250 patent applications between 2000 and 2020. A patent application is considered to have been filed directly when the university or research organisation is listed among the applicants; indirectly when the institution does not appear among the applicants but its affiliated researchers appear among the inventors. The latter case reflects "university-based" innovation, as it derives from research activities conducted in academia.

42. Moreover, between 2000 and 2020, the five leading Italian universities jointly recorded fewer patents than the leading French university.

43. The strong growth in their size over the last decade may partly reflect the effects of a specific call published in 2015 by the Ministry of Economic Development (now the Ministry of Enterprises and Made in Italy) and the Italian Patent and Trademark Office.

44. The 2023 Law No. 102, which abolished the so-called professor privilege and assigned ownership of the economic exploitation rights of inventions arising from publicly funded research projects to universities and public research organisations, with the aim of promoting their economic valorisation and technology transfer, could provide further impetus to TTO activities.

Universities are also involved in technology transfer through Competence Centres (CCs), public-private partnerships established in 2018 to promote the adoption of advanced technologies by small and medium-sized enterprises. They provide firms with laboratories, equipment, supercomputers and pilot production lines equipped with cutting-edge technologies to test and experiment with new technologies before proceeding to large-scale investment in their plants. They also provide training and guidance, assess firms' digital maturity, and assist them in applying for funding calls. Similar initiatives at European level differ significantly from Italian CCs in terms of greater specialisation, larger scale, more stable funding and greater availability of resources. By way of comparison, between 2019 and 2025, Italian CCs received total public funding of €186 million, whereas in 2023 alone public revenues amounted to €2.2 billion for Germany's Fraunhofer institutes and £320 million for the United Kingdom's Catapult centres.

Public Policies and the Innovative Capacity of the Productive System

The link between public research, technology transfer and firms' innovation is crucial for strengthening the productivity and competitiveness of the productive system[45]. Innovations based on scientific advances generate higher returns and tend to spread more readily among firms[46]. Universities and public research organisations play a particularly important role in this process, as they are relatively more specialised in the development of frontier technologies. In a context such as Italy's, characterised by a limited propensity of firms to invest in R&D and by patenting activity concentrated in mature technological sectors, support for firms' innovative activities and the production of public scientific knowledge—especially when accompanied by effective transfer mechanisms—constitute a decisive factor in strengthening private innovation, particularly in sectors with higher growth potential.

The analysis of public policies nevertheless reveals significant fragmentation and overlap both among instruments and across the responsibilities of different levels of government. For example, CCs operate within a diverse and extensive landscape of structures aimed at promoting the digital transformation of the productive fabric. Some overlap with one another—for example, the 88 *Punti Impresa Digitale* and 227 *Digital Innovation Hubs*—and often concern activities with limited innovative content; others, such as the European Digital Innovation Hubs established at European initiative, partly share activities and functions with CCs. The large number and overlap of such initiatives result in the dispersion of resources allocated to technology transfer and reduce their effectiveness.

Regional and local government interventions are also widespread, in the absence of close coordination between central and local levels[47]. Regions, in particular, have

45. See A. Gazzani, J. Martinez, F. Natoli and P. Surico, *Le origini pubbliche dell'innovazione negli Stati* Uniti, Banca d'Italia, *Temi di discussione*, no. 1521, 2026. The paper documents the central role of publicly funded innovation in productivity and economic growth in the United States.

46. See A. B. Jaffe, *Real Effects of Academic* Research, American Economic Review, vol. 79, no. 5, 1989; A. B. Jaffe, L. B. Shupp and V. Tartari, *Real Effects of Academic Research* Revisited, NBER Working Paper, no. 35017, 2026; F. Poege, D. Haroff, F. Gaessler and S. H. Baruffaldi, *Science quality and the value of* inventions, Science Advances, 5(12), 2019.

47. See the box *Public policies supporting research, technological development and innovation* in Chapter 6 of Banca d'Italia's *Annual Report 2025*.

broad regulatory autonomy in supporting research and innovation. At the end of 2025, there were more than 100 regional laws in force in this area, 44 intermediate bodies responsible for policy planning and implementation, 139 groupings of operators (firms, research centres and universities), identified by heterogeneous and not always clearly distinguishable labels such as technological districts, innovation poles, regional technology clusters and networks, 38 technology parks and 37 business incubators. This is a system whose complexity and fragmentation have increased over time.

Coordination between different levels of government is only partial and overlap among measures is extensive, including among innovation incentives aimed at firms: almost 10% of beneficiaries between 2019 and 2025 received both national and local funding, while approximately 15% received multiple grants from the same level of government.

BOX

The Impact of Recent Energy Shocks on Italian Firms[48]

Francesco D'Amuri, Rosalia Greco and Giacomo Caserta

Energy is a fundamental input in all productive sectors of the economy. In a context of intense global competition and a reshaping of world trade, energy costs affect a country's competitiveness over the long term. Recent energy shocks have represented an important test of the resilience of the Italian productive system. Following the price increases that began during the post-pandemic recovery, the sharp reduction in Russian supplies and the 2022 invasion of Ukraine led to a substantial increase in gas and electricity prices[49]. Prices subsequently declined from their 2022 peaks, but remain above pre-crisis levels. Volatility in energy markets has also remained high and exposure to geopolitical shocks has not disappeared[50], as illustrated by the recent tensions in the Strait of Hormuz[51].

Italy is particularly exposed to these shocks because of its dependence on imports of natural gas, which is used both as a direct input in production processes and for electricity generation[52]. In countries where natural gas meets a larger share of electricity

48. By Francesco D'Amuri, Rosalia Greco and Giacomo Caserta, Firms and Regional Analysis Division, Economic Structure Service, Economics and Statistics Department of the Bank of Italy.

49. In 2021, Russia was Italy's leading gas supplier, accounting for approximately 38% of imports; in 2022, Russian flows declined by 17.3 billion cubic metres, an amount equal to approximately one quarter of national gas supply. Supply sources were reconfigured through increased flows from other origins and higher imports of liquefied natural gas (LNG). See S. Emiliozzi, F. Ferriani and A. Gazzani, *The European energy crisis and the consequences for the global natural gas market*, Banca d'Italia, *Questioni di economia e finanza*, No. 824, 2023.

50. International Energy Agency, *What drives natural gas price volatility in Europe and beyond?*, IEA, Paris, 2025; International Energy Agency, *Gas Market Report, Q2-2026*, IEA, Paris, 2026.

51. In 2025, approximately one quarter of global seaborne trade in oil and petroleum products and around one fifth of global LNG trade passed through the Strait. See International Energy Agency, *Strait of Hormuz Factsheet*, February 2026. (https://www.iea.org/about/oil-security-and-emergency-response/strait-of-hormuz).

52. In Europe, wholesale electricity markets are organised through auctions in which the quantity to be produced and consumed is traded in 15-minute intervals and in which power plants participate on the supply side, each characterised by different production costs depending on the energy source and technology used. The link between gas and electricity derives from the marginal pricing mechanism of the electricity market: the electricity price is set by the most expensive

demand, prices are higher, and Italy is one of the European countries with the highest share of hours in which a gas-fired power plant is the marginal electricity producer[53]: in 2025, this occurred during at least 46% of hours[54]. Even before the crisis, electricity prices in Italy were higher than average prices in other major European countries, partly because of a greater tax burden[55].

The Effect on Costs and Profitability of Italian Firms

Higher energy prices were transmitted to firms' costs through a direct channel, linked to energy purchases, and an indirect channel, resulting from the energy content of intermediate goods. The impact was mitigated by three factors[56]. First, before the 2021–2022 crisis, the average share of energy expenditure was relatively low—around 5% on average among industrial firms with at least 50 employees, although considerably higher for a minority of firms and sectors. Second, during the initial phase of the crisis, the prices actually paid by firms increased less than wholesale quotations, partly as a result of fixed-price contracts and other hedging arrangements. Public measures also reduced the effective cost of energy borne by firms through generalised interventions on utility bills and more targeted instruments, including tax credits, which were particularly generous for electricity-intensive and gas-intensive firms[57].

The degree to which energy can be substituted with other inputs determines firms' ability to cope with large and unexpected increases in energy prices. Recent empirical evidence[58] shows that electricity demand by Italian industrial firms with at least 50 employees did not respond significantly to higher prices during 2021–2022, confirming the short-run rigidity of demand for this input. For gas, by contrast, a substantial reduction in consumption emerged only in the second half of 2022, in connection with a deterioration in firms' expectations about the duration of the shock[59]. High exposure to the shock does not necessarily coincide with a greater capacity to adjust. Gas-intensive firms, despite accounting for a very large share of industrial gas consumption, display

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plant among those called upon to meet demand, i.e. the marginal producer. When this plant is gas-fired, the electricity price therefore reflects the cost of gas and emission allowances under the European Union Emissions Trading System (EU ETS).

53. A. Gasparella, D. Koolen and A. Zucker, *The merit order and price-setting dynamics in European electricity markets. A 2022 and 2030 Investigation using METIS*, European Commission, Science for policy brief, 2023.

54. Banca d'Italia, *Annual Report 2025*, Chapter 14.

55. I. Faiella and A. Mistretta, *Spesa energetica e competitività delle imprese italiane*, Economia pubblica, vol. 2015/3, issue 3, pp. 85-121, 2015.

56. M. Alpino, L. Citino and A. Frigo, *The effects of the 2021 energy crisis on medium-sized and large industrial firms: evidence from Italy*, Banca d'Italia, Questioni di economia e finanza, no. 776, 2023.

57. For an analysis of the effects on fiscal costs and energy consumption of alternative measures to contain retail prices, see M. Alpino, L. Citino and A. Frigo, *Firms in the energy crisis: evidence from 2021–22*, mimeo, May 2026; for an analysis of the effects of measures in wholesale markets, see M. Alpino, E. Ciapanna, L. Citino and G. Rovigatti, *Navigating the electric storm: assessing policy responses to Europe's energy shock*, *The Electricity Journal*, vol. 38, issue 4, 2025.

58. M. Alpino, L. Citino and A. Frigo (2026), op. cit.

59. In that semester, the estimated elasticity of gas demand was approximately -1.1, whereas it remained close to zero in the two previous semesters. For an estimate of the price elasticity of gas demand for productive uses over longer time horizons, see S. Emiliozzi and F. Favero, *Le elasticità di prezzo settoriali della domanda di gas naturale*, Banca d'Italia, *Questioni di economia e finanza*, No. 941, 2025.

almost perfectly inelastic demand[60], partly because gas is difficult to substitute in their production processes.

During 2021–2022, higher energy prices are estimated to have increased production costs in Italian manufacturing by 4–5%, with a much larger impact in energy-intensive sectors, amounting to 9.5%, compared with approximately 3% in other manufacturing sectors as a result of the combined direct and indirect effects[61]. Firms passed a considerable share of the higher costs on to final prices. The pass-through to final prices was nevertheless incomplete: although to a lesser extent, firms also reduced their profit margins in 2022[62]. The effects on margins differed substantially between energy-intensive and other firms. The former passed almost the entire increase in their expenditure on intermediate goods between 2021 and 2022 through to final selling prices and also increased their profitability, partly as a result of the stronger public support they received. In 2023, as energy costs declined, the reduction in selling prices was smaller than the reduction in production costs. The margins of these firms therefore increased further, but quantities sold declined, reducing total profits, which nevertheless remained above pre-pandemic levels

The Impact on Productivity, Exports and Innovation

The short-term resilience of profit margins does not exhaust the potential effects of energy shocks. High and volatile energy prices may affect production, investment and innovation decisions, with consequences for productivity and competitiveness over the medium term. There is no specific evidence for Italy on these aspects. However, evidence concerning manufacturing and construction firms in a broad group of European countries indicates that the impact on productivity may differ in the short and medium term[63]. Energy price shocks reduce capacity utilisation and productivity in the short term. Over the medium term, they may potentially stimulate investment in energy-saving technologies and generate productivity gains. These gains are more likely among firms operating in low-energy-intensity sectors and in the case of relatively small shocks, whereas they tend not to materialise at all in the case of very large shocks. Severe energy price shocks may in fact not only constrain firms' ability to sustain investment because of the substantial increase in production costs caused by the shock, but may also reduce demand, making investment itself less profitable.

European evidence also points to adverse effects of unexpected increases in energy commodity prices on investment and exports. Energy shocks reduce firms' total fixed investment and the component more closely associated with innovation, such as R&D

60. The estimated elasticity of gas demand for these firms in the second half of 2022 was approximately -0.03, compared with -1.3 for other firms.

61. See the box *The impact of energy costs on the industrial sector* in Banca d'Italia's *Annual Report 2024*.

62. Analysis of firm-level balance-sheet and price data for 2016–2023 confirms that the average firm, when faced with higher input costs, applies incomplete pass-through and experiences a decline in margins; an exception is firms with at least 1,000 employees, which display greater ability to pass through cost increases and experience an increase in profit margins. See F. Parlapiano, *The pass-through of cost shocks to firms' prices and profits*, Banca d'Italia, *Temi di discussione*, No. 1501, 2025. On the impact of energy price increases and input supply difficulties on pricing and production strategies of Italian industrial firms since 2021, see also F. Corsello, M. Flaccadoro and S. Villa, *Il ruolo dell'energia e dei problemi di approvvigionamento di input nel settore industriale in Italia*, Banca d'Italia, *Questioni di economia e finanza*, No. 781, 2023.

63. C. André, H. Costa, L. Demmou and G. Franco, *Rising energy prices and productivity: short-run pain, long-term gain?*, OECD Economics Department Working Papers, no. 1755, 2023. The study covers manufacturing and construction firms in a broad group of European countries over the period 1995–2020.

expenditure; the effects are stronger for financially constrained firms and for those operating in energy-intensive sectors[64]. Recent shocks have also adversely affected euro-area exports, with limited aggregate effects but much more severe contractions in more energy-intensive sectors, such as basic metals and chemicals[65]. Exposure to high and volatile energy prices therefore represents an important factor affecting the competitiveness of the productive system.

According to a counterfactual exercise by Banca d'Italia, aligning the electricity prices paid by Italian firms with the European Union average would reduce manufacturing production costs by approximately 1%; aligning them with US levels would reduce them by more than 4%[66].

