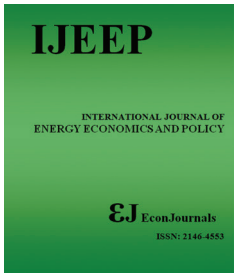

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Exploring the Economic Recovery of Italy's Regions Post-COVID-19: A focus on Energy, Services, ICT Opportunities, and the Digital Divide

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ABSTRACT

The world is gradually coming out of the COVID-19 emergency and what emerges from the Italian scenario presents two sides of the same coin. A large part of the investments made at this juncture have been distributed directly to the regions. Unfortunately, in the last 9 years, the twenty Italian regions have adopted different ITCs and distributed different levels of services and wealth. In doing so, there has been a lack of opportunity and development. The paper aims to understand how the Italian regions have recovered economically by analyzing variables such as services, the digital divide, energy management and the economic inequality. The investigation with a qualitative and quantitative analysis helps to understand these issues for Italian and non-governmental institutions.

Keywords: Digital Technology, Digital Divide, Energy, Disruptive Technology, SME, Italy
JEL Classifications: O3, O33, O38, R1, R11, R12

1. INTRODUCTION

Currently, the use of digital technologies has had a disruptive effect on various application areas, both in the public and private sectors. What emerges, by carrying out a SWOT analysis, are several bottlenecks that are multidisciplinary: Social, legal, economic, future vision, technological capabilities of individuals, limitation of the economic-social market, and lack of governmental vision. Some studies claim that these problems are avoidable or at least limited, because either they are the result of mentalities that will change over time and unwittingly accept change, or because they do not represent - for the reference area-a real problem. The human aspect, both in terms of managing the digital transformation, and in terms of government (skills) that must belong to the figure to proceed in the transition aspect, are still poorly considered. Human empathy and the phenomenon of burnout associated with this radical change are not investigated effectively, nor is it investigated the possible social repercussions of the massive use of artificial intelligence and digital technologies in a broad sense (Lee et al., 2020; Marino et al., 2022e). The objective is to monitor those gray areas to identify the corrective factors to be used to avoid the problems.

Over the last two decades, digital tools and in particular, information and communication technologies (ICT) have been strategic pillars in the growth of economic and social contexts (Marino and Pariso, 2022b). Digitization processes, characterized by disruptive innovation, fully revolutionize the previous innovations implemented (Marino et al., 2023). This type of innovation has resulted in far reaching changes in business models, improving their competitiveness, profitability and long-term growth. The innovation process has many social consequences: It enhances a

company's products and services, ensures its success and growth, and therefore employment. At the same time, innovation enhances the quality of infrastructure in geographic areas, thus improving the well-being of their communities (Welby, 2019; Qureshi et al., 2021; Li et al., 2022). For this reason, the countries have to improve their management capacity of technological innovations by assuming adaptive behaviors concerning changes that the external reference environment may generate.

The digital divide, where the lack of a digital culture makes it difficult to implement the e-government model based on digital, making its implementation and future development cumbersome (Pérez-Morote et al., 2020). Any process that is to be developed under the aspect of e-government must be harmonized in the cultural, economic and social contexts between EU countries, so as not to create a bottleneck to the action taken (Marino et al., 2021). Therefore, for this to happen fairly and equitably, ICT technology must be used in such a way that the market, the citizen and the State, have a mutually beneficial and fair role to play, so a strategy must be prepared.

The researchers examined the opportunities offered by information and communication technologies (ICT) in the field of energy saving. ICT-enabled smart grids can optimize energy generation, distribution and consumption, enabling more efficient use and integration of renewable energy sources. ICT solutions can also be used to manage energy in buildings and homes, optimizing energy consumption and identifying areas for improvement. In addition, ICT technologies can support demand response programs, encouraging users to reduce consumption during peak periods. IoT devices and sensors can be used to monitor and manage energy consumption in buildings, homes and industrial processes. ICT tools such as mobile applications, smart meters and real-time energy feedback systems can increase energy awareness among consumers and promote energy saving behaviors. By leveraging these ICT opportunities, we can work towards a more sustainable and energy efficient future, addressing global environmental concerns and contributing to economic recovery and growth (Badli, 2020).

