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The generative effects of economic crises: the case of the Italian innovation system

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Abstract

This article seeks to shed light on the profound changes taking place in the Italian innovation system. While the system ensured sustained growth until the Eighties, the country's competitiveness in the high and medium-high tech sectors was eroded by the shift from Fordism to post-Fordism. Recently, however, there have been signs that firms are once again showing an appetite for innovation, and that there is a renewed commitment on the part of the state to supporting business' technological advances and digitalization. After detailing the distinctive features of the Italian innovation system, we describe the striking improvements in digital propensity and capacity for innovation that Italian firms have made in recent years. On the whole, as we show, the Italian economic system has benefited from "generative dynamics" triggered, first, by the Great Recession of 2008 and, later, by the 2020 pandemic crisis. In addition, we discuss the role of public policies in promoting the Italian innovation system with a specific focus on medium-high tech manufacturing.

Keywords: digitalization, political economy, Italy, institutional change, economic sociology.

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Los efectos generativos de las crisis económicas: el caso del sistema de innovación italiano

Resumen

Este artículo busca arrojar luz sobre los profundos cambios que se están produciendo en el sistema de innovación italiano. Si bien el sistema aseguró un crecimiento sostenido hasta los años ochenta, la competitividad del país en los sectores de alta y media alta tecnología se vio erosionada por el paso del fordismo al posfordismo. Sin embargo, recientemente ha habido señales de que las empresas están mostrando una vez más apetito por la innovación y de que hay un compromiso renovado por parte del Estado para apoyar los avances tecnológicos y la digitalización de las empresas. Después de detallar las características distintivas del sistema de innovación italiano, describimos las sorprendentes mejoras en la propensión digital y la capacidad de innovación que las empresas italianas han logrado en los últimos años. En general, como mostramos, el sistema económico italiano se ha beneficiado de la "dinámica generativa" desencadenada, primero, por la Gran Recesión de 2008 y, después, por la crisis pandémica de 2020. Además, discutimos el papel de las políticas públicas en la promoción del sistema de innovación italiano con un enfoque específico en la manufactura de media-alta tecnología.

Palabras clave: digitalización, Economía Política, Italia, Cambio Institucional, Sociología Económica.

Introduction

This article seeks to shed light on the profound changes taking place in the Italian innovation system. While the system had ensured sustained growth until the Eighties (Malerba, 1993), the country's competitiveness in the high and medium-high tech sectors was eroded by the shift from Fordism to post-Fordism (Lucchese; Nascia; Pianta, 2016; Nuvolari; Vasta, 2015). Recently, however, there have been signs that firms are once again showing an appetite for innovation, and that there is a renewed commitment on the part of the state to supporting business' technological advances and digitalization. After detailing the distinctive features of the Italian innovation system, we will describe the striking improvements in digital propensity and capacity for innovation that Italian firms have made in recent years.

In light of these developments, the primary research question arises: what are the main factors that could explain the big leap forward of the Italian economy in growth and digitalization? To address this question, we consider several factors that may have played a significant role. Firstly, we explore the impact of the Great Recession of 2008 as a form of creative destruction and creative accumulation, shaping the trajectory of the Italian economy. Secondly, we examine the pandemic crisis of 2020 and its role as a catalyst for firms to invest in information and communication technology (ICT), leading to further advancements in digitalization. Lastly, we investigate the influence of public policies implemented since 2017 that promote the adoption of new IT technology, both in firms and among the general population. By analyzing these factors, we aim to provide a comprehensive understanding of the drivers behind the recent advancements in the Italian innovation system and the resulting growth and digitalization of the economy.

On the whole, as we will show, the Italian economic system has benefited from "generative dynamics" triggered, first, by the Great Recession of 2008 and, later, by the 2020 pandemic crisis. In addition, we will discuss

the role of public policies in promoting the Italian innovation system with a specific focus on medium-high tech manufacturing.

The Italian innovation system before the crises

The concept of national innovation systems (NISs) was introduced in the 1980s (Dosi *et al.*, 1988; Edquist, 2005; Freeman, 1987; Lundvall, 1992; Malerba, 2004; Nelson, 1993) and refers to "all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovation" (Edquist, 1997, p. 14). Despite substantial differences, certain basic features are common to studies using this concept. First, they embrace the idea that knowledge and learning processes are key drivers of innovation and development. Second, they abandon a strictly economistic view of innovation, acknowledging: a) that it requires the contribution of a plurality of actors (companies, universities, governments, etc.); b) that institutions play an important role in shaping the context in which these actors operate; and c) that these processes are embedded in networks of relationships between people and organizations (Ramella, 2016).