64. See the article *Energy shocks, corporate investment and potential implications for future EU competitiveness* in the *Economic Bulletin* of the European Central Bank, No. 8/2024. The study uses balance-sheet data for listed companies for the period 1999–2022 and approximates energy price shocks using oil-price shocks.

65. See the box *The energy shock, price competitiveness and euro area export performance* in the *Economic Bulletin* of the European Central Bank, No. 3/2023.

66. See Banca d'Italia, Annual Report 2025, Chapter 14.

CONCLUSIONS
MEASUREMENT, ALLOCATION AND INCENTIVES: WHY IMPROVEMENTS FAIL TO AGGREGATE[1]

A FINDING THAT RUNS THROUGH THE ENTIRE REPORT

The Report is structured as a progressive descent through different levels of analysis: Chapter 2 places Italy in a European comparison, Chapter 3 decomposes aggregate trends into the contributions of capital and efficiency, Chapter 4 disaggregates the analysis by geographical area, and Chapter 5 moves down to the firm level, with dedicated boxes on research and innovation. At the beginning of this descent, Chapter 1 sets out the methodological caveats and provides a guide to reading the Report as a whole. Each chapter draws on different sources and methods. Despite this diversity of analytical approaches, one finding runs through the entire volume: since the mid-1990s, Italian growth has been driven by the greater quantity of labour employed, rather than by increases in its productivity. Between 1995 and 2025, labour productivity grew by an average of 0.2 per cent per year, compared with 1.1 per cent in the EU27, while hours worked increased by 0.5 per cent, in line with the European average. The divergence became clear in the 2019–2025 period: GDP grew at an average annual rate of 1.0 per cent, faster than in Germany and France, but labour input increased by 1.3 per cent and labour productivity fell by 0.3 per cent. On average, during the period under consideration and according to the data examined, recent Italian growth has been entirely extensive in nature.

The evidence can be interpreted not as indicating an economic system that is failing to improve, but rather one that is struggling to combine improvements within a transition that remains largely incomplete: the shift from an export-led model based on wage restraint to a model driven by domestic demand, social inclusion and the endogenous productivity growth that these can generate. So far, the new model has taken shape through disconnected components on both the demand and supply sides. Employment growth has primarily involved the less-educated segments of the population, while the workforce's educational attainment has increased without translating sufficiently into skilled occupations. Capital has been reallocated towards intangible assets, but overall capital intensity has stagnated because capital accumulation has failed to keep pace with hours worked. In this context, firms are converging towards the technological frontier but are not reaching the scale needed to exploit intangible capital and economies of scale. At the

1. By Pasquale Lucio Scandizzo and Giovanni Tria, with contributions from Paola Bonacci and Nicola Rossi, members of the National Productivity Board and of the CNEL Panel of Experts.

same time, less-developed areas are catching up, with growth rates above the average, but still lack the endowments needed to make these gains sustainable. Meanwhile, increasingly large numbers of highly educated young people, whose education has required substantial public and family resources, are transferring their human capital abroad. In other words, Italy's problem is the limited capacity of a system in transition to turn improvements by individual actors and territories into aggregate growth. This failure to aggregate improvements, rather than misallocation in the abstract, is the thread connecting rising employment, lower capital intensity, higher educational attainment, smaller firm size, territorial disparities, distance from the technological frontier and youth emigration. The demand constraint discussed in the section "The Demand Constraint" offers one possible explanation.

The new estimates in the 2026 Public Finance Planning Document (*Documento programmatico di finanza pubblica*, DPFP) suggest that the diagnosis should remain open to revision. The National Productivity Board will need to assess how far the improvements identified alter Italy's relative position and which conditions could consolidate and spread them.

WHAT ARE WE MEASURING WHEN WE MEASURE PRODUCTIVITY?

Before interpreting the trends captured by the statistics, it is necessary to recall the premise underpinning Chapter 1's approach to the Report as a whole. Productivity is not a given quantity that can be directly observed and subsequently explained: it is a statistical construct whose interpretation requires particular caution in mature economies characterised by services, intangible assets and, now, artificial intelligence. Four caveats, corresponding to the methodological warnings set out in that chapter, deserve to be reiterated.

The first is that value added, the numerator in every productivity measure, incorporates prices and therefore market power. The second is that the conversion of current values into volume measures depends on deflation methods and thus on conventions concerning the quality and nature of output that remain largely unresolved in the services sector. The third is that intangible capital is only partly included in national accounts, leading simultaneously to an underestimation of capital input and an overestimation of the residual in the productivity measure once the contributions of labour and capital inputs have been deducted. The fourth is that this residual is interpreted as technical progress, even though it incorporates everything that has not been measured: total factor productivity (TFP) remains a residual variable, sensitive to measurement errors, omitted variables and cyclical factors, as the OECD itself has recently reiterated[2]. These caveats do not call into question the overall reliability of the indicators, but they do shape how they should be interpreted. A country that shifts employment from manufacturing, where output is observable and more readily deflated, towards services, where output is more difficult to measure, records a decline in productivity that

2. *OECD Compendium of Productivity Indicators 2026*, OECD Publishing, Paris, particularly Box 4.2, «Interpreting Multifactor Productivity: What it measures and what it misses».

partly reflects a change in what is being measured rather than a change in the system's efficiency[3].

These caveats are particularly relevant to the most recent years. Italian TFP fell by 1.5 per cent in 2024 and, according to preliminary estimates, by 0.5 per cent in 2025, following a prolonged period of positive changes. Between 1995 and 2025, the modest growth in labour productivity was entirely attributable to TFP, while capital intensity made no net contribution. This phenomenon affects many advanced economies: in 2024 alone, TFP made a negative contribution to growth in fourteen OECD countries. Sectoral disaggregation nevertheless reveals substantial heterogeneity. Positive changes were concentrated in information and communication services and in professional, scientific and technical activities, while manufacturing, trade and logistics recorded negative movements in the indicator.

The distinction between level and trend must also be reiterated. Italy's productivity level remains that of an advanced economy: measured in purchasing power parity terms, output per employed person is in line with the EU27 average, having long been above it, whereas output per hour worked remains below the levels recorded in France and Germany[4]. The issue with Italian productivity is therefore not so much a low level of output as the failure to increase it, which has progressively eroded a historical advantage. Confusing these two dimensions leads to an incorrect diagnosis—that Italy produces too little—and an equally misguided prescription, namely policies aimed at catching up rather than unlocking potential that has already been accumulated.

This distinction is crucial for the most recent period. The decline in productivity between 2023 and 2025 is partly the accounting counterpart of strong employment growth, which brought workers into activities with below-average productivity. Growth accounting makes the mechanism explicit. Under constant returns to scale, the change in average labour productivity is the sum of the change in TFP and the change in capital intensity, weighted by the elasticity of capital[5]. When hours worked grow faster than capital accumulation, average productivity declines even in the absence of any loss of efficiency. Similarly, when newly employed workers have lower average quality than those already in employment, and this difference is not accounted for separately, the residual also absorbs it as a negative contribution.

Employment growth that is not offset by capital accumulation and TFP is therefore

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3. Z. Griliches, *Productivity, R&D, and the Data Constraint*, American Economic Review, 84(1), 1994, pp. 1-23. On the measurement of output in services, see also the volume edited by the same author, *Output Measurement in the Service Sectors*, University of Chicago Press, 1992.

4. Eurostat, *Labour productivity and unit labour costs*: in purchasing power parity terms, Italy's GDP per employed person is now in line with the EU27 average, having long been above it. GDP per hour worked remains below the levels recorded in France and Germany, partly because the number of hours worked per employed person is higher in Italy. See also OECD, *Productivity Database* (GDP per hour worked in purchasing power parity terms).

5. With $Y = A \cdot K^{(1-\alpha)} \cdot L^{\alpha}$, in growth rates: $\Delta(Y/L)/(Y/L) = \Delta A/A + (1-\alpha) \cdot \Delta(K/L)/(K/L)$; labour quality, when not measured separately, is captured by $\Delta A/A$. The marginal product of labour is $\alpha \cdot (Y/L)$) and, under constant elasticity, follows the average product. Equality between the factor income share and the elasticity requires perfect competition and constant returns to scale: in the presence of markups, the capital share also incorporates pure profits, while the capitalization of intangible assets mechanically broadens its scope. For recent trends in factor income shares, see Istat's quarterly national accounts: the share of labour income in value added declined markedly in 2022–2023, followed by a partial recovery.

responsible for the decline, but in an arithmetical rather than an economic sense: its contribution to output is real and, net of the opportunity cost of employing labour, increases the social surplus. A fall in average productivity does not, in itself, measure inefficiency. The picture is further complicated by the capital share of value added, which approximates capital's elasticity in the decomposition. This share increased during the inflationary phase of 2022–2023 and has only partly receded since. Assigning greater weight to declining capital intensity amplifies the drag on average productivity, while the corresponding reduction in labour's elasticity means that marginal productivity—the benchmark towards which wages would tend to converge under competition—increases less than average productivity. If the capital share rises while accumulation stagnates, this may reflect rents or the inclusion of a greater amount of intangible assets within the accounting perimeter, rather than technological change. In that case, as discussed in the section "Relative Prices and Measured Productivity", the decomposition inherits some of the same distortion.

The redistribution of income away from labour is also consistent with the model based on wage restraint, whose exhaustion is discussed in the section "The Demand Constraint". Restoring balance is one of the indicators through which the transition can be monitored. The weak productivity trend is not caused by employment growth itself, but by the fact that this growth has not been accompanied by capital accumulation and innovation capable of increasing efficiency.

Alongside employment reaching record levels, Italy's next step must therefore concern capital accumulation and innovation. It is true that, as argued in the section "Why Does the System Reallocate Resources Poorly?", a supply of low-cost labour may delay this process.

A ratio between aggregate quantities cannot, on its own, distinguish these components. Decomposition is what makes interpretation possible, and this issue lies squarely within the debate on moving beyond GDP as the sole indicator: conventions about what counts as output distort both the measurement of income and that of productivity. Recognising this does not weaken growth accounting, which remains the most robust tool available; it defines the limits of its interpretation and justifies the multidimensional decomposition framework developed in the NPB Working Papers[6].

FIVE REGULARITIES

Starting from these considerations, the evidence presented in Chapters 2–5 can be organised into five regularities. They concern distinct subjects, but are not independent of one another.

The first concerns the relationship between the sectoral composition of value added and efficiency. Between 2007 and 2025, changes in the sectoral distribution of value added—a summary measure of the intensity of structural transformation—amounted

6. On the multidimensional decomposition of productivity and the classification of the critical literature into six measurement wedges, see CNEL Working Paper No. 3. On intangible capital, see C. Corrado, C. Hulten, D. Sichel, *Intangible Capital and U.S. Economic Growth*, *Review of Income and Wealth*, 55(3), 2009, pp. 661–685.

to 4.1 percentage points in Italy, compared with 5.3 in France, 6.4 in Germany and 8.6 in Spain. Looking instead at the sectoral distribution of employment, Italy recorded a much larger change, of approximately 7.3 percentage points. This reallocation moved in an unfavourable direction: between 2007 and 2024, manufacturing lost 3.3 percentage points of its share of employment, falling to 14.1 per cent, while growth was concentrated in low-productivity sectors. In other words, what is produced has changed little; who produces it, and where, has changed considerably. The contribution of sectoral reallocation to productivity growth was negative in Italy, virtually zero in Germany and positive in France and Spain.

Part of this finding is nevertheless accounting-related. It reflects the valuation at cost of non-market services and some market services, as well as the Baumol effect[7]. According to the estimates in the Working Paper No. 3, the portion of the gap that could be closed through actual resource shifts between sectors, net of these accounting effects, is more limited and, as discussed below, is not primarily located between sectors.

The second regularity concerns capital. The change in capital per hour worked made no overall contribution to labour productivity growth, declining by an average of 1.1 per cent per year over the 2014–2025 period. The aggregate figure conceals a significant change in the composition of capital itself: ICT capital grew by 2.6 per cent per year and non-ICT intangible capital by 2.2 per cent, while non-ICT tangible capital remained stagnant. This shift in composition does not, however, establish that the capital stock has been modernised sufficiently. It must be assessed against the international comparison, which shows Italy still lagging behind in intangible assets; the prolonged period of low investment has also probably reduced capital quality as assets have aged. The problem concerns both the quality and the quantity of accumulation: hours worked have grown faster than capital, whose overall stock has declined, while the most dynamic component of the capital stock is also the most difficult to measure.

The third regularity is the paradox of educational attainment. Between 2007 and 2025, the number of employed graduates increased by 2.6 million. At firm level, education is associated with higher productivity: a 1 per cent increase in the education indicator is associated with an increase of approximately 0.75 per cent in labour productivity, as well as a greater propensity to innovate and adopt digital technologies.

At aggregate level, however, the effect appears limited. The share of skilled occupations rose from one fifth to approximately one third of employment between 1992 and 2024, but has increased by only two percentage points since 2011. It remains well below the levels recorded in France and Germany, where it stands at around 43 per cent. Education has increased where employment has not grown, while employment has expanded where education is not required. This paradox also has an external dimension, documented in detail by the CNEL's 2025 *Report on Italy's Attractiveness to Young People from Advanced*

7. The Baumol effect refers to the tendency for relative prices to rise in sectors with low productivity growth, where wages follow those in more dynamic sectors. This leads to an expansion in their share of nominal output and dampens measured aggregate productivity growth: W. J. Baumol, *Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis*, *American Economic Review*, 57(3), 1967, pp. 415–426. For an estimate of the component of the sectoral allocation gap that can effectively be eliminated, net of these accounting effects, see CNEL Working Paper No. 3, cited above.

Economies and its report on young Italians living abroad[8]. Between 2011 and 2024, a net 441,000 young people aged 18–34 emigrated, after accounting for return migration. Graduates accounted for 40 per cent of those emigrating—twice their share among their peers living in Italy—with a broadly balanced gender composition and young female graduates at the forefront of outflows. The value of the human capital lost, estimated on the basis of public education expenditure and family care costs, amounted to approximately €16 billion per year over the most recent three-year period. The exchange with other advanced economies is radically asymmetric: for every ten young Italians who move there, only one young person comes to Italy. A system whose productive structure generates little demand for skilled labour does not merely underuse the skills it develops; it exports them, to the benefit of competing economies.