In terms of data centers, online services heavily rely on them to store and process vast amounts of data. Implementing energy-efficient practices in data centers, such as using energy-efficient servers, optimizing cooling systems, and adopting virtualization techniques, can significantly reduce energy consumption (Beloglazov et al., 2012). Cloud computing offers opportunities for energy savings by consolidating computing resources and enabling efficient utilization, while green cloud computing research focuses on developing energy-efficient algorithms, resource management techniques, and virtualization approaches to reduce energy consumption (Liu et al., 2013; Zhang et al., 2013). Furthermore, software optimization techniques, such as efficient algorithms, streamlined code, and resource management techniques, can reduce computational requirements, leading to lower energy consumption (Singh et al., 2020; Orgerie et al., 2014). Studies have also explored various strategies (Koomey, 2011), such as efficient cooling techniques, server consolidation, dynamic workload allocation, and power management systems, to minimize energy usage in data centers. Sustainable software engineering is another area researchers are investigating to develop energy-efficient software applications and platforms.

Within the e-government aspects, the focus was on social and public health aspects (Marino et al., 2022; Marino et al., 2022c). The latter has emerged forcefully because of the COVID-19 pandemic that has affected the entire globe (Marino et al., 2021a; Marino and Pariso, 2022; Marino et al., 2022d; Chuvakhina et al., 2022). While it has given several stopping points to certain economic and socio-cultural aspects, it has also accelerated the digital transition.

The research will highlight a set of correlations between the level of digitization and the socio-economic indexes considered (Social Progress Index-SPI, Corruption Perception Index-CPI, Global Innovation Index-GII, and Doing Business-DB). This condition must be verified in scenarios in which socio-economic improvements are positively influenced by digital improvements.

So, how many digital dimensions will have correlations and intensity with socio-economic indexes, highlighting some of them as the most effective digital levers (Human Capital, Connectivity, Integration of Digital Technology) on the aforementioned socio-economic indexes? (Marino et al., 2021) Following this approach, in the European context, countries should operate mainly on the digital dimensions, which have emerged as the most effective, to aspire to obtain satisfactory results in the socio-economic context.

2. CONCEPTUAL BACKGROUND

Establishing clear governance frameworks and mechanisms ensures transparency in decision-making processes and fosters accountability among service providers. This helps ensure that online services adhere to ethical standards, respect user privacy, and avoid discriminatory practices (Taddeo and Floridi, 2016).

Including users in the governance process allows them to have a voice in shaping online services. Feedback mechanisms, user surveys, and participation in policy discussions help service providers understand user needs and preferences, enabling them to deliver better services. Value governance should encompass ethical considerations, such as promoting inclusivity, diversity, and fairness. The literature emphasizes the need for ethical frameworks and guidelines in the development and deployment of AI-powered online services, particularly in areas such as transparency, accountability, privacy protection, and fairness in algorithmic decision-making. Service providers should ensure their services do not perpetuate bias, discrimination, or harmful practices and should actively work towards fostering a safe and inclusive online environment. By considering these factors, online services can be designed and governed in a way that benefits both users and society as a whole.

The gap between the lack of preparation for digital disciplines and the mental approach to digitization is one of the major obstacles within a public or private organization (Solc, 2020), associated with the issue of the digital divide. The digital divide is wide and

is a complex and debated issue: limited access to Information and Communication Technologies (ICT) resources, and the lack of cultural background to fully understand these technological characteristics, means that a large part of stakeholders cannot exploit the potential of e-Government (Marino et al., 2020; Marino et al., 2020a). To fill these gaps, it might be interesting to involve intermediaries in the process of education and training citizenship, through appropriate preparation courses or in the implementation of info-kiosk and telecentres to mitigate the problem (Marino et al., 2022b).

The analysis is also focused on the most energy-intensive structures: They typically are those that require a lot of energy for heating, cooling, lighting, and other operations. Some examples of the most energy-intensive structures are Commercial and Industrial buildings, Data centers, Transportation infrastructure, Sport facilities, Residential buildings, Public buildings and also Medical facilities.

What no one had foreseen was COVID-19, which, as a result of strong health protection policies, quickly blocks all work activities where contact between two or more people is expected. Old and recent studies (Ben Sta, 2018; Gharami et al., 2019; Gunadi, 2019) have confirmed the different speeds with which individual countries make a digital transition or a change of technology, stressing the disparity in per capita income (Gross Domestic Product-GDP or Gini Coefficient) as a key factor.

The first case refers to the gap between the north and south of the world (Antwi-Gyamfi et al., 2022), the second case refers to a single country within a homogeneous area, and the third within a region that is part of a country (Dias et al., 2016; Gharami et al., 2019; Mangset and Asdal, 2019).