While the national innovation systems approach has proven valuable in analysing and understanding the dynamics of innovation ecosystems, it is not without its weaknesses. Three key limitations should be considered. First, the concept often struggles to capture the complex interactions and interdependencies between various actors within the system, leading to a potential oversimplification of the innovation process. Second, the focus on knowledge and learning processes can overshadow other crucial factors such as market dynamics, entrepreneurial culture, and access to capital, which also play significant roles in fostering innovation. Lastly, the concept's emphasis on institutions and their role in shaping the innovation context may downplay the importance of spontaneous bottom-up initiatives and

grassroots innovation that can emerge independently of formal institutional support (Ramella, 2016).

Despite these well-known biases and limitation, we will use this concept to shed light on what the Italian development model was like before the Great Recession and to understand the difficult process of digitalization of the Italian economy.

By contrast with the major economies of North-Western Europe, Italy took a low road to competitiveness in the years preceding the Great Recession, relying chiefly on labor market precarization and cost compression (Burroni; Gherardini; Scalise, 2019). The growth rate was thus almost always below the European average, held back by the massive public debt and demographic decline, plus scanty investments in innovation and human capital, poor public regulation and ageing infrastructures. All of this translated into particularly discouraging productivity dynamics that not even the country's low labor costs were able to offset. This disappointing economic performance ties in with the weakness of Italy's national innovation system and contrasts with Northern Europe performances. Indeed, in economies that choose the high road to competitiveness, firms are mainly specialized in industries with a high level of R&D and wages. In this case, the competitive advantage is based on increased productivity and capital investment. On the contrary, the economies of Southern Europe have a different and specific innovation regime, which is associated with specialization in medium-low technology sectors (Donatiello; Ramella, 2017). They show a distinctive mix of scarce collective goods and resources for innovation on the one hand, and greater state involvement and loose ties between actors in the system on the other.

To flesh out the Italian NIS, it can be useful to refer to the European Innovation Scoreboard (EIS), which the European Commission (2021) has published every year since 2001 to provide a comparative analysis of the Member States' innovation performance and their relative strengths and weaknesses. In 2008, Italy ranked among the Moderate Innovators, i.e., the

Member States whose performance was below the European average. At that time, one of the first features of Italy's NIS was thus its weakness compared to the major North-Western European economies. Scores were far below average in several areas: i) investments in qualified human resources; ii) R&D expenditure; iii) innovative services and collaborations; iv) developing and protecting intellectual assets (European Commission, 2021, p. 5-6).

The second feature of Italy's NIS was weak integration. In 2008, a) per capita expenditure on R&D was below the EU average; b) firms' share of total R&D spending was also below average, resulting in a more public-centered NIS despite the fact that public expenditure falls below the European average; c) innovation policy was decentralized, relying primarily on fiscal incentives for private enterprise; d) interconnections between actors in the system were weak; and e) the model was mainly oriented to coping with low or medium-high tech industrial districts whose innovation style is mainly incremental and based on learning by doing (Marshall, 1920; Bellandi, 1989). These features are in telling contrast with those of the European Innovation Leaders, and the Scandinavian countries particularly. The latter have NISs that show high performance in terms of private and public investments in R&D, coordinated and centralized governance and, lastly, more science-based regimes. On the brink of the Great Recession, then, Italy had a fragile production system and a weak NIS, which made it especially vulnerable to the international crisis. By the time the latter came to an end in 2014, GDP had lost a full eight percentage points from its 2008 level, while Germany and France had gained 5% and 3% respectively. Per capita GDP in real terms fell even farther, by 9.3 points, while that of the EU held fairly firm. Investments also declined sharply because of the austerity policies imposed by the European Union, which prevented the Italian government from putting counter-cyclical measures in place, as Europe's Innovation Leaders were able to do (Donatiello; Ramella, 2017). Though the Great Recession was a severe shock, it would be wrong to blame it for Italy's economic decline. In fact, the country's growth paths

had begun to diverge from those of the more advanced economies well before the international crisis exploded. Painful as it was, however, the crisis also set off "generative dynamics", bringing a re-thinking of outworn competitive strategies.

The Great Recession as a game-changer

The Great Recession was a "game-changer", because it laid bare all the woeful inadequacy of the low road to competitiveness and the policies – neoliberal in essence – that underpinned it. Not only did these policies make Italian firms less competitive and heightened social inequalities, providing fertile ground for the rise of populist parties, but they also stunted domestic demand and depleted the stock of collective goods, thus putting the brakes on Italy's economic, social and political modernization.