The fourth regularity, the most significant for interpreting overall productivity trends, is microeconomic convergence without aggregation. Holding structural characteristics constant, firms initially further from their sectoral frontier record higher average productivity growth rates: catch-up exists and can be measured. Firms moving into a higher size class, however, display systematically stronger growth, less dependent on their initial gap, but such transitions involve a very small share of firms. The same pattern can be observed at the innovation frontier. The European Commission considers the number and quality of Italian start-ups satisfactory, yet the ecosystem generates only a modest economic impact, with few scale-ups and clear bottlenecks in the growth process[9]. In other words, some firms improve but neither have nor acquire the weight needed for their improvements to matter for the country as a whole.

The fifth regularity concerns territories and takes the form of apparent convergence. During the 2019–2024 five-year period, differences in GDP per capita growth rates between Italy's macro-regions narrowed, but the underlying drivers remain fundamentally different. Lombardy's growth is productivity-led, whereas growth in Sicily and Apulia is driven almost entirely by employment. Growth-rate decomposition shows that the dynamics of each macro-region are attributable almost entirely to growth within individual regions, and only marginally to shifts in the relative weight of regions. Similar aggregate results conceal underlying trajectories that are not comparable, nor are the conditions for their sustainability, although, as the box on territorial disparities cautions, the findings may change when a longer period is considered.

RELATIVE PRICES AND MEASURED PRODUCTIVITY

Part of measured productivity reflects differences in relative prices rather than differences in the quantities produced alone. In international comparisons, the Balassa–Samuel-

8. CNEL, *L'attrattività dell'Italia per i giovani dei Paesi avanzati*, Report 2025 and CNEL, *Giovani Expat. Come farli tornare*, Report 2026. The Reports estimate the value of the human capital lost through emigration between 2011 and 2024 at €159.5 billion and introduce the Migration Flow Symmetry Index (ISFM). For Italy, the Index indicates that ten young people emigrate to advanced European countries for every young person arriving from those same countries.

9. European Commission, European Innovation Council and SMEs Executive Agency, European Startup and Scaleup Scoreboard, Report for Italy 2026, Publications Office of the European Union, 2026.

son effect links higher relative prices for non-tradable services to higher productivity in sectors exposed to competition. As a result, productivity comparisons in services may be affected by price differences that do not reflect efficiency, although this relationship is not automatic[10]. In territorial comparisons, national accounts apply sectoral deflators that are broadly national, based on the unverified assumption that prices are uniform across the country. Experimental estimates available, as well as Istat's own surveys of consumer price levels, instead indicate significant regional price differences. Consequently, a portion of the North–South productivity gap measured in real terms—which cannot be quantified using current statistics—reflects differences in relative prices rather than quantities[11]. Finally, when comparing manufacturing and services, deflators for sectors exposed to international competition incorporate quality improvements and price reductions that remain invisible in protected services, where prices are often constructed from costs. The shift of employment towards services therefore increases the weight of the part of the economy in which efficiency gains are more difficult to detect.

This group of issues also includes divergences between prices and marginal costs, whatever their origin. When such divergences arise from market power, measured productivity incorporates a rent component[12]; when they arise from taxes, subsidies and regulation, the same measure incorporates the structure of public intervention[13]. In the literature on resource allocation, the two distortions are formally equivalent: gaps between prices and costs distort measured productivity even when technology is unchanged. None of these phenomena eliminates the North–South or manufacturing–services productivity gaps, which remain large and persistent under every measure. All of them, however, affect how those gaps should be interpreted.

WHY DOES THE SYSTEM REALLOCATE RESOURCES POORLY?

The regularities described above rule out some explanations for Italy's weak productivity performance and lend support to others. The hypothesis of generalised technological backwardness is not fully borne out, nor is that of widespread competitive fragility. ICT and intangible capital have been growing for thirty years; goods exports have kept pace with those of France and Germany despite severe shocks; and specialisation is shifting towards high-technology products. Significant gaps nevertheless remain in innovation

10. B. Balassa, *The Purchasing-Power Parity Doctrine: A Reappraisal*, Journal of Political Economy, 72(6), 1964, pp. 584-596; P. A. Samuelson, *Theoretical Notes on Trade Problems*, Review of Economics and Statistics, 46(2), 1964, pp. 145-154.

11. Istat, *Indici spaziali dei prezzi al consumo*, experimental statistics, 2023 and 2024 editions (2021 data), which identify regional price differences of up to approximately 15 percentage points, with northern regions being more expensive on average; L. Cannari, G. Iuzzolino, *Le differenze nei livelli dei prezzi al consumo tra Nord e Sud*, *Questioni di Economia e Finanza*, No. 49, Banca d'Italia, 2009. These purchasing power parities refer to consumption, not to value-added prices. Their application to productivity measures is therefore indicative and is more robust for services that are not exposed to competition across territorial boundaries.

12. J. De Loecker, J. Eeckhout, G. Unger, *The Rise of Market Power and the Macroeconomic Implications*, Quarterly Journal of Economics, 135(2), 2020, pp. 561-644.

13. Value added at basic prices includes subsidies on products and excludes taxes on products; measured productivity in subsidized sectors is therefore directly increased. On the formal equivalence between market power and idiosyncratic tax wedges in explaining productivity dispersion across firms, see Hsieh and Klenow, cited above.

inputs and outputs—from research expenditure to patents—which are concentrated in traditional sectors, as well as in the diffusion of new technologies, beginning with artificial intelligence.

What emerges is a system in which productive factors are available and progressively improving, but are combined within firms and contexts that prevent them from expressing their full potential[14]. The quantitatively decisive dispersion is not between sectors, but between firms within the same sector. This is not an academic distinction: if the former were the case, policies would need to restructure the sectoral composition of the economy; in the latter case, what is needed is policies supporting the selection and growth of firms and the exit of others from the market.

To say that the system allocates resources poorly is, however, a statement of fact, not an explanation. An explanation requires treating the productive structure for what it is: the equilibrium outcome of a complex socioeconomic system, the incentives and disincentives it generates endogenously, and those arising from the external forces to which it is exposed. This is a dynamic equilibrium characterised by an insufficient capacity for self-generation, understood as the ability to create internally the conditions for its own expansion: demand justifies scale; scale makes innovation profitable; innovation, in turn, supports incomes and skills. The available evidence makes it possible to identify where this virtuous chain breaks down. Firms do not remain small solely because of preferences or historically determined constraints. The costs of growing include tax, social security, regulatory and reporting thresholds, while the benefits are uncertain and deferred. A system that taxes the transition to a larger size class but not the decision to remain unchanged will, in equilibrium, produce the distribution we observe. Skills are not underused by chance either. A productive system dominated by small, family-controlled firms with limited internal management functions generates structurally less demand for graduates than the available supply. The low wage premium for education, together with the widespread underemployment of people with higher qualifications, is both a symptom of this deficient demand and a documented driver of skilled emigration[15]. Investment does not slow down spontaneously. A predominantly bank-based financial system that assesses creditworthiness on the basis of tangible collateral struggles to finance intangible assets whose value is specific to each firm. Meanwhile, intermediaries specialising in risk capital remain too small and insufficiently equipped to support the growth of innovative firms.

The same weakness is reflected in research, as documented in Chapter 5 and the box on research and innovation. R&D expenditure stands at approximately 1.4 per cent of GDP, with private expenditure amounting to half the European average. It is concentrated in larger firms and predominantly traditional fields, while patenting activity struggles

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14. C.-T. Hsieh, P. J. Klenow, *Misallocation and Manufacturing TFP in China and India*, Quarterly Journal of Economics, 124(4), 2009, pp. 1403-1448; G. S. Olley, A. Pakes, *The Dynamics of Productivity in the Telecommunications Equipment Industry*, Econometrica, 64(6), 1996, pp. 1263-1297. On the greater importance, in Italy, of productivity dispersion among firms within the same sector compared with dispersion across sectors, see CNEL Working Paper No. 3, cited above.

15. CNEL, *Giovani Expat. Come farli tornare*, cited above. The CNEL survey of young people who have emigrated identifies working conditions, wage levels and a lack of meritocracy among the main reasons for leaving the country. The low wage premium for graduates and the underutilization of educational qualifications are attributed to weak demand for highly educated workers on the part of the productive system. An issue already highlighted in the 2025 CNEL Report on *Italy's Attractiveness to Young People from Advanced Economies*.

to translate the recognised quality of basic research into applications, confining it to niches too narrow to have a macroeconomic impact[16].

The evidence on incentives provides a further element, perhaps the most direct empirical confirmation of the argument advanced in these conclusions. Evaluations of the Transition 4.0 Plan document positive effects on investment and employment, but no significant increase in productivity in the absence of complementary investment in human capital, organisation and innovation. They also show that firms using incentives are those already more inclined to invest, while most manufacturing firms that invested in digitalisation did not use any public incentive[17]. Public support can encourage and accelerate a propensity to innovate, but it cannot create that propensity on its own. Instruments that address effects while leaving causes unchanged generate local improvements that fail to add up at aggregate level.

Finally, there is the question of selection. The mechanism through which productive systems aggregate improvements by individual actors is the reallocation of market shares towards more efficient firms and the exit of less efficient ones. Where exit costs—economic, but also personal and social costs for entrepreneurs—are high, insolvency and restructuring procedures are lengthy, access to public contracts is not sufficiently sensitive to productivity, and public support is distributed in proportion to the existing structure, this mechanism operates only weakly. The microeconomic convergence towards higher productivity documented in Chapter 5, without corresponding system-wide aggregation, is consistent with a selection mechanism that, although it contributed positively to productivity until recent years, has not been strong enough to offset other weaknesses.

This also explains why TFP, understood as proposed in Working Paper No. 3—as a measure of overall allocative efficiency rather than as a residual arising from our ignorance—is the appropriate summary variable for the phenomenon described here.

One final mechanism connects this explanation to the Report's main finding: a relatively low-cost supply of labour reduces the return on replacing labour with capital and on organisational innovation. Recent extensive growth is therefore not merely an observed outcome; it is itself an equilibrium generated by incentives, in which the relative cost-effectiveness of labour simultaneously depresses capital deepening, skills upgrading, organisational redesign, firm growth and competitive pressure on less efficient firms. From this perspective, wage dynamics are not merely a consequence of productivity, but one of its determinants. The relationship operates in both directions, from low productivity to low wages and vice versa. Substitution between capital and labour also depends on technological elasticity, demand and the financing conditions for capital accumulation.

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16. For an examination of issues relating to research, technology transfer and innovation, see M. Andini, F. Bertolotti, L. Citino, F. D'Amuri, A. Linarello and G. Mattei, *Research, Innovation and Technology Transfer in Italy*, Questioni di Economia e Finanza (Occasional Papers), No. 954, July 2025.

17. See the in-depth analysis of Industry 4.0 tax incentives and capital intensity in manufacturing firms accompanying this Report. For an analysis of the effects of these incentives, see also: Bank of Italy and Ministry of Economy and Finance, in collaboration with the Ministry of Enterprises and Made in Italy, *Transition Plan 4.0: An Assessment of the Effects on Investment, Employment and Productivity*, May 2026.

THE DEMAND CONSTRAINT

The analysis so far has focused on the supply side, whose weaknesses remain the foundation of the diagnosis. What follows is an interpretative hypothesis that goes beyond the findings of the individual chapters and should be read as such. The results nevertheless suggest that demand plays an important role in stimulating productivity. If skills are improving, intangible capital is accumulating, specialisation is shifting and firms are catching up with the frontier, yet none of these developments is visible at aggregate level, then either the aggregation mechanism is broken, as argued in the previous section, or the economic environment does not reward aggregation. The two hypotheses are not mutually exclusive: an incentive structure is defined in relation to expected demand and has no meaning independently of it. The main candidate for explaining the insufficient growth of total demand in the Italian economy is the export-led growth model[18]. Within a monetary union, competitiveness cannot be adjusted through the nominal exchange rate and must therefore be adjusted through costs and, ultimately, wages. Competitive devaluation through wage restraint generates a trade surplus by compressing real income, which would otherwise support domestic demand. In this sense, the effect is a reversal of the Balassa mechanism. Under the original mechanism, competitiveness based on productivity growth in sectors exposed to international competition is compatible with rising real wages and expanding domestic demand. In Italy's case, however, the improvement in the external position occurred without corresponding growth in real incomes. The same improvement in the balance was achieved through income compression, which affects exports by increasing cost competitiveness and imports by reducing domestic absorption. The latter reduction pushes firms to seek abroad the demand necessary for their survival and, potentially, their growth.

Moreover, since exports are less responsive to changes in labour costs and much more responsive to non-price competitiveness—as recorded in the literature through Kaldor's paradox[19]—wage restraint contributes relatively little to improving the external accounts while weighing heavily on domestic growth. The strength of this effect depends, however, on the elasticity of exports to labour costs, which varies across sectors and countries and would require a specific estimate.

The key hypothesis is that insufficient domestic demand does not merely reduce output growth: it also reduces productivity growth. The relationship between output growth and labour productivity growth, first established using Italian and European data and subsequently incorporated into models of cumulative causation[20], implies that market expansion itself generates efficiency through economies of scale, learning and a deeper

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18. L. Baccaro, J. Pontusson, *Rethinking Comparative Political Economy: The Growth Model Perspective*, Politics and Society, 44(2), 2016, pp. 175-207.

19. S. Storm, C. W. M. Naastepad, Crisis and Recovery in the German Economy: The Real Lessons, Structural Change and Economic Dynamics, 32, 2015, pp. 11-24.