How fast, effective and efficient was this response of the national plans to the economic and health crisis? The analysis focused on the role of national and international institutions; in the first case, at the national level, the research paid attention to emergency responses to the economic crisis (Dimopoulos, 2013). This has led to a greater fragmentation between countries in the "rural" area and those with a more change-oriented vision. Within the European scenario, a double concept has been created: PIGS and Pearls. Pigs are linked to four European countries: Portugal, Italy, Greece and Spain.

Unpopular measures linked to the crisis have developed both social and economic emergencies. All these countries presented a profound constitutional review, investment in ICT and wealth distribution. What emerges, however, according to White (2015) is that the state of emergency sustained in the long term because unable to remedy or justify certain choices, will lead to an acceptance of the rule as routine, to the detriment of legitimate authority. In Italy, there have been and are, not only in this emergency phase, many actions to overcome economic crises, in particular, the digital divide and economic inequality.

There is a general correlation between income per capita and energy-intensive consumption in European countries, although the specific relationship can vary depending on factors such as the country's level of economic development, energy mix, and energy efficiency policies.

Generally, as income per capita increases, so does energy consumption. This is because higher income levels are typically associated with increased energy use for transportation, heating and cooling, and appliances and electronics. However, the relationship between income per capita and energy-intensive consumption can vary depending on the types of energy sources used in a given country.

One important factor is the energy mix of a given country. Countries that rely heavily on fossil fuels for energy production, such as coal or oil, tend to have higher energy-intensive consumption rates than countries that rely more on renewable energy sources, such as wind or solar power (Fankhauser and Jotzo, 2018).

Another important factor is energy efficiency policies. Countries with strong energy efficiency policies tend to have lower energy-intensive consumption rates, regardless of income per capita. For example, Denmark has implemented several energy efficiency policies, such as building codes and standards, energy labeling requirements, and energy efficiency subsidies, which have helped reduce its energy consumption despite its relatively high-income level (Osuntuyi and Lean, 2022).

Additionally, Italy has made significant investments in renewable energy sources such as solar and wind power, which have helped to reduce its reliance on fossil fuels and lower its greenhouse gas emissions. These investments have been supported by national policies and incentives, such as feed-in tariffs, tax credits, and subsidies for renewable energy projects (Hoseinzadeh and Garcia, 2022).

However, the country's reliance on energy-intensive industries such as manufacturing and mining can contribute to higher energy consumption levels in those sectors. Overall, continued investment in energy efficiency and renewable energy technologies can help Italy reduce its energy-intensive consumption and achieve sustainable economic growth. Starting from conceptual background is possible to formulate the following Research Questions (RQ):

- RQ1: How has the diffusion of ICT infrastructure and services in Italy impacted the country's energy consumption, and what strategies can be implemented to reduce the energy intensity of ICT while maintaining growth in the sector?
- RQ2: What is the relationship between investments in digital infrastructures and energy-intensive consumption in Italy, and how can public and private investments in ICT infrastructure be optimized to minimize their environmental impact?

The following methodology is developed to answer the two research questions. The greater the digital divide, the greater need for intervention. Having such a strong digital divide means investing in IT technologies and digital services as a priority so that citizens can use them.

3. METHODOLOGY

The importance of understanding where the diffusion of new digital technologies and therefore their use is concentrated is strategic because it represents a vehicle of diffusion of social and business relationships among stakeholders, contributing to the creation of value along the supply chain. To govern this phenomenon, we need to identify some key indicators that are representative of this evolution: the diffusion of ICT technologies, the creation of possible industrial realities and the GINI Coefficient, comparing them within the individual areas of the Italian State.

The analysis carried out on the Italian territory, distinguishing the entire country according to three geographical areas: north, center, and south, aims to evaluate the spread and adoption of ICT in Italian macro-areas. This analysis was carried out based on the elaboration of 12 indicators grouped on the data of the National Statistical Office (ISTAT, 2022). The period is 2007-2022, the last 13 years. In addition to geographical location, three strategic macro-classes have been taken into account: total residents, corporations and PAs. To measure access to information, it becomes strategic to have a global trend of dissemination and adoption of ICT in Italy (Table 1).

At the same time, it is advisable to verify, in line with the literature, the energy scenario which are the energy-intensive structures-for example, health and public administration (Black bones)-going to verify the energy consumption according to the drivers chosen through DESI, ISTAT, TERNA and ENEA.

On the other side According to the 2020 Statistical Report on Energy Consumption in Italy, the regions with the highest energy consumption per capita were Lombardy, Emilia-Romagna, and Veneto. Lombardy consumed 3,455 tonnes of oil equivalent (Toe) per capita, followed by Emilia-Romagna with 3.101 Toe/capita, and Veneto with 2.667 Toe/capita.