We claim that the Great Recession brought a course correction in Italy's development strategies. As we know, crises are powerful learning triggers, or in other words opportunities to start lesson-drawing processes (Deverell, 2009). But what were the drivers of these learning processes? First, policies supporting technological innovation were implemented. National policies and the regional innovation systems both provided firms with stimulus and support in the process of adjustment that followed the Great Recession. Second, typical market adjustment mechanisms were in place. In fact, two classic Schumpeterian processes were at work: "creative destruction" and "creative accumulation" (Filippetti; Frenz; Archibugi, 2009). And both these drivers of learning processes – policies and market mechanisms – were intertwined and imbued with a strong relational dimension that has given rise to cooperative games between public and private actors.

To illustrate this intertwining, we will start with the first market process, *creative destruction*, where old firms that are no longer able to compete are displaced by new and tendentially more innovative firms. As we mentioned earlier, an enormous number of Italian firms shuttered during the Great

Recession, especially among the less competitive micro-enterprises. But what is less well-known is that new firms continued to enter the marketplace throughout the harshest years of the crisis. From 2009 to 2020, new registrations in the Business Registers maintained by Italy's Chambers of Commerce invariably exceeded strike-offs. In 2019, just before the pandemic crisis broke, the number of registered firms was virtually identical to that in 2009, though trends varied widely from sector to sector. Moreover, many innovative start-ups appeared in the years immediately following the Great Recession, taking advantage of the incentives offered in the "Growth 2.0 Decree" enacted by the Monti government in 2012. In the two years after this measure was introduced, around 3,700 start-ups were entered in the so-called special section of the Business Register, the majority operating in knowledge-intensive services (information technology, research, etc.), high-tech manufacturing and mechanical engineering (InfoCamere, 2015; Cerved, 2015). In October 2021, the total number reached fourteen thousand, with an impact in terms of production and employment that was beginning to be anything but negligible (InfoCamere, 2021).

We will now turn to *creative accumulation*, i.e., solid, well established firms' response to the market adjustment. Here again, the Great Recession spurred innovation, not least because of the incentives for investments provided by the government in subsequent years (Pessina; Ramella, 2022). The data suggest that a fair number of Italy's enterprises, especially the more export-oriented among them, reacted forcefully to the crisis, as befit the dramatic nature of the situation. A noticeable increase in gross fixed capital formation began after the Great Recession, and a similar surge can be seen in firms' research and development spending in recent years. In investment volumes, Italy is now third in Europe after Germany and France, though these countries still have an enormous lead in per capita terms: Italy's figures are barely one third of Germany's, and slightly over half of France's.

And indeed, EUROSTAT data show that between 2015 and 2018, manufacturing labor productivity (gross value added per person employed)

increased more in Italy (11.1%) than in Germany (8.7%), France (7.9%) and Spain (3.8%). This was the first and only time since the late Nineties that such an event had been seen. The results of this heightened pace of investment are beginning to make themselves felt. According to the Community Innovation Survey, only 35% of Italian enterprises were classified as innovative in 2006: four points below the European average and a troubling 26 points below Germany (European Commission, 2006). But improvements soon followed, and by 2018 Italy's share reached 63%: 13 points above the EU average and a mere five less than Germany (European Commission, 2018). Moreover, the Financial Times FT 1000 list of Europe's fastest-growing companies in the three-year period 2017-20 shows the same picture. For the second time in a row, Italy ranks first in 2022 (with 235 companies), followed by Germany (194) and the United Kingdom (155). A similar pattern can be seen in the digitalization of the Italian economy, which can be used as a litmus test of the transformations induced by the Great Recession, first, and by the pandemic crisis later.

The digitalization of the economy and society

The ICT revolution that got under way in the Nineties had transformative effects on the economy. Many of the costs that firms and consumers incurred in searching for information, transporting goods, replicating sounds and images, and tracking and verifying movements and information fell dramatically (Goldfarb; Tucker, 2019). Obviously, this had repercussions that echoed throughout society and the economy. In particular, an extensive economic literature has emphasized that digitalization was the key factor for productivity growth both for the advanced economies and for developing and emerging countries (Jorgenson; Ho; Stiroh, 2008; Niebel, 2018). It brought efficiency gains in the production process and, more generally, in corporate organization (Brynjolfsson; Saunders, 2009), bringing structural changes to global value chains (Strange; Zucchella, 2017). In addition, it

created new digital markets and socio-economic platforms for collaboration (Ramella; Manzo, 2021). As pervasive as they are, however, the spread of digital technologies and their ability to seize the opportunities opened by this technological revolution depend on a variety of geographical, organizational, social and institutional factors.