20. A. Young, *Increasing Returns and Economic Progress*, Economic Journal, 38(152), 1928, pp. 527-542; P. J. Verdoorn, *Fattori che regolano lo sviluppo della produttività del lavoro*, L'Industria, 1, 1949, pp. 45-53; N. Kaldor, *Causes of the Slow Rate of Economic Growth of the United Kingdom*, Cambridge University Press, Cambridge, 1966. For the formalization of innovation-driven endogenous growth, see P. Aghion, P. Howitt, *A Model of Growth through Creative Destruction, Econometrica*, 60(2), 1992, pp. 323-351.

division of labour. If the division of labour is constrained by the size of the market, firms will not move into larger size classes when expected demand does not justify the fixed costs associated with that transition. The first casualty of this mechanism is precisely intangible investment, which entails high fixed costs and increasing returns to scale. The literature on hysteresis has shown that demand shocks have permanent effects on the level of output and, where learning and investment are endogenous, on its growth rate as well[21]. One final piece is needed to complete the puzzle. A persistent current account surplus is, by accounting identity, an excess of national saving over domestic investment; this, in turn, translates into a net acquisition of foreign assets. Such acquisitions finance growth elsewhere and therefore help explain Italy's weaker relative performance[22]. The same causal mechanism can be identified, with the necessary qualifications, in youth emigration. A system that fails to reward skills—because it compresses wages and favours small firm size—exports not only its savings but also its human capital, that is, both the demand and the supply underpinning its own future.

This argument should be presented for what it is: an interpretative hypothesis, not an established analytical result. The Report can nevertheless support a more limited claim, which is robust precisely because of its narrower scope: insufficient demand and inadequate allocation are not competing explanations, but two sides of the same mechanism. Weak domestic demand perpetuates fragmentation, while a fragmented productive structure generates incomes that are too low to sustain domestic demand. This circularity is not a flaw in the argument; it is the issue to be investigated and the reason why thirty years of interventions targeting only one side of the cycle have failed to change the outcome.

The circularity also points to a way out and underpins the interpretation of Italian productivity dynamics introduced at the beginning of these Conclusions. The model showing signs of strain is export-led growth based on cost compression: it generated an external surplus at the expense of weak domestic demand, while Kaldor's paradox shows it to be ineffective even on its own terms, since market shares respond more to quality than to costs. The model towards which the system could move, and of which only partial signs are visible so far, is one of endogenous growth in the precise sense given to the term by Verdoorn's relationship: growth in which domestic demand and productivity reinforce one another through market expansion, economies of scale and learning, rather than depending on foreign demand secured by compressing incomes.

The extensive growth of recent years could itself represent the first phase of a transition towards this new regime: growth beginning to draw support from domestic demand through employment expansion, which has achieved greater inclusion but has not yet activated the productivity cycle. It must nevertheless be recognised that fiscal stimulus has supported growth in recent years, particularly in construction and services. Part of the recent expansion may therefore reflect this stimulus rather than the beginning of a structural transition. Completing the transition means precisely turning demand for quantity

21. V. Cerra, A. Fatas, S. C. Saxena, *Hysteresis and Business Cycles*, Journal of Economic Literature, 61(1), 2023, pp. 181-225; O. J. Blanchard, L. H. Summers, *Hysteresis and the European Unemployment Problem*, NBER Macroeconomics Annual, 1, 1986, pp. 15-78.

22. A. P. Thirlwall, The Balance of Payments Constraint as an Explanation of International Growth Rate Differences, Banca Nazionale del Lavoro Quarterly Review, 32(128), 1979, pp. 45-53.

into demand for quality, capable of justifying changes in firm size, intangible investment and the absorption of skills that are currently emigrating. This does not mean sustaining demand through deficits or imposing exogenous wage increases. It means fostering wages that grow in line with productivity, public demand that creates markets for innovation, and higher domestic investment that reduces the external surplus. The enabling condition is European. Within a monetary union, internal devaluation is the integration strategy of an economy competing on costs. An alternative is integration through capital markets, the quality of production and common public goods. From this perspective, the Capital Markets Union and the revival of domestic investment are not merely financial measures: they are the mechanism through which higher domestic accumulation can absorb the external surplus that currently finances investment elsewhere.

ARTIFICIAL INTELLIGENCE BETWEEN *CAPABILITY* AND *CAPACITY*

One further factor must be considered, as it will change both what is measured and the conventions used to measure it in the coming years. Treating artificial intelligence as a new component of intangible capital, alongside software and databases, is correct but insufficient. General-purpose technologies have been defined in the literature by the breadth of their applications, their capacity to improve over time and their complementarity with downstream innovation[23]: It is useful to articulate this characteristic by distinguishing two concepts that are often conflated in everyday usage. *Capacity* refers to the quantity of productive services installed and available—that is, the stock as understood in capital accounting. *Capability*, by contrast, refers to the set of tasks that a factor is able to perform, or the breadth of its field of application[24]. In all previous technologies, the expansion of capability was a slow process, external to the factor itself and mediated by research and organisational learning. The distinctive feature of artificial intelligence is its ability to convert capability into capacity through self-learning, over short periods and at declining marginal cost. The factor is partially autonomous from the complementary investments that condition its returns. This autonomy justifies treating it as a distinct factor of production, as proposed in the series of NPB Working Papers.

Three consequences follow for future editions of the Report. The first concerns productivity measurement. A factor that can expand autonomously, and whose services are largely supplied at prices that do not reflect their use value and are declining, generates a surplus that current accounting conventions do not record. This creates a measurement lag similar to that observed during the spread of information technology, but potentially on a larger scale. The second concerns allocation. Complementarity with skills and organisational scale means that the returns on adopting artificial intelligence increase with firm size and the level of human capital. Unless corrective measures are introduced, the technology will therefore amplify the differences already documented between firms and

23. T. F. Bresnahan, M. Trajtenberg, *General Purpose Technologies: Engines of Growth?*, Journal of Econometrics, 65(1), 1995, pp. 83-108.

24. The term *capability* is used here in its technological sense, referring to the set of tasks that a factor is able to perform, rather than in the distinct sense adopted in the human development literature.

territories. The initial data confirm this risk: the share of firms with at least ten employees using AI doubled in 2025, rising from 8.2 to 16.4 per cent, although it remained below the European average. Growing territorial disparities accompany the gap between small and medium-sized enterprises, around 16 per cent of which use AI, and large firms, among which adoption exceeds 53 per cent[25]. An AI divide thus risks being superimposed on a digital divide that has yet to be overcome, with direct effects on productivity differences between firms and territories. The third consequence concerns the nature of the good itself. The non-rival nature of AI models and the fact that access to them can be only partially restricted make them an imperfect public good. As a result, decentralised market equilibrium does not guarantee either a socially efficient level of investment or a distribution of benefits consistent with their collective origins.

IMPLICATIONS

The evidence and arguments presented in the Report do not translate into a list of specific measures. They do, however, make it possible to set out a number of guiding principles for policy design. These principles follow directly from the findings rather than from external assumptions.

The first principle is that a policy aimed at aggregate productivity must, above all, address the incentives that shape the productive structure. If the distribution of firms by size, the composition of capital and the use of skills are outcomes of these incentives rather than exogenous givens, instruments that address the effects while leaving the causes unchanged will produce local improvements that fail to aggregate. This is the generalisable lesson of the evaluations of the Industry 4.0 incentives. The operational priority is to remove discontinuities that make it costly for firms to move into a larger size class and to strengthen selection mechanisms. This means facilitating orderly market exit, directing public support selectively towards the quality and growth potential of business initiatives, and providing the instruments—including risk capital—needed for innovative start-ups to become scale-ups.

The second principle is that human capital must be addressed from the demand side as well as the supply side. Italy has significantly increased skilled employment without a corresponding expansion in the productive functions that make use of those skills. The most extreme consequence of this gap is the emigration of people who find such opportunities elsewhere. The appropriate policy response therefore cannot consist solely of further expanding educational provision, although this remains necessary given Italy's delays in educational attainment. It must also stimulate demand for the skills associated with higher education by acting on firm size, specialisation, ownership and management structures, remuneration and the recognition of merit, with specific attention to gender equality. Young female graduates face a double disadvantage and emigrate in greater numbers than any other group. Willingness to return is nevertheless widespread: almost two thirds of young Italians living abroad do not rule out returning, provided that better

25. Istat, Imprese e ICT, Statistiche Report, 15 December 2025; Eurostat, Use of artificial intelligence in enterprises.

opportunities materialise. Policies to attract talent and encourage return migration are therefore, in their own right, productivity policies.

The third principle is that territorial policies should be differentiated according to growth trajectories, not simply according to the size of the gap. A territory whose growth is driven by employment and one whose growth is driven by productivity may record similar aggregate rates while requiring opposite interventions. The sustainability of the former trajectory is intrinsically limited in a context of a declining working-age population. The warning set out in the section "Relative Prices and Measured Productivity" also applies: since prices are lower in southern Italy, part of the productivity gap measured in value terms reflects price differences rather than efficiency differences, and this should be taken into account when determining the scale of interventions.

The fourth principle follows from demographic arithmetic. If hours worked cannot continue to grow faster than output, and declining birth rates—compounded by youth emigration—make this outcome inevitable within a foreseeable time horizon, the extensive growth model of recent years is unsustainable. A return to positive growth in capital intensity, together with a recovery in TFP, from which it cannot be separated, is therefore not one option among many. It is a necessary condition for preventing growth in output per capita from coming to a halt. This also requires action on the relative cost-effectiveness of production factors and, consequently, on the relationship between wages, prices and productivity.

The fifth principle is that productivity policy cannot be designed entirely from the supply side. If the expected size of the market helps determine firm growth, intangible investment and the absorption of skilled labour, then the composition and stability of demand are full-fledged productivity policy variables, not merely background conditions. These include the direction of public demand, which can create markets for innovation and serve as a selection mechanism as well as a means of support; the evolution of real incomes; and the level of domestic investment. None of these elements replaces supply-side interventions. The argument is that, when isolated from them, such interventions have produced—and will continue to produce—improvements that fail to aggregate.

The sixth principle concerns the innovation ecosystem. Strengthening public research and technology transfer, bringing the many initiatives connecting universities, research institutions and the productive system within a coherent regulatory framework, and integrating them with European competitiveness and capital-market instruments offer a way to turn Italy's recognised pockets of research excellence into widespread productive capacity. The aim is to reduce, rather than amplify, the disparities between firms and territories that new technologies tend to accentuate.

The seventh principle concerns the measurement of changes in productivity itself. Completing the framework for decomposing productivity dynamics, estimating mark-ups, developing more informative territorial and sectoral deflators, extending social accounting to externalities and natural capital, and assessing productivity in terms of well-being[26] are not merely technical refinements. They are conditions for ensuring that public debate is based on interpretable measures. A country that measures its produc-

26. S. Basu, L. Pascali, F. Schiantarelli, L. Serven, *Productivity and the Welfare of Nations*, American Economic Review, 112(4), 2022.

tivity using a method unable to distinguish between losses of efficiency, expansion of the employment base, shifts in sectoral composition and changes in relative prices is exposed to systematically distorted diagnoses, which in turn lead to poorly targeted policies. These adjustments do not explain why nominal output per hour worked has grown less in Italy than in other countries, but they are necessary to interpret the components of that difference.

THE ITALIAN PRODUCTIVITY PUZZLE

The Italian productivity puzzle is not the absence of improvements. The Report documents many of them, across every dimension examined: workforce education, the stock of intangible capital, export specialisation, firms' convergence towards their sectoral frontier, and the capacity to recover from successive and severe shocks. The puzzle is that these improvements do not combine[27]. Combining improvements means two things: first, that the units making progress gain weight, through their own growth and the exit of other units from the market; and second, that improvements interact through complementarities that make the whole greater than the sum of its parts. In Italy, the first condition is missing, and the second consequently fails as well. The clearest sign of this failure is that the people embodying these improvements—particularly highly educated young people—increasingly choose to put their skills to use elsewhere.

As far as the available evidence allows us to argue, the failure to combine improvements stems not only from insufficient resources, which are indeed lacking in human capital, research and innovative investment, but also from the incentives and mechanisms through which those resources are combined and selected. Among these mechanisms, the section "The Demand Constraint" identified demand—the factor that gives resources a destination—as the most neglected. This conclusion returns the productivity problem to its proper setting: not the technological frontier, but economic organisation. It also explains why thirty years of supply-focused policies have produced measurable results among the individual beneficiaries without generating any appreciable results at system level. It also explains why pessimism is unwarranted. The productive factors are there, firms that improve are there, and the young people who have emigrated, in most cases, do not rule out returning if better opportunities become available. What is missing is not the raw material for growth, but the mechanism that enables it to be fully harnessed.

Finally, this explains why measurement is not merely a preliminary issue but already part of the solution. If productivity is both an indicator of efficiency and the product of the conventions, prices and institutions through which it is measured, improving its measurement means making observable the coordination mechanisms that determine its level. This is the programme set out by the Working Papers issued by the Italian NPB and systematically linked in this Report to an empirical framework. The task for the coming years is to complete it.

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27. P. L. Scandizzo, P. Bonacci, *Productivity in Complex Systems*, CNEL Working Paper No. 2, 2026.

BEYOND THE REPORT

The body of information on which the Report is based reflects the current state of knowledge on productivity and constitutes an essential reference point for comparative productivity analysis. The Report's task, however, is not only to take stock of the state of the art, but also to identify its limitations and lay the groundwork for overcoming them. In some cases, these limitations arise from genuine information gaps; in others, they take the form of equally significant shortcomings in interpretation.

Neither type of limitation fundamentally undermines the conceptual framework underlying the productivity measures examined in the Report. Rather, they point to the need to adapt its application, information base and measurement conventions to the transformations that have taken place in the economic system. The framework combines internal consistency with considerable flexibility. It can accommodate many of the extraordinary changes that have occurred since the second half of the twentieth century, either by measuring inputs differently or by extending the basic framework to market structures other than perfect competition. The fact that the most authoritative explanations of the so-called productivity puzzle operate within this framework, rather than challenging it, is evidence of its resilience. In other words, the information gaps and interpretative shortcomings discussed below reflect not so much a limitation of the underlying conceptual framework as the difficulty of fully exploiting its potential.

One of the information gaps concerns business births and deaths, and in particular the availability of comparable cross-country data on net business birth rates—calculated after deducting death rates—and on so-called business churn rates, defined as the sum of business birth and death rates. The former indicate the expansion of each country's productive base, while the latter provide a highly imperfect indicator of the continuous process of market entry and exit through which the dynamism of market economies manifests itself to a greater or lesser extent.