On the other hand, the regions with the lowest energy consumption per capita were Basilicata, Valle d'Aosta, and Molise. Basilicata consumed 1.306 Toe/capita, Valle d'Aosta consumed 1.554 Toe/capita, and Molise consumed 1.581 Toe/capita (TERNA, 2021).

It's important to note that energy consumption per capita doesn't necessarily indicate the overall energy consumption of a region, as it could be affected by factors such as population density and economic activity. Additionally, energy consumption data can vary from year to year depending on changes in energy policies, weather conditions, and other factors.

The Piano Nazionale di Ripresa e Resilienza (PNRR) recognizes the crucial role of local governments in the transition to a green and digital economy. The PNRR allocates 25.1% of resources to the ecological transition and 37.5% to the digital transition. The local authorities are responsible for implementing the projects financed through calls for proposals that are gradually published. About one-third of the total resources of the PNRR, equal to about 66 billion euros, is destined for the territory, of which about 40% is addressed to the Mezzogiorno.

Table 1: ICT diffusion and adoption in Campania region

Indicator	Technical definition of indicator/associated data Set	Time framework
Total resident population		
Degree of Internet diffusion in families	Percentage of households who claim to have Internet access out of total households	2007-2022
Degree of internet use in households	Percentage of 6 years old and over people who report using the Internet out of total 6 years old and over people	2007-2022
Ultra broadband penetration	Number of ultra-broadband subscriptions as a percentage out of total resident population	2007-2022
Companies		
Degree of diffusion of the personal computer in companies with more than ten employees	Percentage of companies (with more than ten employees) in the industrial and services sector that have personal computers	2007-2022
Diffusion index of companies' websites	Percentage of companies (with more than ten employees) in the industry and services sectors that have a website	2007-2022
Broadband diffusion index in companies	Percentage of companies (with more than ten employees) in the industry and services sectors that have broadband connections	2007-2022
Degree of Internet use in companies	Percentage of employees of enterprises (with more than ten employees) in the industry and services sectors using computers connected to the Internet	2007-2022
Public administration		
Degree of diffusion of broadband in local administrations	Municipal administrations with broadband access out of total municipal administrations (percentage)	2007-2022
Municipalities with fully interactive services-fourth stage of OCSE classification (OECD, 2003)	Number of municipalities with fully interactive services as a percentage out of total number of municipalities	2007-2022
Availability of public wi-fi in the municipalities	Percentage of Municipalities that provide free wi-fi access points in their territory out of total of Municipalities	2007-2022
Local government employees who have followed ICT training courses	Number of employees of local administrations who have followed ICT training courses as a percentage of total employees	2007-2022
Use of e-government by companies	Percentage of companies that have had online interactions with the PA	2007-2022

ICT: Information and communication technologies

Local authorities involved in territorial-specific actions include regions, autonomous provinces, metropolitan cities and municipalities. The municipalities and metropolitan cities are the main recipients of investment, followed by local health companies (ASL) and hospital companies. The missions with the greatest investments for the territory are the "green revolution and ecological transition," "inclusion and cohesion" and "health" (Italia domani, 2021) (Table 2).

In Mission 6, which concerns health, resources have been allocated for strengthening prevention and health services in the area, modernizing and digitizing the health system and ensuring equal access to care. In total, as of December 2021, 13.232 billion euros have been allocated for ongoing projects and 13.864 billion euros for new projects, for a total of 66.4 billion euros allocated to the territory through the PNRR (Italia domani, 2021).

In 2020, energy consumption in the service sector decreased by 9.0%, with a total consumption of 16.6 million tonnes of oil equivalent (MTeP). This sector, after that of transport, has been particularly affected by the contraction of economic activity due to the COVID-19 pandemic. The impact of the pandemic on services can be highlighted by the consumption of electricity, the main energy source in the sector together with natural gas (Matthew, 2019). In 2020, electricity consumption in services decreased by 15.6%. The sectors most affected were housing (−30.6%), education (−28.8%), arts, sports and entertainment (−35.5%) and catering (−18.4%). This, therefore, excluded the activities of PA (−9.7%) and Health (−6.9%) that have occurred a minimal contraction (TERNA, 2021) (Table 3).