From the geographical standpoint, digitalization has had paradoxical effects (Moriset; Malecki, 2009). On the one hand, it has made distance less relevant, so that people and firms in outlying locations can potentially stay in the loop – if their connectivity is good enough. On the other hand, it brings clear processes of spatial concentration. Digital ecosystems chiefly take root in more developed regions and metropolitan areas, where there is likely to be a high density of qualified human capital, creative content producers, startups and specialized finance, as well as large corporations.

Varying levels of digital maturity also lead to an organizational divide. In this case, how far digitalization is able to penetrate depends on whether qualified manpower is available, on the capacity to invest in IT, and, lastly, on the organizational culture, particularly as regards management's ability to collaborate with specialized customers and suppliers (Bloom; Sadun; Van Reenen, 2012; Shamim *et al.*, 2016; Downing, 2005; Fossen; Sorgner, 2021). In this respect, larger firms or young, agile startups are better placed to reap the benefits of digitalization (Horváth; Szabó, 2019).

Society's level of digitalization also exerts a direct influence on economic opportunities. The more citizens are imbued with digital culture, the more skills can be deployed in the spheres of work and consumption. At the same time, a digitally savvy population will demand more digitalized services and products from firms and government. Lastly, how advanced an economy's process of digitalization is will also depend on the role played by the state and its national innovation system. Public policies, for example, are decisive in narrowing the geographical and dimensional divide. In this regard, access to ultrafast connections even in remote areas, support for small and medium

enterprises and the spread of digital competences among the population are the main areas for state intervention.

In view of these considerations, we can now turn to Italy's level of digitalization and the organizational and institutional factors that influenced the country's performance after the Great Recession and, above all, in more recent years. Italy was a latecomer to digitalization. Today, the country's Digital Economy and Society Index (DESI) puts it in 18th place out of the 27 EU Member States. In other words, Italy ranks ahead of a few Eastern European countries, but below the EU average and very far behind the more digitalized nations. On a more positive note, Italy is gaining ground at an impressive pace. Convergence towards the most digitalized countries, in fact, is proceeding at the fastest rate in Europe (European Commission, 2022a, p. 17-18): as recently as 2017, the country ranked fourth-to-last, ahead of only Romania, Bulgaria and Greece.

Nevertheless, there is still a gap between Italy and the other countries that can undoubtedly be seen as the result of a weak and poorly integrated national innovation system. Here, Italy has lagged behind since the Nineties. As national budget data show, in the mid-Nineties Italy began to invest less than other advanced countries in tangible digital technologies such as computers, networks and so forth. While in 1995 the shortfall between Italy's investments in this area and the OECD average was negligible, by 2007 the gap had grown to 0.4% of GDP. While the OECD countries spent 1.1% of GDP on average, Italy invested a mere 0.7% (Calvino *et al.*, 2022).

There are many reasons for the divide separating Italy and the other advanced economies. In particular, a frequent target of blame is the weakness of the productive structure we mentioned earlier. Suffice it to say that in 2019, 41.9% of Italian job holders were employed in firms with fewer than 10 employees, as against a European average of 28.5% and the far lower percentages in France (22.5%) and Germany (18.7%). We should also add that Italy's small enterprises grow less and for fewer years than their counterparts in other countries (Manaresi, 2015). The effect that all this has

on digitalization is clear: as the proportion of small and micro enterprises increases, it becomes less feasible to invest in digital technologies and, at the same time, firms will have weaker ICT skills.

Continuing with structural considerations, Italy's sector specialization is less worrisome. Though a far from insignificant slice of Italy's production is in industries with low or medium-low knowledge content (e.g., textiles, apparel, footwear, furniture, etc.), international projections for digital propensity are more optimistic. Italy's potential for digitalization would appear to be on a par with the OECD countries (Calvino *et al.* 2022, p. 98), with some northern regions such as Piemonte and Lombardia having quite a sizable percentage of workers in high digital intensity sectors (Gherardini; Ramella, 2021, p. 21).

The fragmentation of the Italian productive system should thus be emphasized. This is not simply a question of the distinction between the few large corporations and the multitude of SMEs, or between industries that are closest to the frontiers of innovation – like pharmaceuticals or aerospace – and those that are farther away, which include all of the so-called Made in Italy sector. It is also the result of the country's regionalized form of capitalism (Burroni; Trigilia, 2009).