In this respect, the available information falls well short of what would be needed to make reliable assessments of trends that can reasonably be evaluated only over the medium to long term. Business birth and death rates also present three limitations. The time series are short, beginning, at best, in the early 2000s. They contain breaks that reduce comparability over time, the most recent of which occurred in 2021. Finally, in some countries the data are so incomplete that their reliability is questionable.

Drawing conclusions about the prospects of Italy's productive system or its capacity for renewal through innovation on the basis of the three-year period 2021–2023—the latest period available on a consistent basis—would not only be premature but potentially hazardous. It is certainly worth noting that, during those three years, Italy recorded net business birth rates below those of 21 of the 30 OECD countries for which data are available, including France but not Germany or Spain[28]. It is equally clear that Italy's business churn rate over the same period was below that of 16 of the 30 OECD countries

28. For net birth rates, the robustness check for 2008–2020, prior to the break in the series in 2021, conducted for the 22 OECD countries with comparable data (out of the 27 for which data are available), confirms the findings for the 2021–2023 period.

for which the necessary information is available, including Germany but not France or Spain[29]. These findings, however, do not justify going beyond the general—and, frankly, unsurprising—conclusion that Italy's productive system displays limited dynamism.

Overcoming the limitations of the partial and fragmented information currently available on business demography must therefore be one of the objectives of future editions of the Report.

Among the analytical shortcomings, the most significant concerns the often exclusive emphasis placed on labour productivity, the only productivity measure available, for example, in territorial analyses. Since labour productivity depends on capital intensity—a factor subject to diminishing returns—it cannot, particularly over the medium and long term, be interpreted separately from the contributions of capital accumulation and TFP. Under the standard framework of growth accounting, once the effects of accumulating factors subject to diminishing returns have been exhausted, TFP dynamics are what sustain lasting productivity growth.

As Peter Howitt, winner of the 2025 Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel, has observed, "the only thing that theory would seem to have to explain is the so-called Solow residual" (or TFP). In many cases, including perhaps most notably territorial analysis, this analytical shortcoming originates in a significant information gap. At territorial level, the information required to estimate TFP, even on a conventional basis, is not available. Overcoming this gap must therefore be another objective of future editions of the Report.

Last but not least, there is a tendency to treat certain structural features of the Italian economy—such as firm size or sectoral location—as the key to interpreting productivity trends, whatever measure of productivity is used, particularly in comparative analysis. Treating these structural characteristics as exogenously given also reflects a tendency to interpret them as an expression of business preferences rather than as the outcome of the incentive structure and the set of constraints, of varying nature and force, to which business decisions must adapt. This is perhaps more evident in Italy than in other countries.

That structure of incentives and constraints is itself, among other historical causes, an expression of a deep-rooted distrust of business, firm growth and competitive mechanisms within part of Italian society. The economic-policy implications of these two perspectives are clearly different. It is therefore necessary not only to clarify the actual meaning of correlations that appear obvious but are not necessarily so, but also—and above all—to move beyond such correlations and identify the origins of structural characteristics that remain structural only for as long as their economic, institutional and cultural foundations are not called into question.

Here too, future editions of the Report will need to go beyond the information currently available, providing increasingly robust and well-documented answers to the questions that this edition has helped bring into focus and for which it has already offered initial evidence and interpretative hypotheses.

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29. For the churning rate, the robustness check for 2008–2020, prior to the break in the series in 2021, also confirms the findings for the 2021–2023 period.

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APPENDIX I
ARTIFICIAL INTELLIGENCE AND PRODUCTIVITY[1]

CNEL Committee for the Economics of Artificial Intelligence

A REVIEW OF EMPIRICAL EVIDENCE

Microeconomic and Macroeconomic Results and Initial Evidence on Agentic AI

EXECUTIVE SUMMARY

This study reviews the available empirical evidence on the effects of artificial intelligence on productivity, distinguishing between: i. microeconomic studies, including experiments, field applications and econometric analyses of firms; ii. macroeconomic assessments; and iii. initial findings relating to agentic systems. Experimental studies identify significant increases in execution speed or output across a range of cognitive tasks, with effects varying substantially according to workers' experience, task characteristics and forms of supervision. The transmission of these gains to business processes and aggregate economic outcomes depends on the depth of adoption, how the time released is allocated, and complementary investments in human capital, data and organisation. This approach makes it possible to interpret together often substantial microeconomic results, more limited effects observed in firm-level data, and aggregate signals whose causal attribution to AI remains uncertain. Labour market analyses have so far found no generalised changes in employment or wages, although changes in the composition of tasks and indications of more pronounced effects among younger workers are emerging. Causal evidence on agentic AI remains limited and is concentrated primarily in computing-related domains. In Italy, AI adoption has increased rapidly, although it remains below the European average and is strongly correlated with firm size. Analyses by the Bank of Italy produce differentiated findings, with positive effects among adopters in a sample of medium-sized and large firms and no systematic short-term effects in a broader panel, characterised by uses that are still predominantly experimental. Italy's high density of industrial robots also provides a favourable productive base for the potential integration of AI and physical automation. Overall, the technology's capacity to affect productivity appears to depend on how organisations embed it in their processes, accumulate organisational capital and assess its effects over time.

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INTRODUCTION

This appendix reviews the evidence on the impact of artificial intelligence on productivity, complementing the analyses of capital, skills and innovation developed in Chapters 3 and 5 of the Report. Its interpretation nevertheless requires the unit of analysis, time horizon and nature of the indicators used to be considered jointly, since a reduction in the time required to perform a single task can have different effects on firms' value added, while results observed among adopting firms may take time to be reflected in aggregate statistics. The contribution therefore examines the steps linking the task to the process, the firm and the economy, with particular attention to the conditions that determine the transmission of the initial benefit.

The study provides a selective review of the evidence available as of the end of September 2026. Following an examination of microeconomic studies, including experiments and applications relating to tasks and workers, econometric analyses of firms and findings on the labour market, it discusses macroeconomic studies and signals emerging from aggregate statistics. This is followed by a section on agentic AI, for which the empirical evidence remains preliminary and is largely based on technical benchmarks. The final part considers the implications for Italy in light of data on AI adoption and industrial robotics.

The distinction between the different levels of analysis also responds to an identification problem. In experiments, the tool is assigned under controlled conditions, often together with instructions or training, and the task is selected so as to make the outcome measurable. In the real economy, adoption is endogenous, as workers and firms decide whether, where and with what intensity to use AI, with use more likely in organisations that possess the necessary skills and other complementary factors. Comparing microeconomic and macroeconomic results therefore requires distinguishing the technical capabilities of the systems from their actual use and the subsequent transformation of the organisation. A limited aggregate effect in the short term may coexist with causal gains on individual tasks when diffusion is still limited, constraints persist at other stages of the process, or initial intangible investments absorb resources before generating measurable output.

A substantial part of the effects of AI on productivity is determined during the adoption process. Transforming more capable models into productive capital requires access to usable data, technical and managerial skills, process redesign and sufficient scale to absorb initial costs. Where these complementary factors are present, benefits may emerge rapidly, whereas their absence tends to confine AI use to individual or experimental applications, even when such uses are relatively widespread. The share of users therefore provides an indication of the diffusion of the technology, but it must be complemented by measures of the intensity of the production transformation.

Measuring adoption must take account of the depth of use, the number of processes involved, continuity of use and how the time released is allocated. The composition of adopters is also relevant, since an initial concentration among more highly skilled workers and firms that already possess data and managerial capabilities may lead to a reduction in gaps within a specific task while widening differences across organisations. The share of firms reporting that they use AI alone is therefore insufficient to adequately distinguish experimentation from integration into production processes.

MICROECONOMIC EVIDENCE

Productivity in Cognitive Tasks

The most robust evidence concerns narrowly defined cognitive tasks, for which outcomes can be measured in terms of time, quantity and quality. Although the results point, on average, to positive gains, their magnitude depends on workers' initial position, the possibility of verifying output, and the match between the task and the model's capabilities. This heterogeneity limits the possibility of using a single experimental result as a prediction of the effect on the organisation as a whole.

In the study by Brynjolfsson et al. (2025), conducted on 5,172 customer service operators, the introduction of a generative AI assistant increases the number of queries resolved per hour by 15 per cent. The effect is approximately 30 per cent for less experienced and less skilled operators and close to zero for the most experienced; the 34 per cent estimate that is often cited belongs to the 2023 version of the study. The result is consistent with the hypothesis that the system makes procedures and tacit knowledge embedded in the practices of the best-performing workers available to a broader group.

Noy and Zhang (2023), in a pre-registered experiment on professional writing tasks, find a 40 per cent reduction in the time required and an 18 per cent increase in quality, with larger benefits for participants starting from lower levels of performance. A similar result emerges from the randomised experiment by Cruces et al. (2026) involving 1,174 adults, in which access to AI reduces the performance gap associated with educational attainment from 0.55 to 0.14 standard deviations. The underlying skills gap nevertheless re-emerges when the tool is removed.

A laboratory experiment conducted by researchers from Italian universities on 360 participants provides an additional finding on creative quality. Atzori et al. (2026) find that access to a generative model improves the score assigned by independent evaluators, but the benefit is entirely associated with actual use. The relationship between interaction intensity and outcome is concave, reaching its maximum at around eight prompts. The controlled design identifies the interaction mechanism, but does not allow a direct inference about the effect on the productivity of Italian firms.

Taken together, these studies document an equalising effect within homogeneous tasks, which may nevertheless be accompanied by different dynamics among firms and workers in the real economy. Early adopters are often more highly skilled, better paid and employed in organisations with greater complementary capabilities, a circumstance that may attenuate or reverse the distributional effect observed in laboratory settings.

Software Development and the Capability Frontier

Software development provides particularly informative results because it combines objective measures of output with a considerable variety of tasks. Peng et al. (2023) estimate that developers assisted by GitHub Copilot complete a controlled exercise 55.8 per cent faster. Three field experiments involving 4,867 developers at Microsoft, Accenture and a large US company find a 26 per cent increase in completed code integration requests, while the successful build rate, used as an indicator of quality, shows no statistically sig-

nificant change in the aggregate estimate and deteriorates only in the Accenture experiment (Cui et al., 2026). Output quantity can therefore increase without an improvement in the quality signal.

A further field experiment concerns CodeFuse, a programming assistant introduced at Ant Group. Gambacorta et al. (2024), using a sample of 1,219 programmers, estimate an overall 55 per cent increase in the number of lines of code produced; approximately one third of this increase is directly attributable to AI-generated code. The effects are larger for less experienced workers, while they are more limited for senior programmers, also owing to lower intensity of use. The output measure does not, however, fully capture the quality, maintainability and economic value of the code.

Different results emerge from the METR study of experienced open-source developers. In repositories familiar to the participants and using the tools available at the beginning of 2025, AI use increases completion time by 19 per cent, while the same developers believe that they were approximately 20 per cent faster (Becker et al., 2025). The gap between actual and perceived performance indicates that self-assessment should be complemented by objective measures of performance.

The experiment by Dell'Acqua et al. (2023), conducted on 758 consultants, helps explain this heterogeneity. For tasks within the model's capability frontier, AI-assisted participants complete 12.2 per cent more work, operate 25.1 per cent faster and produce results of up to 40 per cent higher quality. For a task just outside this frontier, the probability of providing a correct solution is 19 percentage points lower. The frontier is therefore irregular, meaning that apparently similar tasks may receive very different levels of support, while inadequately calibrated confidence may reduce the benefits of the tool.

Skills Development and Quality

The immediate effect on productivity should be assessed together with the consequences for learning. Shen and Tamkin (2026) randomly assign 52 developers to use or not use an assistant while learning a new library. In the subsequent test, the assisted group achieves an average score of 50 per cent, compared with 67 per cent for the control group, with no statistically significant time saving. Participants who use the assistant to obtain explanations retain learning better than those who delegate the entire task, indicating that modes of use affect the future ability to monitor and correct generated output.

In settings with measurable clinical outcomes, the evidence can be equally robust. The MASAI trial, conducted in Sweden on more than 100,000 women, shows that AI-assisted mammography screening reduces radiologists' reading workload by 44 per cent and increases the number of cancers detected by 29 per cent without increasing false positives (Lång et al., 2023; Hernström et al., 2025); the final results record 12 per cent fewer interval cancers (82 compared with 93), a statistically non-significant difference demonstrating non-inferiority to double reading, with fewer interval cancers associated with an unfavourable prognosis (Gommers et al., 2026). In this case, the efficiency gain is associated with an improvement in outcomes, within a process redesigned around the tool.

Evidence on creative products also shows that quantity and quality can diverge. Reimers and Waldfogel (2026), studying the e-book market, document that new publica-

tions nearly tripled between 2022 and the end of 2025, while average indicators of use and quality deteriorated. The increase in supply nevertheless generates new products used by consumers, but welfare gains are more limited than the number of titles alone would suggest. The case confirms that gross output should be accompanied by measures of quality and effective demand.

For manufacturing, the quality of the evidence is lower. The most mature applications concern predictive maintenance, visual quality inspection, adaptive optimisation and collaborative robotics. However, reductions in machine downtime reported in application cases and industry estimates derive from selected cases and often from technology providers. They should therefore be regarded as indications of technical potential rather than as estimates that can be generalised to the production system as a whole.