The indicators provide preliminary strategic information to analyze the reference environment, within three macro sectors, in which the technological innovation is diffused and adopted. In line with this research stream, we have analyzed ICT diffusion and adoption, and how, the total resident, companies, and the PA can access information as a pre-requirement of changing processes. This last aspect has been developed with the support of the Gini coefficient. It provides interesting information on the inequalities and their distribution in the three considered geographical areas. In particular, the distribution of inequalities is a strategic variable to understand the possibilities of access to information by the total resident, businesses, and PA. The inequalities that occur in the distribution according to the economics view built on the principle of scarce resources lead to imbalances in the economic system. The unequal sharing of resources leads to different well-being levels and thus the decrease in social welfare. Thereby it is important to measure the levels of inequality, which are denoted as situations in which the distributions are different from each other (Karoly, 1992). This method provides the opportunity to denote numerically the inequality caused by the different income distributions (Ceriani and Verme, 2012). The Gini coefficient is obtained by taking as basis the Lorenz curve, which is the graphical display, Figure 1, of income inequality. The Lorenz curve depicts graphically the ratio of the share received by the individuals from the total produced income (Kakwani, 1977). The population is divided by the determined income levels and the incomes of each segment are cumulatively determined (Chakraborty and Bosman, 2002). Figure 1 demonstrates the Lorenz curve, which shows the income distribution inequalities (A area) within the population segments (Maclachlan and Sawada, 1997). The Gini coefficient is the most appropriate method used for the measurement of inequalities (Chakraborty and Bosman, 2005).

Table 2: Estimated resources allocated to local and regional authorities by type of entity

Municipalities	Resources (Billions of Euro)
Municipalities and Metropolitan Cities	28.32
Regions, Provinces, Municipalities	10.79
Regions	10.84
ASL/Hospitals	15.10
Other	1.36
Total	66.41

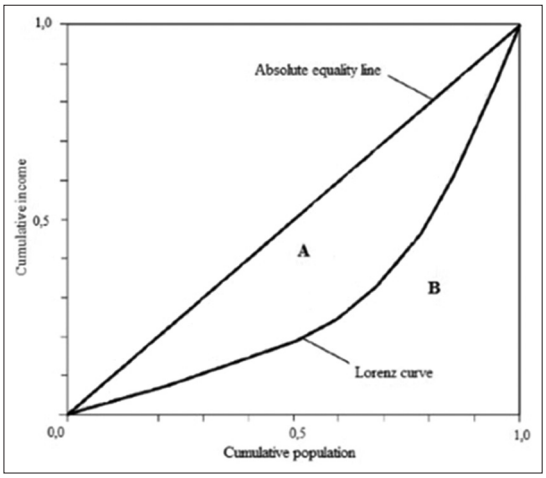
Source: "I Comuni e le Città nel PNRR: le risorse e le sfide"

Table 3: Final consumption of electricity in Italy in the services sector. Years 2019 and 2020 (TWh)

Activities/Year	2019 (TWh)	2020 (TWh)	Variation (2019/2020) (%)
Trade	21.4	21.0	−1.7
Accomodation	4.5	3.1	−30.6
Catering	8.9	7.2	−18.4
Professional activities (Credit, Insurance, etc.)	16.0	13.3	−17.2
Public Administration	10.6	9.6	−9.7
Education	2.4	1.7	−28.8
Health	5.9	5.5	−6.9
Arts activities, Sports, Entertainment	2.7	1.7	−35.5
Other activities and services	16.9	12.1	−28.3
Total	89.2	75.3	−15.6

Source: TERNA

Figure 1: Lorenz Curve



The ratio of the area between the Lorenz curve and the absolute equality line (A) to the right triangle located under the absolute equality line (A+B), as provided in Figure 1 is denoted as the Gini coefficient and is obtained with equation (1).

$$G = \frac{A}{A+B} \quad (1)$$

In cases in which the intergroup's population sizes are equal the Gini coefficient may be calculated with equation (2).

$$G = \frac{1}{n}(n+1-2\frac{\sum_{i=1}^{n}(n+1-i)y_i}{\sum_{i=1}^{n}y_i} \quad (2)$$

Each of the n groups in the equation is denoted as i and Y_i shows the cumulative percentage of the income (Shankar and Shah, 2003). The equation (Gini value) calculated without including population, may be used under the assumption that population distribution is even. However, in the analysis of the regions with different population sizes, weighting the calculations according to the population will give healthier results. In this case equation (3),

$$G = \sum_{i=1}^{n}\left|X_iY_{i+1} - X_{i+1}Y_i\right| \quad (3)$$

Shall be used for the calculation of the Gini coefficients. The n shows the region number, X_i the cumulative population ratio and Y_i the cumulative income ratio of region i. It is emphasized that an ascending sort of income group is needed before the calculation is made by using this equation (Maclachlan and Sawada, 1997). The G value resulting from the ratio is between 0 and 1.