The disparities between Italy's regions have a significant influence on the country's digitalization. Exercises in applying the DESI index on a regional scale (Benecchi *et al.*, 2021) demonstrate that the Southern regions lag behind those in the Center-North in most dimensions of digital performance except connectivity. They also tell us that the digitalization process has made the greatest strides in the major producing regions of the Center-North (Lombardia, Emilia-Romagna and Piemonte), as well as in Lazio (the region surrounding the capital). In these regions, the DESI index indicates levels of digitalization well above the EU average. By contrast, the Southern regions at the bottom of the national rankings (Sicilia, Calabria, Basilicata and Molise) have entirely inadequate levels of digitalization, among the lowest in Europe. We are thus dealing here with a geographical

duality that reflects and even aggravates the socioeconomic split that has been such a feature of Italy ever since the country's unification in 1860.

Another factor that puts a damper on firms' adoption of digital technologies is their limited stock of human capital (Fabiani; Schivardi; Trento, 2005). Italy's workforce suffers from a low proportion of college graduates and, at the same time, has demonstrated an ability to master literacy and numeracy skills that is far from encouraging (Kankaraš *et al.*, 2016). In addition, the 2022 DESI Country Profile for Italy reports that only 46% of the population has at least basic digital skills, and that the percentage of ICT specialists in the workforce is below the EU average. This situation is compounded by the fact that only 1.4% of Italian graduates opt to study ICT programs, which is the lowest percentage in the European Union (European Commission, 2022b). Lastly, data from the World Management Survey show that Italian firms score lower on management efficiency measures than those in other advanced economies (Schivardi; Schmitz, 2019).

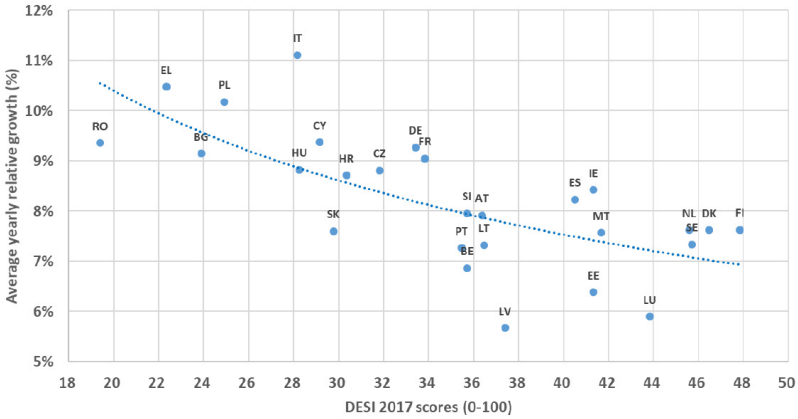
Italy's digital infrastructures are another problematic area. According to OECD data, only 30% of Italian citizens had a broadband connection in 2019, as against approximately 40% in Germany, France and the United Kingdom. In addition, the average fixed network Internet connection speed in 2017 was far below the OECD average: 9.2 Mbps versus 15.25 (Akamai, 2017). On the other hand, connectivity has risen significantly now that 5G mobile coverage has reached nearly all populated areas (Akamai, 2017).

The great leap forward in the digital transition

All of these factors thus paint a picture of a digitalization process beset by weaknesses that are both internal and external to Italy's firms. But it should also be born in mind that in this respect, as for the economy as a whole, convergence on other European countries has picked up speed in recent years. As the Digital Economy and Society Index Report for 2022 (ibidem) shows, Italy is something of a standout on the continental scene: it

is the country whose DESI score rose at the fastest clip between 2017 and 2022. This impressive overperformance corresponds to an average yearly relative growth of 11%, or around 2.2% above what would be expected from the curve shown below, which represents the estimated pattern of convergence between European countries (Figure 1).

Figure 1. DESI scores: average yearly relative growth (2017-2022)



Source: European Commission (2022a).

Italy's businesses are the main drivers behind this trend. In terms of enterprise digitalization, Italy now ranks eighth in Europe, while in 2016 it was close to bringing up the rear in 20th place.

From what we have seen so far of Italy's productive fabric, this high ranking is nothing short of amazing, and especially so because it shows Italy outperforming the other major European economies. Germany, for instance, stands at 16th place, and France at 20th.