TABLE 1

Main microeconomic evidence on cognitive work, software development and services with measurable outcomes

Study	Context	Main effect	Evidence
Brynjolfsson et al. (2025)	Customer service, 5,172 operators	+15% queries per hour; approximately +30% for novices; ≈0 for experts	Quasi-experiment
Noy and Zhang (2023)	Professional writing, 453 people	−40% time; +18% quality	Pre-registered experiment
Cruces et al. (2026)	Business problem-solving, 1,174 adults	Education-related gap from 0.55 to 0.14 s.d.	Randomised experiment
Peng et al. (2023)	Programming, GitHub Copilot	−55.8% completion time	Controlled experiment
Cui et al. (2026)	Software development, ≈5,000 developers	+26% pull requests; successful builds with no significant change	Three field experiments
Becker et al. (2025)	Experienced developers, own repositories	+19% time (slower); perceived −20%	Controlled experiment
Dell'Acqua et al. (2023)	Consulting, 758 BCG consultants	Up to +40% within the frontier; −19 p.p. in probability of a correct solution outside the frontier	Pre-registered experiment
Shen and Tamkin (2026)	Learning a library, 52 developers	Test score 50% versus 67%; time unchanged	Randomised experiment
Gommers et al. (2026)	Mammography screening, 105,915 analysed	−44% readings; +29% cancers detected; −12% interval cancers (non-inferiority; non-significant difference)	Randomised trial
Atzori et al. (2026)	Creative tasks, 360 participants	Higher quality among those who actually use AI; concave relationship, maximum at around 8 prompts	Controlled experiment
Gambacorta et al. (2024)	Programming, 1,219 Ant Group developers	+55% lines of code; approximately one third of the increase directly generated by AI; larger effects among less experienced workers	Field experiment
Reimers and Waldfogel (2026)	E-books, 2022–2025 market	New publications nearly tripled; average use and quality indicators deteriorated	Market data

Source: Authors' elaborations based on bibliographic sources. Estimates are not directly comparable because of differences in research design, sample, adoption indicator and time horizon.

Overall, microeconomic studies document gains on specific tasks, particularly when output is well defined and workers have verification procedures available, but they also show that speed, quantity, quality and learning may follow different trajectories. For the result to translate into firm productivity, the time saved must be reallocated, constraints at other stages of the process must be removed, and review costs must remain below the benefit obtained. Estimates referring to individual tasks therefore represent one component, rather than a comprehensive measure, of the productivity effect.

Firm-Level Evidence and Complementary Investments

Analyses based on firm-level data produce smaller and less uniform average effects than experiments, because they observe the technology in the context in which it must contribute to the creation of value. Results depend on firms' ability to select use cases, integrate the tool, redefine responsibilities and productively allocate the time released. Evidence on the significant role of complementary investments in training, data, software and organisational capital further develops, in the case of AI, the relationship between human capital, innovation and productivity analysed in §5.1 of the Report.

The field experiment by Dell'Acqua et al. (2026) extends the analysis from individual performance to collaboration. Among the 776 Procter & Gamble professionals involved in product development activities, individuals assisted by AI achieve results comparable to those of groups without AI assistance and display a better balance between technical and commercial contributions. The productivity effect may therefore result both from the acceleration of activities and from a different organisation of skills.

A five-month experiment involving 640 small business owners in Kenya finds no statistically significant average effect of access to AI on revenues and profits (Otis et al., 2023). Effects nevertheless vary considerably: firms that initially perform better improve by slightly more than 15 per cent, while weaker firms deteriorate by approximately 8 per cent. The choice of problems assigned to the tool and the ability to assess the recommendations received therefore appear to be decisive, suggesting that, in the absence of complementary skills, access to the technology may widen existing gaps.

Aldasoro et al. (2026) use EIBIS data linked to balance-sheet information for more than twelve thousand non-financial firms in the European Union and the United States observed between 2019 and 2024. In the European Union, AI adoption is associated, on average, with a 4 per cent higher level of labour productivity, with no negative short-term employment effects and higher wages among adopting firms. Benefits are greater among medium-sized and large firms. Each additional percentage point of expenditure on workforce training increases the estimated productivity effect by 5.9 points, compared with 2.4 points for software and data. This relationship indicates that human capital is an important complement, while not ruling out the possibility that part of the differential reflects unobserved characteristics of adopting firms.

Babina et al. (2026) construct a measure of AI investment based on the employment of workers with specialised skills and link it to firm outcomes. The association with productivity growth emerges in more recent years and is not detectable in the preceding decade. The authors identify a channel operating through the accumulation of organisational capital, understood as the set of firm-specific knowledge, procedures and capabilities

developed through operational learning. The result is consistent with the hypothesis that the returns to AI depend on its ability to bring about lasting changes in the organisation of production.

Surveys of senior business executives indicate widespread adoption accompanied by still limited intensity of use. Based on responses from nearly 6,000 executives in the United States, the United Kingdom, Germany and Australia, Yotzov et al. (2026) find that approximately 70 per cent of firms actively use AI. With regard to the three years preceding the survey, around nine out of ten firms report no effects of AI on productivity or employment. Expectations for the following three years are more favourable, pointing on average to an expected 1.4 per cent increase in productivity and a 0.7 per cent reduction in employment.

Baslandze et al. (2026), surveying approximately 750 US business executives, find that perceived gains exceed those measured in revenues. The gains do not primarily result from an increase in capital per worker, but rather from increases in revenue-based total factor productivity linked to innovation and demand channels; the gap between perceived and measured gains likely reflects the lag with which revenues materialise. The distinction between the availability of the tool and its effective integration into processes therefore helps explain why a high share of users may coexist with modest effects in firm accounts.

TABLE 2

Firm-Level Evidence and the Role of Complementary Investments

Study	Data and method	Main result	Interpretation
Dell'Acqua et al. (2026)	776 P&G professionals; field experiment on product development	Individuals using AI perform comparably to teams without AI; better integration of technical and commercial skills	Returns may also arise from reorganising collaboration
Otis et al. (2023)	640 small business owners in Kenya; five-month experiment	No statistically significant average effect on revenues and profits; positive effects for initially better-performing firms and negative effects for weaker firms	Skills and evaluation capabilities condition the benefit
Aldasoro et al. (2026)	>12,000 EU and US firms; EIBIS and balance sheets, 2019–2024	+4% labour productivity among adopters; no negative short-term employment effect; stronger complementarity with training	Robust association, but unobserved selection may remain
Babina et al. (2026)	AI investment measured through employment of specialists; longitudinal firm-level data	Association with productivity growth in recent years; channel through organisational capital	The effect emerges when AI changes firm-specific procedures and knowledge
Yotzov et al. (2026)	Nearly 6,000 executives in four countries; business survey	Around 70% use AI; around 9 in 10 firms report no past effects; expectations: +1.4% productivity and −0.7% employment over the following three years	Widespread but still shallow adoption, with benefits largely expected
Baslandze et al. (2026)	Approximately 750 US business executives; survey and firm-level indicators	Perceived gains exceed measured gains; effects operate through total factor productivity rather than capital per worker	Tool availability does not amount to organisational integration

Source: Authors' elaborations based on bibliographic sources. Estimates are not directly comparable because of differences in research design, sample, adoption indicator and time horizon.

Labour Market and Task Reallocation

Humlum and Vestergaard (2025, revised version March 2026) link adoption surveys to administrative data covering 25,000 workers and 7,000 workplaces across eleven AI-exposed occupations in Denmark. Two years after the launch of ChatGPT, the effects on wages and hours worked are statistically close to zero, and the confidence intervals rule out changes greater than 2 per cent, while the average time saving is approximately 3 per cent. Changes in tasks and job responsibilities are observed, together with partial reallocations, consistent with an initial impact on the content of work that is more pronounced than the effect on its overall volume.

In the United States, Bick et al. (2025) estimate that, by the end of 2024, approximately 40 per cent of the working-age population used generative AI and that the time saved corresponded to around 1.4 per cent of total hours. Not all of the time released translates into additional output. The transition from reduced task time to higher value added depends on the reallocation of hours, any increase in demand, and the presence of other production constraints. Brynjolfsson et al. (2026) estimate, for US workers aged 22–25, a relative employment reduction of 19 per cent in occupations more exposed to AI compared with the employment trajectory observed in less exposed occupations, controlling for firm and employment. The authors present this result as descriptive evidence rather than as a causal estimate. The available evidence does not currently indicate a generalised contraction in employment and is consistent with effects being more concentrated on entry pathways and on the tasks through which skills are acquired.

TABLE 3

Labour market and task reallocation evidence

Study	Scope and method	Main result	Interpretation
Humlum and Vestergaard (2025, revised 2026)	25,000 workers and 7,000 workplaces in Denmark; surveys linked to administrative data	Effects close to zero on wages and hours; average time saving of around 3%; new tasks and changes in job responsibilities emerge	Initial effects are more pronounced on the content of work than on its overall volume
Bick et al. (2025)	US working-age population; survey on generative AI use	Almost 40% use AI (end-2024); time saved equivalent to around 1.4% of total hours	Time released translates into productivity only if it is reallocated towards additional output
Brynjolfsson et al. (2026)	US labour market; occupations with different levels of AI exposure	−19% relative to the employment trajectory in less exposed occupations for workers aged 22–25	Signal concentrated on labour-market entry; causal attribution remains debated

Source: Authors' elaborations based on bibliographic sources.

From Tasks to Firms

The experiments reported in Table 1 identify the causal effect of access to a tool in defined settings that reproduce only part of the firm-level adoption process. Participants generally receive information on how the application works, are assigned a task selected by

the researchers and operate over a short period. In firms, use is preceded by the selection of the use case, data preparation, integration with existing systems and the allocation of responsibilities in the event of errors. These activities require resources and introduce forms of selection that the experimental design tends to neutralise; the resulting estimate therefore measures performance under specific conditions of use.

Task-level productivity translates into process-level productivity when output produced more quickly can be used at limited verification, waiting or rework costs. Since jobs comprise interdependent activities, in software development a larger number of completed changes may not translate into more reliable versions being deployed to users, while in professional services greater speed in preparing a first draft may shift the bottleneck to review, source research or coordination. In the presence of such complementarities, a different allocation of time does not necessarily result in higher final output; measures of adoption and speed should therefore be complemented by indicators covering the entire production workflow.

The time horizon adds a further dimension. Static effects measure performance during the period in which the tool is available; dynamic effects include learning, potential loss of skills, changes in job responsibilities, product innovation and the accumulation of organisational capital. An immediate gain may coexist with lower future autonomy when the system replaces the practice required to develop capabilities. Conversely, initially modest results may precede larger benefits if the firm is building data, procedures and firm-specific knowledge. Without longitudinal observations, these trajectories remain indistinguishable.

Differences across empirical designs clarify the scope within which results can be interpreted. Experiments estimate the performance of the technology when the task, access and, often, training are defined in advance, whereas firm-level analyses capture how frequently such conditions are actually established and maintained. The potential gap between the two levels therefore provides information on the constraints governing the diffusion of technological progress.

MACROECONOMIC EVIDENCE

The available macroeconomic studies do not yet make it possible to measure an established historical effect of AI. Instead, they construct aggregate scenarios from microeconomic evidence, combining assumptions about task exposure, the economic viability of adoption, the magnitude of gains and the speed of diffusion. The variation across estimates therefore reflects not only statistical uncertainty but also different assessments of the share of technical gains that will overcome organisational constraints and translate into value added.

Under the most cautious scenario, Acemoglu (2025) estimates an overall increase in total factor productivity of approximately 0.7 per cent over ten years, equivalent to around 0.07 percentage points of annual growth. Aghion and Bunel (2024), applying a broader interpretation of the same task-based approach, obtain a median estimate of 0.68 additional percentage points per year; comparison with previous technological revolutions produces a range between 0.8 and 1.3 points. The gap between the estimates shows how decisive the share of economically adoptable tasks and the magnitude of actual savings are.

Filippucci et al. (2024) develop for the OECD a multisectoral micro-macro model with input-output linkages. For the United States over a ten-year horizon, they estimate an annual contribution of between 0.25 and 0.60 percentage points to total factor productivity growth and between 0.4 and 0.9 percentage points to labour productivity; extending the analysis to the other G7 countries indicates gains up to 50 per cent lower, reflecting sectoral composition and adoption assumptions (Filippucci et al., 2025). Diffusion across sectors and firms, together with the reallocation of labour and capital, determines how much of the task-level gains reaches the economy as a whole.

For Italy, the macroeconomic analysis considered is that presented by the Bank of Italy in Bellomarini et al. (2026), applying the production-network model developed by Bertolotti et al. (2026). The model, calibrated on 98 sectors and the national network of production relationships, simulates over ten years an average annual increase in the growth rate of labour productivity of 0.2 percentage points under the slow-adoption scenario, 0.7 under the intermediate scenario and 1.1 under the rapid-adoption scenario. These scenarios complement the historical analyses in Chapters 2 and 3 of the Report, providing values that depend on assumptions regarding technology diffusion and do not measure effects already observed in Italian data.

TABLE 4

Main macroeconomic estimates of the effect of AI on productivity

Study	Scope and method	Central estimate or range	Interpretation
Acemoglu (2025)	United States; task-based model; 10-year horizon	Approximately +0.07 p.p. annually in TFP	Conservative scenario, limited to economically automatable tasks
Aghion and Bunel (2024)	Historical comparison and task-based model; 10 years	Median +0.68 p.p. annually in TFP; historical comparison +0.8/+1.3 p.p.	Results sensitive to exposure, economic viability and savings per task
Filippucci et al. (2024)	United States; OECD multisector micro-macro model; 10 years	+0.25/+0.60 p.p. annually in TFP; +0.4/+0.9 p.p. in labour productivity	Diffusion and sectoral linkages determine the aggregate effect
Bellomarini et al. (2026), using the Bertolotti et al. (2026) model	Italy; production network covering 98 sectors; 10 years	+0.2/+0.7/+1.1 p.p. annually in labour productivity	Slow, intermediate and rapid adoption scenarios

Source: Authors' elaborations based on bibliographic sources. Estimates are not directly comparable because of differences in model, scope and assumptions; TFP = total factor productivity; p.p. = percentage points.

US aggregate statistics showed more favourable dynamics in 2025 and 2026 than the average of the preceding decade. In the second quarter of 2026, the Bureau of Labor Statistics recorded an annualised 1.4 per cent increase in productivity in the non-farm sector and growth of 2.2 per cent compared with the same quarter of the previous year; since the fourth quarter of 2019, average annual growth has been 2.1 per cent, compared with 1.5 per cent in the previous cycle. This is consistent with broader diffusion of new technologies, but it does not make it possible to isolate the contribution of AI from that of the economic cycle, sectoral composition, capital accumulation and other innovations.