In Figure 1, if the A area increases (becomes distant from the certain equality line of the Lorenz curve) G value approaches 1 and this means that the inequality increases. If A area decreases (approaches the certain equality line of Lorenz curve) G value approaches 0 and inequality decreases.

4. RESULTS

To investigate if, in this geographical area, the digital divide is also linked to the inequality of cumulative income per capita, Gini Coefficient has been calculated and the results are in Table 4.

By setting the average Italian limit value, it is possible to notice-in Table 5-leopard-spot dissemination of the digital divide phenomenon. The regions that makeup are: Lazio, Campania, Calabria, Sicilia and Sardegna. It is interesting to note that this macro area displays also a strong digital divide in terms of access to information. Starting from this assumption, the results will be elaborated on in the next paragraph.

For the digital divide, scholars emphasize the importance of ensuring access to energy-efficient technologies, promoting awareness and education on energy-saving practices, and sustainable infrastructure development. Providing affordable and sustainable technology options to underserved communities helps them overcome barriers and access energy-efficient solutions. Promoting awareness and providing education about energy-saving practices can empower communities affected by the digital divide to make informed decisions regarding energy usage and adopt energy-saving behaviors. Addressing the digital divide should go hand in hand with sustainable infrastructure development, extending reliable electricity access and deploying energy-efficient communication networks in underserved areas.

Table 4: Gini coefficient, income per capita by Italian regions

Income per capita Italian regions	Gini Coefficient
Italy	0.305
North 36.218 € per capita year	
Piemonte	0.287
Valle d'Aosta	0.266
Liguria	0.288
Lombardia	0.285
Trentino Alto Adige	0.276
Veneto	0.273
Friuli-Venezia Giulia	0.262
Emilia-Romagna	0.269
Toscana	0.272
Middle 33.837 € per capita year	
Umbria	0.270
Marche	0.252
Lazio	0.311
Abruzzo	0.277
South 26.984 € per capita year	
Molise	0.285
Campania	0.339
Puglia	0.292
Basilicata	0.282
Calabria	0.339
Sicilia	0.328
Sardegna	0.304

Source: Our elaboration by ISTAT (2022)

From what emerges between the experimental studies it is clear that there is not only an extremely significant relationship of mutual influence between them, but also the differences in each region are very clear. This is mainly reflected in the fact that the economic growth of the three regions (economically developed region, rapidly developing region and slow and constantly developing region) can stimulate energy consumption, that is, it is a one-way causal relationship. Among these, economic growth in economically developed areas does not so clearly promote energy consumption (Wang, 2022).

5. DISCUSSION

From a comparison analysis, using the ICT indicators and the Gini coefficient, it is possible to affirm a close correlation between the two: Specifically, the regions that have uniformity in the distribution of the gross domestic product (Gini coefficient) are those that have the highest values for indicators of adoption and use of ICT. Moreover, the same regions have a reduced presence of the digital divide phenomenon. At the same time, in regions where the spread of ICT indicators is lower, there is also a high inequality, and the digital divide is very present and widespread.

A strong improvement in ICT indices in the southern regions, compared to previous years, due to the phenomenon of forced digital transition by the pandemic COVID-19. Nevertheless, there is a strong correlation between GDP and digital divide, in particular in the field of Public Administration and government services and health.

In many other European areas, as in the world, there are countries with blocked economic development (Porumbescu, 2016). Would

Table 5: Investment on three driver sector in digitalization: Energy and economic safe

Topic	Italian region	Type of investments
ICT Infrastructure	Lombardia	ICT Infrastructure, especially in the metropolitan area of Milan
	Lazio	ICT infrastructure in Rome, given its importance as the capital of the country
	Emilia-Romagna	ICT infrastructure to promote innovation and competitiveness
	Piemonte	ICT infrastructure in the Automotive and Industrial sectors
	Veneto	ICT infrastructure to support the development of manufacturing, tourism and services
Digitalization of PA	Lombardia	Invested in digitalization, thanks to its role as the financial and economic center of Italy
	Emilia-Romagna	Investments in the digitization of Public Administration, promoting the adoption of online services and interoperability between public bodies.
	Toscana	The region has actively promoted the digitization of public services, implementing innovative technological solutions to improve the accessibility and efficiency of administrative procedures.
	Piemonte	Digitalization of public administration to make public services more efficient and improve interaction with citizens and businesses.
	Veneto	Digitalization of public administration aims to simplify the interaction between citizens, businesses and public bodies through the use of digital technologies.
Public health	Emilia-Romagna	Public Health's investments in prevention, health promotion and quality of health services.
	Lombardia	One of the most populous and industrialized regions of Italy, focusing on the modernization of health facilities and improving access to health services.
	Veneto	Veneto region is focusing on disease prevention, the promotion of healthy lifestyles and technological innovation in the health sector.
	Toscana	Toscana region has made investments in health promotion, disease prevention and medical research.
	Piemonte	Investment with particular attention to health promotion and disease prevention, as well as to the development of high-quality health services.