For a better understanding of this *great leap forward* by Italy's firms, we must focus on the three sub-dimensions of the integration of digital technology where Italian enterprises did best: the percentage of SMEs that

have at least a basic level of digital intensity (60%, as against the EU average of 55%), the uptake of cloud services (52%, well above the EU average of 34%) and the use of e-invoices (95%, versus the EU average of 32%). By contrast, the outlook is less rosy when we compare other equally important aspects of digitalization with the EU average: the use of big data (-5%), the adoption of artificial intelligence (-2%), the uptake of e-commerce (-3%) and the share of SMEs selling online (-5%). In other words, Italy's great leap forward would appear to reflect a transition on the part of the country's productive system as a whole to basic levels of digitization. Though this could be the harbinger of a true digital renaissance, any such outcome is still a long way off.

The latest report on the digital scene by Italy's largest employers' association, Confindustria, provides an effective illustration of how the digital transition is proceeding, underscoring the fact that the key propellant has been the increase in firms' investments. As the report points out, not only has the percentage of Italian firms that invest in digital technologies risen above the EU average of 61% in recent years and now matches the United States' 65%, but the average expenditure per employee went from 1,742 to 1,977 euros between 2018 and 2021. Moreover, the report estimates that industry's digital spending amounted to 8.5339 billion euros, up 7.9% from 2020 (Confindustria Digitale, 2022).

There can be no doubt that the change in enterprises' habits and attitudes was spurred by the Covid-19 pandemic, the second game-changer after the Great Recession discussed above. The uptake of digital technologies surged despite the economic fallout from the crisis.[1] In the two years between 2018 and 2020, the percentage of enterprises using cloud services went from 23 to 59%. As regards e-commerce, the Italian National Institute of Statistics (Istat) reports that the number of enterprises selling via online channels has increased by 43%. The Istat data also show that pandemic-era expectations about future growth in online sales have had a multiplier

[1] In 2020, industrial production dropped by 11.4%, while GDP shrank by 8.9% (Istat, 2021).

effect. At the end of 2021, e-commerce turnover accounted for 17.5% of total sales, or 3.8% more than in 2019 and a 2.3% increase over Istat's most optimistic growth projections (Istat, 2022). As further confirmation of the general rise in the Italian productive fabric's digital quality, firm size was not a significant factor in this growth. Micro-enterprises, for example, upped their online sales from 12 to 15%, while small enterprises' online turnover went from 4 to 7.3% (Istat, 2022).

Yet another boost to digitalization came from the extensive reliance on remote working, which in the acute phase of the pandemic involved nearly nine million workers. Even now that the worst is over, around 30.8% of private sector workers and 39.7% of public sector employees are still working from home (Confindustria Digitale, 2022). Shifting the workstation away from the employer's premises increased the demand for ICT. This is one of the reasons for the rise in per-employee ICT expenditure we cited above. Here, in fact, spending climbed at an annual rate of 7% between 2020 and 2021, as against 3.7% between 2019 and 2020, and 2.7% between 2018 and 2019 (Confindustria Digitale, 2022).

Lastly, we must not underestimate the pandemic's effect on how citizens interact online over the Internet with public authorities. This is an area of digitalization where Italy has always been conspicuously absent from the forefront. In 2016, only 16% of Italians used e-government services, a far cry from the 34% in the rest of Europe (European Commission, 2017). In 2021, the number rose by 24 percentage points, with usage reaching 40% of Italians (European Commission, 2022a). Though this is still well below the EU average of 65%, it is an encouraging sign, especially if we look at it in the light of the pandemic's effects on the public administration's digitization. A good example of these effects can be found in the rapid spread of electronic identification. According to data from AgID, the Agency for Digital Italy, the number of people with an e-ID rose at a rate of around 145,000 a month between January 2018 and February 2020, the month before the pandemic broke out. Between March 2020 and March 2022

or, in other words, between the beginning of lockdown and the end of the health emergency, the monthly increase in e-IDs reached 940,000. Currently, Italians with an e-ID number approximately 30 million, or some 60% of the adult population, as against 11.9% prior to the pandemic.

As we have seen, the pandemic fast-tracked change to an extraordinary extent. But even before, public policies played a major role. Take, for example, mandatory e-invoicing for all private enterprises doing business with the public administration – introduced as early as 2007 – and above all, the extension of mandatory e-invoicing to all transactions by all private parties starting in January 2019. Or again, the fact that applications for the stimulus payments and financial aid available for businesses and the public during the pandemic had to be submitted online using e-ID. Even more significant were the efforts to make production processes more interconnected. Here, obviously, we are referring to digitalization in manufacturing and the so-called 4.0 paradigm, which calls for production systems to interface more readily with machine operators and other equipment inside and outside the factory. Since 2017, successive Italian governments have implemented a policy to encourage private investment and promote specialized skills. First known as Industry 4.0, the policy has gone through several name changes, becoming Enterprise 4.0 in 2017 and Transition 4.0 in 2019. The policy's central measure was undoubtedly the so-called hyper-depreciation allowance, whereby the government allowed enterprises investing in certain types of equipment using 4.0 technologies to calculate depreciation at 150% over the purchase price of the asset, resulting in a higher tax deduction.[2]