Some benefits may escape traditional measures when they take the form of higher quality, fewer errors or lower prices. Macroeconomic scenarios and current statistics should therefore be considered jointly, bearing in mind that the former depend on the assumptions adopted, while the latter do not in themselves provide evidence of the technology's impact.

The gap between microeconomic results and aggregate statistics may be attributable to several mechanisms (Imas, 2026). In the real economy, adoption is endogenous and generally receives less training support than in experiments; moreover, early adopters are selected among workers and firms that are already more productive, while the acceleration of certain tasks may leave constraints at subsequent stages unchanged. Intangible investments in data, skills and reorganisation may ultimately reduce measured productivity during the initial period, before benefits emerge. This dynamic corresponds to the J-curve described by Brynjolfsson et al. (2021), according to which a general-purpose technology requires a phase of organisational accumulation during which its potential may grow faster than observed outcomes.

The evidence points to a logical sequence in which gains are initially observable in measurable tasks, affect the firm when adoption involves processes, human capital and coordination arrangements, and reach aggregate statistics when diffusion is sufficiently broad, the time released is reallocated and complementary investments generate returns. The transition may be interrupted at any of these stages, and its duration cannot be mechanically inferred from the experience of previous technological revolutions.

Measurement Issues

Conventional measures may underestimate some benefits and overestimate others. Time saved is an intermediate input and translates into productivity when it makes it possible to increase output, improve quality with the same resources or reduce costs. Part of the technical gain may be absorbed by additional reviews, waiting times or low-value activities, limiting the effect on value added. Subjective assessments by managers and workers may signal changes not yet visible in revenues while also being affected by expectations or errors in the perception of time spent; self-reported indicators should therefore be compared with operational and balance-sheet data.

As discussed in Chapter 1 of the Report, productivity measurement must also take price effects into account. If AI increases the supply of a service and reduces its price, consumer surplus may increase even when the nominal value of output rises only modestly. Similarly, reductions in errors, waiting times or machine downtime improve economic performance without always being recorded as an increase in quantity, particularly in public services and other sectors in which output quality plays a significant role.

Intangible investment may result in a temporary decline in measured productivity while the firm is building future productive capacity. Resources devoted to data cleaning, process redesign and training generate current costs before the new organisational capital produces benefits, and part of this capital is not fully captured by accounting systems. In the presence of a J-curve, short-term comparisons between adopters and non-adopters may therefore depend on the stage reached by the project; estimates should report the start date, depth of use and share of the process affected, so as to distinguish the cost of building capacity from its subsequent return.

INITIAL EVIDENCE ON AGENTIC AI

The literature reviewed focuses predominantly on assistive systems, used by an individual to perform a defined task, whereas agentic systems are designed to execute sequences of actions with more limited supervision. From an empirical perspective, their relevance stems from the possibility of extending automation to the process itself, where coordination costs, waiting times and verification currently absorb part of the gains achieved at the level of individual tasks.

In theory, the coordination of multiple stages by an agent may reduce the constraints that limit the transmission of microeconomic gains to firm-level productivity. Expanding the operational scope, however, also increases the number of actions exposed to error and requires standardised data, clearly defined responsibilities, controls and traceability. The net benefit therefore depends on the balance between potential coordination gains and the higher costs of integration and supervision.

The available empirical evidence exhibits a strong sectoral imbalance. Wang et al. (2026) analyse 43 agent benchmarks, i.e. standardised collections of tasks used to measure the performance of agentic systems, covering more than 72,000 tasks and 1,016 US occupations. Computer and mathematical occupations, which account for 7.6 per cent of employment, dominate benchmark development. Management, legal activities and engineering, despite being largely digitalisable, account for less than 2 per cent of coverage. Manufacturing is even further removed from the centre of gravity of these tools.

The composition of the benchmarks limits the external validity of the observed performance, since results obtained on programming or digital navigation tasks provide only partial information on processes characterised by exceptions, legal responsibilities, interaction with the physical world or objectives that are difficult to formalise. The assessment of agentic AI should therefore include, in addition to task completion, the frequency of human intervention, the cost of verification, the reversibility of actions and the quality of the final outcome.

The sequential nature of agentic systems amplifies the problem of the irregular capability frontier. An error that is not corrected at one stage may propagate throughout the entire chain of actions. The increase in output observed in software experiments, without a corresponding improvement in the successful build rate, shows that quantity and reliability can move in different directions. For agentic systems, traceability, control points and the ability to interrupt or restore the process therefore become central.

The available causal evidence on the effects of agents on productivity, employment and quality remains limited. Existing information concerns primarily technical capabilities or selected advanced uses and does not make it possible to estimate representative average outcomes, nor to establish whether the automation of entire workflows will generate an acceleration in aggregate productivity or which organisational configurations will prove most effective. The analysis must therefore maintain a distinction between the assessment of technological potential and that of empirically observed effects.

TABLE 5

Available empirical evidence on agentic AI

Study	Scope	Main result	Limitation for productivity analysis
Wang et al. (2026)	43 benchmarks, more than 72,000 tasks and 1,016 US occupations	Strong concentration on computer and mathematical occupations; coverage below 2% for management, legal activities and engineering	Maps the representativeness of benchmarks, but does not estimate a causal effect on productivity, employment or quality

Source: Wang et al. (2026).

An empirical research programme for the coming years should combine field experiments and administrative data, using processes as the unit of analysis and jointly measuring time, costs, quality, errors, supervision and learning. Documenting discontinued projects, which are rarely included in case-study collections, would also contribute to a less selective estimate of the expected return on investment.

THE ITALIAN CONTEXT

AI Adoption and Economic Impacts on Firms

The acceleration of AI adoption in Italy is accompanied by differences by firm size, sector and geographical area, which should be considered together with the analyses in Chapters 4 and 5 of the Report. The increase in the share of users coexists with still uneven capacity to integrate AI into processes, an aspect that is relevant in light of international evidence associating the largest productivity effects with the availability of human capital, data and organisational capabilities. These resources are unevenly distributed across the Italian production system (Cerra and Crespi, 2023), while the experience of the information technology revolution, during which a lack of managerial capabilities constrained the adoption of information technologies and productivity gains in Southern Europe (Schivardi and Schmitz, 2020), indicates that this constraint is not new.

As already noted in the Introduction and Conclusions of the Report, according to Istat, in 2025, 16.4 per cent of firms with at least ten employees used at least one AI technology, compared with 8.2 per cent in 2024 and 5.0 per cent in 2023. The share remains below the European Union average of 20.0 per cent (Eurostat, 2026). Among firms that had considered AI but had not adopted it, 58.6 per cent identified a lack of skills as an obstacle, followed by insufficient legislative clarity, at 47.3 per cent, and the unavailability or poor quality of data, at 45.2 per cent. Moreover, one third of adopting firms, largely small businesses, do not associate AI use with a specific business function.

The size gap has widened rapidly. In 2025, adoption concerned 15.7 per cent of SMEs with between 10 and 249 employees and 53.1 per cent of large firms. The latter are broadly aligned with the European average for large firms, at approximately 55 per

cent. The gap between large firms and SMEs increased from approximately 20 percentage points in 2023 to 25 in 2024 and 37 in 2025. Italy's average lag therefore primarily reflects the low level of adoption among smaller firms.

TABLE 6

Adoption of AI technologies in Italian firms (at least 10 employees), 2023–2025

Firm category	2023	2024	2025
Total firms (≥ 10 employees)	5.0%	8.2%	16.4%
SMEs (10–249 employees)	n.a.	7.7%	15.7%
Large firms (≥ 250 employees)	n.a.	32.5%	53.1%
Large firms / SMEs gap (p.p.)	≈ 20	25	37

Note: n.a. = not available.
Source: Istat, Imprese e ICT, 2025 (15 December 2025). The 2023 gap is reported by Istat as an approximation.

Use is concentrated in marketing and sales, reported by 33.1 per cent of adopting firms, administrative processes, at 25.7 per cent, and research and development, at 20.0 per cent. IT reaches 53 per cent and telecommunications 37.3 per cent, while manufacturing stands at 14.7 per cent. Adoption in the North-West increased from 8.9 to 19.3 per cent in one year, placing it ahead of the other geographical areas. Adoption therefore tends to follow the geography of pre-existing skills and productivity.

Further evidence for Italy comes from an analysis by the Confcommercio Research Department, carried out in collaboration with the Centro Studi Tagliacarne, using microdata from the 2024 and 2025 Istat ICT surveys (Confcommercio, 2026). Linking the two years made it possible to construct a balanced panel of 6,664 firms, appropriately reweighted to align its structure with the reference population. The analysis also distinguishes between firms that do not use AI technologies, firms that adopt at least one, and firms characterised by more intensive use, defined as "strong adopters" because they employ at least four of the technologies considered. In 2025, 16.2 per cent of firms with at least ten employees in the balanced panel used at least one AI technology, while 2.0 per cent used at least four. The size gradient is particularly pronounced: the share of strong adopters rises from 0.8 per cent among firms with 10–19 employees to 6.2 per cent among those with 100–249 employees and 17.8 per cent among firms with at least 250 employees.

Combining adoption information with economic data allows for a first assessment of its relationship with performance. In 2025, average revenue per employee was €289,000 among firms that did not use AI technologies, rising to €368,000 among those adopting at least one technology and reaching €539,000 among strong adopters. Initial econometric estimates, obtained by linking the panel to balance-sheet data and controlling for sector, region, size class and year, also identify a positive association between AI adoption and productivity: value added per employee is 11.1 per cent higher and total factor productivity 10.3 per cent higher. These coefficients do not, however, identify a

causal effect, as the analysis does not yet resolve the problem of endogeneity and possible reverse causality: firms that are initially more productive may also be more inclined to adopt AI.

The results are consistent with the hypothesis, highlighted in the preceding sections, that the mere presence of AI within a firm is not sufficient to realise its productive potential. The differential observed as the number of technologies used increases suggests that diffusion indicators should be complemented by measures of adoption depth, the processes affected, and complementary investments in human capital, data and organisation. The evidence does not make it possible to determine how much of the observed higher performance is generated by AI and how much reflects pre-existing characteristics of adopting firms, but it reinforces the need for longitudinal analyses capable of distinguishing occasional experimentation from the effective integration of the technology into production processes.

Additional indications on the possible evolution of adoption come from the 2026 survey by Unioncamere and Centro Studi Tagliacarne, conducted on approximately 4,500 manufacturing and service firms with between 5 and 499 employees (Unioncamere, 2026). Some 21.8 per cent of firms report that they have already made investments in AI during the 2023–2025 period or plan to do so during 2026–2028. This figure is not directly comparable with the adoption rate reported by Istat, as it combines investments already made with future intentions and covers a different population of firms. The same survey finds that 53.6 per cent of firms plan investments aimed at improving technical and professional skills during 2026–2028, following the 52.9 per cent that had already made such investments during the preceding three-year period. Although these findings do not establish an individual-level link between AI investment and training, they are consistent with the role attributed by the literature to skills as a complementary factor in the adoption process and in the subsequent translation of technology into productive outcomes.

To complement the picture presented in the Report, recent studies by the Bank of Italy examine more specifically the relationship between AI adoption and firm outcomes. Bellomarini et al. (2026), using a balanced panel of approximately 900 Invind firms with at least twenty employees and a difference-in-differences design based on adoption cohorts between 2024 and 2026, find no systematic short-term effects on revenue per employee, employment or investment. In 2026, the share of firms using AI reached 32 per cent, up from 27 per cent in 2025, while intensive use concerned 5 per cent (Bank of Italy, 2026b). Seventy per cent of adopters report no current effects on productivity, while approximately half expect a positive effect over the following three years.

Ropele and Tagliabracci (2026) obtain more favourable results by linking a different Bank of Italy survey to balance-sheet data and administrative data on employment relationships for firms with at least fifty employees. Among these firms, just over 10 per cent used AI in 2024 and approximately one third expected to adopt it within two years. In their difference-in-differences design, adoption is associated with a 5.2 per cent increase in value added per employee and an 11.9 per cent increase in EBITDA per employee. Overall employment shows no significant changes, while the share of white-collar employees increases by approximately 0.7 percentage points.

A new Bank of Italy survey covering approximately 5,000 microenterprises with fewer than ten employees extends the analysis to the largest segment of the production system

(Bank of Italy, 2026a). In 2025, 5 per cent reported extensive or limited use of AI, while 19 per cent were experimenting with it or expected to adopt it within one year. Controlling for other characteristics, the adoption of AI, robotics or process interconnection is positively associated with the owner's financial literacy. The percentages are not directly comparable with those reported by Istat or Invind, given the different reference populations, but they indicate that, among smaller firms, the ability to assess the return on investment constitutes an important complementary factor.

TABLE 7

New empirical evidence for Italy

Study	Data and method	Main result	Interpretation
Ropele and Tagliabracci (2026)	Firms with at least 50 employees; survey, balance sheets and employment data; difference-in-differences	+5.2% value added per employee; +11.9% EBITDA per employee; no effect on total employment	Positive effects among medium-sized and large adopters; shift towards white-collar employees
Bellomarini et al. (2026)	Approximately 900 firms with at least 20 employees; 2022–2026 panel; difference-in-differences by adoption cohorts	No systematic short-term effect on revenue per employee, employment or investment	Adoption is often recent and low-intensity; possible implementation lags
Bellomarini et al. (2026), using the Bertolotti et al. (2026) model	Production-network model calibrated on 98 Italian sectors	+0.2, +0.7 or +1.1 p.p. annually in labour productivity over ten years	Simulated scenarios, not estimates of an effect already observed
Banca d'Italia (2026a), microenterprise survey	Microenterprises; 2025 survey and multivariate analysis	5% use AI extensively or to a limited extent; 19% are experimenting with it or plan to adopt it; technology adoption is associated with financial literacy	In smaller firms, owners' assessment capabilities are a complement to adoption
Confcommercio – Centro Studi Tagliacarne (2026)	Istat ICT 2024–2025 microdata; balanced panel of 6,664 firms with at least 10 employees, integrated with balance-sheet data; regressions with controls and Entropy Balancing	AI adoption associated with +11.1% value added per employee and +10.3% TFP; descriptive performance increases with adoption intensity	Positive association, but not causal: more productive firms may also be more likely to adopt AI

Source: Authors' elaborations based on bibliographic sources. Results are not directly comparable because of differences in sample, definition of adoption and methodology.