Source: Own making. ICT: Information and communication technologies

this allow the development of a new governance model? (Shankar and Shah, 2003; Dekker and Bekkers, 2015). It should be noted, however, that the Italian governing body is substantially different from the others in these respects:

- The Council of ministers is larger than similar councils of any other European government
- Currently Italy has the largest number of ministries and central units of any other country in the Europe.

The hierarchical structure inside the PA is variable in the time in function of the executives that follow each other, so as the positions to disposition for the figures of high-manager, regarding the employee are greater. Moreover, local government is not autonomous, but depends on ministries in terms of investment and management, although it is in a satellite position relative to the central government. This configuration type has created a hierarchical pyramid with 20 regions and 7.904 municipalities on 10.286 local government units. The considerable territorial fragmentation does not block the training activities that the local government applies, instilling a consciousness of continuing education in terms of the use and dissemination of ICT. Everything, however, is subordinated to the apical and managerial functions and especially to the degree of motivation of the employees, so the human factor represents an additional bottleneck (Marino et al, 2021a). What also emerges is the telematic infrastructure that has difficulties: The "degree of broadband in local government" is 16% points lower than the average and about 6 times in northern Italy. Southern Italy, therefore, is in the background both for problems of infrastructural type, is for lack of motivation of the dependent and farsightedness of the managers.

This bottleneck is confirmed by the low level of wi-fi in the municipalities with 13.3% points and a high spread with middle (+20%) and more than 6 times with north Italy. These negative trends are confirmed in the service assessment by OCSE "Local government with fully interactive services" (fourth stage of OCSE classification)," where southern Italy highlights the worst score with a spread of 13.1% points with middle and 65.6 with northern Italy. Furthermore, there is also a low "Use of e-government by companies" that confirms the trends previously described.

The government of the territory has a fundamental role within the Italian scenario: the citizens of these municipalities elect a mayor and a council composed of a minimum of 15 and a maximum of 60 members. Note how the spread linked to PA is 6 times greater in northern Italy than in other areas; in southern Italy, there is the lowest per capita income of the year (26,984) to which added a greater inequality of distribution, in all 0.28.

This type of negative distribution, unfortunately, is also reflected in the total resident population and businesses.

After the COVID pandemic, there was a substantial leveling of the GDP, considering a limit value of 0.29, which involves both regions of southern Italy and the Centre, which belongs to 6 regions (Lazio, Campania, Puglia, Calabria, Sicily and Sardinia) out of a total of 20 regions.

In these regions also the Gini coefficient displays a range between 0.29 and 0.340.

Public Administration, unfortunately, is in deficit in terms of digital innovation, and in central-southern Italy this technological and economic gap is present. The profile of the northern macro area is very different, with a wide diffusion and adoption of ICT, a higher GDP and its fair spread.

With a GDP of about 36,200 euros and a coefficient of Gini, which has values between 0.288 and 0.26, as confirmed by ICT indicators, confirm the technological leadership.

The analysis of these data leads us to the evidence that the long queue of exits from COVID-19, where Italian institutions are starting to leave behind, will have a different impact in the country and especially in individual regions. Following the COVID-19 pandemic, many investments have focused on disruptive technologies and the health sector, as well as on the contingent factors that feed the distribution of the wealth produced. The resident population, the companies, and the PA are all involved and this represents a factor of complexity in the logical-decision-making processes. Based on the calculated indicators and the Gini coefficient, central Italy will have some opportunities, but the best-performing geographical area, northern Italy, will create opportunities and wealth (Bertot et al., 2016) in the last phase.