The initiative was then expanded with two additional types of measure. The first is intended to build skills through the "Training 4.0" scheme (2017), i.e., a 40% tax credit on expenditures incurred for training employees in 4.0 technologies. Later (in 2019), innovation manager vouchers were introduced to encourage firms to hire outside consultants to assist them in

[2] Since 2020, the mechanism has been replaced by a simpler tax credit for up to 40% of actual investment.

the digital and technological transition and help modernize management and organizational practices. The second type of 4.0 measure is more place-based, in that it set up three kinds of institution across the country. The first are the *Competence Centers*, i.e., eight public-private partnerships located in specific regions but supra-regional in scope, which serve as a bridge between research centers and firms dealing with such central paradigm 4.0 technologies as cybersecurity, additive manufacturing, robotics, big data and so forth. The second are the *Digital Innovation Hubs*, regional organizations created by trade associations to assist firms in digitalization processes by providing services and training. The third form consists of the *Digital Enterprise Points*, digital one-stop shops for businesses organized by the Chambers of Commerce in each province to provide the SMEs with initial guidance in investing in digital technologies.[3]

As yet, no overall assessment of the effects of this digitalization plan has been made, nor – given the complexity of the undertaking – is one likely to be forthcoming. However, there have been a few attempts to gauge the effectiveness of the measures for incentivizing purchases of integrated machinery. Several studies have found that adopting advanced digital technologies has a major impact, and also has positive returns in terms of productivity (Calvino *et al.*, 2022). However, it has also been found that these initiatives have mostly benefited large firms, or those small firms that have more skilled managers (Calvino *et al.*, 2022), as well as firms in institutionally dense locations like the industrial districts in the northern and central parts of the country (Gherardini; Pessina, 2020).

In any case, it would be hard to say what effect any one policy has on the amazing digital transformation now sweeping through Italy's productive

[3] More specifically, the Digital Enterprise Points were set up as part of the Digital Republic program, in which Unioncamere, the Italian Union of Chambers of Commerce, is a partner. The initiative has fielded the SELFI4.0 program whereby firms can measure their digital maturity, and ZOOM4.0, where a Chamber of Commerce Digital Promoter provides an in-depth digital assessment. An internal monitoring report shows that 37 thousand firms throughout the country have participated.

system. A number of public measures that are not expressly intended to encourage digitalization are nevertheless doing so indirectly. One example out of many is the Ministry of Economic Development scheme designed to facilitate access to credit by firms intending to purchase new machinery and equipment. The scheme is known as the "New Sabatini" program, after the Christian Democrat Member of Parliament Armando Sabatini who first proposed a similar facility in 1965. According to Ministry data, 70% of the investments benefiting from the program from the last quarter of 2021 to the first quarter of 2022 were for the purchase of digital-ready machinery, as against 30% for conventional machinery (Confindustria Digitale, 2022).

In addition, measures to encourage digitalization are increasing both in number and in terms of the amount of money involved. This is chiefly thanks to the National Recovery and Resilience Plan or NRRP, funded through the Next Generation EU stimulus package introduced by the European Union to help recover from the pandemic's economic and social damage. Approximately one quarter of the funds provided by the plan are earmarked for the digital transition: 48 billion euros will go towards improving broadband or 5G connectivity in areas underserved by the market, digitalizing schools, hospitals and public offices, creating a highly reliable public cloud and, lastly, R&D and technology transfer. NRRP funding has also been channeled into the National Strategy for Digital Skills, which calls for 111 initiatives designed to achieve three main goals: a) ensure that 70% of the population aged 16 to 74 has mastered basic digital skills by 2025; b) double the number of people with advanced digital skills, reaching a target of 78% of young college graduates, c) triple the percentage of people with degrees in ICT disciplines (only 1.3% in 2019) and double the percentage of SMEs employing ICT specialists (14% in 2019). The latter goals are particularly important, given the major mismatch between the digital skills that Italian workers currently have and those that employers need. To quantify this mismatch, the Digital Skills Observatory estimates that the supply of ICT specialists falls short of demand by 35% (Aica; Anintec-Assinform, 2019).