Industrial Robotics and the Potential of Physical AI

The potential macroeconomic effects of AI diffusion in Italy will be influenced by the composition of the national production system, which continues to be characterised by a broad advanced manufacturing base (Cerra and Crespi, 2025).

In this respect, the stock of industrial robots constitutes a distinctive feature of the Italian production system. According to the International Federation of Robotics (IFR), in 2024 Italy had approximately 237 robots per 10,000 manufacturing employees, a density higher than the European Union average of 231 and the global average of 132. Italy ranks among the top twenty countries worldwide in terms of robot density and is the second-largest European market for annual installations after Germany.

TABLE 8

Robot density in manufacturing, 2024 (robots per 10,000 employees)

Area / Country	Density	Note
South Korea	1.220	1st worldwide
Singapore	818	
Germany	449	3rd worldwide, 1st in Europe
Japan	446	
United States	307	8th worldwide
Western Europe (average)	267	Most automated macro-region
Italy	≈ 237	Among the top 20 worldwide; 2nd European market for installations
EU27 (average)	231	
North America (average)	204	
China	166	1st worldwide market; 22nd in density
World (average)	132	

Source: IFR, World Robotics 2025 (2024 data; press release of 8 April 2026). The Italian figure is taken from the IFR country density chart. China, which ranks first worldwide in terms of installed stock and annual installations, has a lower density because of the size of its manufacturing workforce; the 2024 figure incorporates the revision of manufacturing employment data by the National Bureau of Statistics of China and is not comparable with the 470 robots per 10,000 employees reported for 2023 in World Robotics 2024.

Robot density measures a stock and should be considered together with investment dynamics. In 2024, new installations in Italy decreased by 16 per cent (to 8,783 units), while those in the European Union fell by 8 per cent (to 67,819 units); in 2025, the decline continued, with approximately 7,800 units in Italy (−11 per cent) and 60,500 in the European Union (−11 per cent), while global installations exceeded 600,000 units (+11 per cent) and the global operational stock reached five million (IFR, 2026). The persistence of Italy's relative advantage will depend on the renewal of the installed base and on the ability to integrate sensors, vision, planning and adaptive control.

Istat data show that AI technologies for autonomous machine movement are used by 5.9 per cent of adopting firms, the lowest share among the areas considered. The high level of installed automation is therefore accompanied by still limited diffusion of the intelligence layer that could make it more flexible. Robotics represents a potential foundation for Physical AI, although its productivity effects are not yet observable in the available data.

Relevant applications include predictive maintenance, visual inspection, collaborative robots and systems capable of adapting to process variability. Their assessment requires comparable projects and metrics defined prior to adoption, covering cycle times, machine downtime, scrap rates, energy consumption, human interventions and product quality. Such an information base would make it possible to distinguish the benefits of the algorithmic component from those resulting from the ordinary renewal of capital.

Overall, the available evidence does not make it possible to estimate precisely the effect of AI on Italian productivity. The Bank of Italy simulations referred to in the section "Macroeconomic Evidence" (from 0.2 to 1.1 percentage points per year depending on the adoption scenario) indicate an increase in employment of approximately 0.1 percentage points in all three scenarios; the largest direct contribution comes from manufacturing, followed by trade and professional, scientific and technical activities, which transmit significant indirect effects along supply chains. An alternative exercise based on OECD estimates places the contribution for Italy between 0.19 and 0.89 percentage points per year (Bellomarini et al., 2026). The estimates depend on assumptions regarding adoption and describe scenarios rather than effects that have already materialised.

Taken together, the data describe a production system in which technological potential is growing faster than the average capacity to translate it into outcomes. Rising adoption is accompanied by uses that are often low-intensity and weakly linked to specific business functions, while the gap between large firms and SMEs is widening for a technology that requires skills, data and organisational capital. The robotics base provides an additional channel for integrating AI into the physical world, but the decline in installations and the limited use of autonomous systems indicate that the existing automation stock must be accompanied by new investment in order to generate productivity effects.

Looking ahead, it will be useful to measure the depth of adoption alongside the share of firms using AI, recording the number of processes affected, the presence of structured data, investments in training and reorganisation, the frequency of human checks and operational effects. This information would make it possible to assess the extent to which AI use remains confined to individual tools or contributes to the formation of organisational capital capable of affecting value added per employee.

CONCLUSIONS AND POLICY IMPLICATIONS

The evidence reviewed indicates that artificial intelligence can increase productivity, but that the magnitude and persistence of the benefits depend on the characteristics of tasks, the quality of use and organisations' ability to integrate the technology into processes. Gains observed in individual activities affect firm-level outcomes when output can be verified, the time released is allocated to productive uses and improvements reach a sufficient scale. The transition from the task to the process, and therefore from the firm to the economy, is not automatic.

Microeconomic studies document larger effects in well-defined tasks for which quality indicators and control procedures are available. Increases in speed and quantity may diminish when review costs rise, errors that are difficult to detect emerge, or the organisation does not modify subsequent stages of the process. Technology also tends to benefit less experienced workers more in some activities, but substitutive use may weaken learning. Current productivity should therefore be assessed alongside output quality and the development of future skills.

At the firm and economy-wide levels, effects depend primarily on the depth of adoption (Cerra and Crespi, 2025). The availability of a tool produces limited results if it is not accompanied by investments in data, training, software and organisational capital. This complementarity helps explain the gap between the gains identified in experiments and

the more limited effects observed in financial statements or aggregate statistics. Initial integration and redesign costs may temporarily depress measured productivity, while benefits emerge through the accumulation of firm-specific knowledge, procedures and capabilities.

Evidence on agentic systems remains preliminary. Automating sequences of activities may extend benefits from individual tasks to entire processes, but it also increases the consequences of errors and the need for traceability, control and supervision. Available benchmarks primarily measure technical capabilities and provide limited coverage of occupations in which legal responsibilities, personal interactions or activities in the physical world predominate. Economic assessment should therefore be based on field experiments that jointly consider time, costs, quality, human intervention and final outcomes.

For Italy, the increase in adoption represents a favourable signal, but does not by itself ensure a widespread increase in productivity. Differences between large firms, SMEs and microenterprises show that skills, data and organisational capabilities are constraints at least as important as access to new technologies. The manufacturing base and the stock of industrial robots provide a potential advantage for integrating AI with physical automation; however, the slowdown in new installations and the still limited use of AI in machine control point to the need for new investment and verifiable applications in production processes.

The policy implications of this appendix complement those of the Report's conclusions, with specific reference to AI adoption. The first concerns measurement. Indicators of the share of firms using AI should be supplemented with information on the intensity and continuity of use, the processes affected, complementary investments and operational effects. Linking statistical surveys, balance-sheet data and administrative information would make it possible to track the transformation of firms over time and distinguish occasional experimentation from effective integration of AI.

The second implication concerns the diffusion of the capabilities required for adoption. Policies should support projects that integrate technology, training and organisational redesign, with particular attention to the ability of smaller firms to deploy and leverage the skills acquired. Technology transfer, specialised services and public demand for innovative solutions can reduce the costs of accessing expertise. In the labour market, dialogue between institutions and the social partners should also take into account the training function of entry-level tasks and promote forms of AI use that strengthen rather than replace professional learning. More generally, worker participation can contribute both to higher productivity and to improved working conditions (Milanez, 2023, 2025). From this perspective, participation mechanisms can be a lever for improving the quality of adopted systems, adapting them to specific use contexts, and fostering their acceptance by workers and, consequently, their effective and informed use within production processes.

The third implication concerns the quality of evaluations. Comparable demonstration programmes, particularly in manufacturing and agentic systems, should adopt metrics defined before the introduction of the technology and document projects that fail to achieve the expected results as well. Evaluation should consider economic benefits net of integration, training and supervision costs. Evidence of this kind would make it possible to orient public policy instruments towards applications capable of generating verifiable

benefits in terms of value added, quality, employment and innovation, avoiding support based solely on nominal technology adoption.

With this appendix, the CNEL Committee for the Economics of Artificial Intelligence provides the Report with a review of the evidence on the links between AI and productivity, supporting dialogue among public administrations, the scientific community and the social partners. Its contribution can focus on identifying the information required, periodically assessing results and formulating general policy guidance.

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APPENDIX II
NATIONAL PRODUCTIVITY BOARD
WORKING PAPERS, 2026



Working Paper No. 2, April 2026

Productivity in Complex Systems: Analysis, Conceptual Frameworks and a Comparative Perspective Across European Countries

Pasquale Lucio Scandizzo and Paola Bonacci

Italian version

English version

The Working Paper No. 2 presents an analysis of productivity as a complex phenomenon influenced by the interaction of technological, institutional, organisational and structural factors. The analysis highlights how approaches to interpreting and measuring productivity differ across countries, reflecting their economic characteristics and specific policy priorities. Particular attention is devoted to the limitations of traditional indicators, with reference to total factor productivity (TFP), measurement errors and the growing importance of intangible capital, comprising research and development, software, organisational capital and relational capital. The international comparison also highlights a number of common themes, including the diffusion of technological innovation, the relationship between productivity and inequality, and the difficulties involved in measuring productivity in services. A second strand of analysis reviews National Productivity Reports prepared in different European countries within the framework of the 2016 Recommendation of the Council of the European Union. The comparison reveals substantial differences in national circumstances, but also recurring policy priorities, including strengthening investment and research, digitalisation and innovation, the development of human capital and skills, firms' growth in size and managerial capacity, and a greater ability to reallocate resources towards their most productive uses.



Working Paper No. 3, July 2026

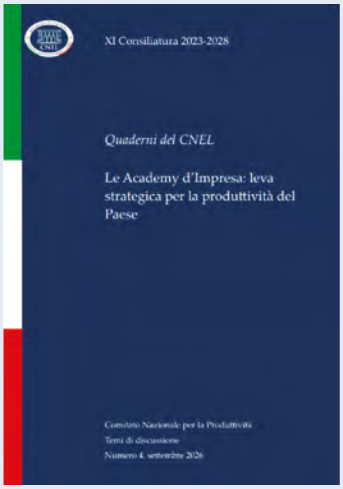
Measuring Productivity. Prices, Quality, Levels and Dynamics in Economies with High Internal Heterogeneity

Pasquale Lucio Scandizzo and Emanuele Canegrati

Italian version

English version

The Working Paper No. 3 examines the main methodologies and issues associated with measuring productivity, with particular attention to the factors determining its dynamics and to the difficulties involved in interpreting traditional indicators. The analysis considers productivity as the outcome of the interaction between capital, labour, innovation, organisation and input quality. It highlights how total factor productivity (TFP), as an accounting residual, combines innovation, unaccounted-for input quality, allocative efficiency and measurement errors, and how its information content emerges through decomposition. The discussion is structured around six "wedges", which progressively bring to light the main factors and conventions that may create a gap between measured and actual productivity. Particular attention is devoted to decomposing productivity growth and to the factors that may affect the measurement of TFP, including measurement errors, input quality, economies of scale and resource allocation. Specific attention is also given to the impact of artificial intelligence and digital technologies, whose effect on productivity depends not only on adoption but also on firms' ability to adapt production processes, skills and organisational arrangements. The analysis also considers misallocation, that is, the inefficient allocation of capital and labour across firms, as a factor capable of limiting aggregate productivity. The resulting interpretation of productivity goes beyond its purely quantitative dimension and requires technological innovation, investment, human capital, firm organisation and the conditions governing resource allocation to be considered jointly. This is an essential premise for understanding productivity dynamics and for designing more effective economic policies.



Working Paper No. 4, September 2026

Corporate Academies: A Strategic Driver of National Productivity

Pasquale Lucio Scandizzo; Laura Deitinger and Alessandro Sciolari

Italian version

English version

The Working Paper No. 4 examines the role of Corporate Academies in developing human and organisational capital and strengthening productivity. Training is analysed as an investment in intangible capital capable of affecting the quality of work, the dissemination of knowledge and the efficiency of organisational processes. Particular attention is devoted to the relationship between human capital and organisational capital, to the misallocation of skills, and to the risk that the concentration of training investment in the most productive firms may widen existing gaps. From this perspective, Academies can promote the dissemination of skills along production chains and across territories, including through cooperation with universities, ITS institutions and training providers. The relationship between Academies and industrial relations is also examined, with reference to training as a form of "extended bargaining" and to the enhancement of workers' training rights. A further focus concerns artificial intelligence and the need to develop hybrid human-machine capital through upskilling and reskilling processes. The empirical section collects the experiences of fourteen firms and analyses the evolution of Academies, also highlighting their growing strategic, identity-building and reputational dimensions as instruments linking firms, people, the education system and local communities. Overall, the Working Paper highlights the potential of Academies as strategic infrastructures for productivity, particularly when training is conceived as an investment and as a lever for disseminating innovation and skills.



Working Paper No. 5, September 2026

The Italian Tertiary Sector. Transformations, Productivity and Prospects

Paolo Feltrin, Sergio Maset, Mariano Bella and Luciano Mauro

Italian version

English version

The Working Paper No. 5 analyses the transformation of the Italian services sector and its relationship with productivity, considering jointly sectoral structure, firm size, human capital, innovation, internationalisation and territorial characteristics. The analysis highlights the internal heterogeneity of services and shows that growth in service-sector employment cannot be interpreted solely as the result of a shift towards lower-productivity activities. Particular attention is devoted to productivity differences between firms of different sizes and between European countries, as well as to the role of organisational, technological and contextual conditions in determining firms' performance. A further area of analysis concerns human capital and the diffusion of knowledge-intensive services. The analysis highlights the relationship between the availability of skills, demand for skilled labour, innovation and productivity, and examines territorial differences in the concentration of knowledge-intensive activities. The Working Paper also considers the internationalisation of services and the limitations of statistical classifications in fully representing their contribution to international trade, as well as the potential of digital technologies and artificial intelligence to transform production processes. Overall, the analysis highlights the need to interpret the evolution of the services sector through the quality of activities, skills, technologies and the conditions that support productivity growth.

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