Despite all these efforts and laudable hopes, Italy's digitalization process has been uneven. As a survey of 40 thousand firms conducted in late 2020 found, there has been a mix of bright spots and pools of darkness (Calvino *et al.*, 2022). Though it is acknowledged that digitalization increased firms' resilience during the pandemic by lightening lockdown's impact, a closer look shows that not all businesses bore up equally well under the strain. As was to be expected, the less digitalized firms found it harder to face lockdown, made less use of remote working, and saw their revenues shrink more sharply. The survey also found that although all firms invested in digital technologies during the pandemic, those that had already been better prepared for digital business invested more, moving even further ahead of the firms that had been slower in buying into ICT (Calvino *et al.*, 2022).

At the same time, despite the advances made in digitalization, smaller firms are still behindhand in their use of advanced digital technologies (Confindustria Digitale, 2022). Compared to their medium-large counterparts, firms with fewer than 50 employees in 2021 are less likely to have adopted Artificial Intelligence systems and Internet of Things technologies, make less use of CRM and ERP software and the like to automate their corporate processes, and are less active in e-commerce and social media (see Table 1).

There is thus a real risk of a two-speed digital transition, where Italy's enterprises recover from the pandemic at a faster pace than firms in the rest of Europe, but the workforce is slow to learn the necessary skills. This would bode ill for the country's SMEs and its more peripheral regions. When resources are scarce, skilled workers inevitably gravitate towards bigger firms that can offer more attractive pay packages and better career prospects. At the same time, it will be more difficult for firms in outlying areas to woo digital skills away from the metropolitan cities. The joint impact of these two trends fueled by a two-speed digital transmission could tilt the balance even further in favor of big firms and, at the same time exacerbate the paradoxical effect of digitalization on the geography of Italy's economic development.

Table 1. Digitalization practices in Italian firms by size (2021)

Indicator	Employees				Total
	10-49	50-99	100-249	250 and over	
Firms using ERP software to share information among corporate functions	28.2	55.9	66.3	78.8	32.3
Firms using CRM software	24.7	40.0	46.5	57.0	27.1
Firms purchasing cloud services	58.7	69.9	73.6	83.0	60.5
Firms purchasing mid-level or sophisticated cloud services	50.4	59.0	64.5	74.2	51.9
Firms using at least one AI technology	5.3	9.4	11.3	24.3	6.2
Firms using at least one IoT technology	30.5	39.1	48.4	59.0	32.3
Firms whose online sales account for 1% or more of total revenues	12.4	14.9	18.3	34.0	13.1
Firms using at least two social media channels	25.8	34.0	39.2	54.1	27.3

Source: ISTAT 2021, Survey on information and communication technologies in enterprises.

Conclusions

Italy has long been considered the "real sick man of Europe" because of the dramatic and long-lasting drop-off in its economic growth. However, thanks to the country's unexpected ability to respond to the pandemic crisis, how Italy is perceived internationally was completely overturned in the course of 2021, so much so that it was hailed by The Economist as "country of the year". The argument we have presented in this article is that the two crises which unfolded in quick succession – the Great Recession of 2008-13 and the 2020-22 pandemic – have created the conditions for a course correction in Italy's growth strategies. In other words, these two external shocks, together with the flood of resources now available through the Next

Generation EU package and the National Recovery and Resilience Plan, have opened a window of opportunity to relaunch the country's economic and social growth, taking a high road to development. In fact, what has happened in recent years testifies to something quite different from a mere rebound after two major crises. Rather, it is a more structural (though not entirely planned) attempt to correct the Italian development model, which has been driven both by specific policies and by two classic Schumpeterian mechanisms: "creative destruction" and "creative accumulation".

This attempt at correction is particularly evident if we look at: a) the surprising strengthening of the national innovation system that took place after the great recession, and b) the "great leap forward" in the digital transition that was propelled by the pandemic. This process, however, is still fragile and fraught with contradictions. If not governed, could widen the long-standing territorial, economic and social gap present in the Italian development model or even create new divides.

In fact, in this phase of rapid technological change, the market creates highly dualizing "winner-take-most" dynamics that threaten to shrink the Italian economy's productive base beyond healthy limits. Both economically and socially, this has negative repercussions that can only be countered by public intervention to shore up social cohesion as well as business competitiveness.

In conclusion, we have proposed an interpretation that sees the two great crises that Italy has experienced in the last fifteen years as game-changers. This interpretation emphasizes the crises' generative dynamics, but without assuming that their potential will necessarily be realized, especially now that the war in Ukraine, the rise in gas prices and the darkening geopolitical outlook are slashing growth expectations for all advanced economies.

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