Several measures are being taken to reduce energy consumption in high-consuming regions in Italy. Some of these measures include:

- Energy efficiency improvements in buildings: One of the most effective ways to reduce energy consumption is to improve the energy efficiency of buildings. This can be done through measures such as insulation, efficient heating and cooling systems, and energy-efficient lighting.
- Promotion of renewable energy sources: The promotion of renewable energy sources such as solar, wind, and biomass can help reduce the consumption of fossil fuels and lower greenhouse gas emissions.
- Energy-saving campaigns: Public awareness campaigns aimed at promoting energy-saving habits can help reduce energy consumption. These campaigns can include information on simple actions such as turning off lights and appliances when not in use, using energy-efficient appliances, and reducing water consumption.
- Incentives for energy-efficient behavior: Incentives such as tax credits, rebates, and subsidies can encourage individuals and businesses to adopt energy-efficient practices and invest in energy-saving technologies.
- Energy audits: Energy audits can help identify areas of high energy consumption and provide recommendations for energy-saving measures.
- Development of smart grids: Smart grids can help optimize energy consumption by balancing energy demand and supply, reducing energy waste, and integrating renewable energy sources into the grid.
- Building codes and standards: Building codes and standards can require new buildings to meet certain energy efficiency criteria and promote the adoption of energy-saving technologies.

These measures are being implemented at various levels, including national, regional, and local levels, and involve collaboration between government, businesses, and individuals. By reducing energy consumption, these measures can help lower greenhouse gas emissions, reduce dependence on fossil fuels, and improve energy security (TERNA, 2021).

Some Italian regions have shown a significant commitment to promoting the effectiveness and efficiency of energy consumption. Some examples include:

- Lombardia: The Lombardia region is one of the major players in the field of energy efficiency in Italy. It has implemented several policies and programs aimed at reducing energy consumption and promoting the use of renewable energy sources.
- Emilia-Romagna: The Emilia-Romagna region has taken measures to promote energy efficiency and environmental sustainability. It has also set up programs to encourage the use of renewable energy and improve the efficiency of public buildings.
- Veneto: The Veneto region has promoted policies and programs for energy efficiency, focusing on reducing consumption and adopting more sustainable technologies. It has also encouraged the production and use of renewable energy.
- Toscana: The Toscana region has invested in policies for energy efficiency, aiming to reduce consumption and promote the use of renewable energy. It has implemented training and support programs to encourage the adoption of sustainable energy practices.
- Piemonte: Piemonte has adopted policies and programs for energy efficiency, focusing on reducing consumption and promoting renewable energy sources. It has also encouraged the energy upgrading of public and private buildings.

What emerges is that the regions that have a value of the GINI Coefficient, medium-high, are those that have been able to make more investments in key energy-intensive sectors. Implementing thus, energy policies of effectiveness and efficiency (Italia Domani, 2021).

6. CONCLUSION

The research shows that in this last phase, connected to COVID-19, it is possible to create value governance in many Italian regions, but unfortunately, it is not possible in these specific six regions out of a total of twenty; ICTs diffusion and adoption, as well as economic inequality, showed widespread bottlenecks as displayed by ICT indicators and Gini coefficient. In this area, the investments, as a strategy to exit the emergency, will be a challenge to implement the last phase related to COVID-19. The Institutional action should create value governance, as discussed, by removing those factors that:

a. Have not accompanied the provision of the digital divide with a reform of the opportunities for citizens, companies and PA to access communication with local and national Institutions;
b. Have not overcome, within institutions, the functions based on any scientific principles
c. It emerged that most of the energy-intensive structures have been taken care of by the regions that have a higher GINI Coefficient, focusing on greater effectiveness and efficiency of resources according to the investments made.

Italian institutions often emphasize rules and procedures rather than outcomes and results. Furthermore, asking a collective sacrifice, such as both social and economic lockdown, into the next phase, it will be necessary to propose a social contract that offers benefits to all. Economic lockdown penalizes especially those that are already in difficulty. Despite the calls for National unity, it is clear that Italy is not in the same social and economic

condition. The perspectives are quite different in the three geographical areas considered. Southern institutions will have to play a more active role in the economy and consider the public sector as an investment. To win these challenges, in South Italy it is important to introduce a new framework of ideas by adopting a new paradigm: the economic weakness and the technological lag in six regions are two sides of the same problem. Starting from these two assumptions, the nature of the Italian digital divide and economic inequality highlight bottlenecks dated and unsolved. In line with this statement, the Italian digital divide and economic inequality are complex and debatable, particularly in southern Italy. In this way, an accurate diagnosis, by Institutions, of the digital divide and economic inequality in southern Italy is imperative to understand and implement the proper solutions. The digital divide and economic inequality are open questions but it is necessary to break speedily both the ICTs diffusion-adoption and economic inequality vicious circle. Without this approach, it will be impossible to improve the performance of rural southern Italy in this last phase of the pandemic time.

REFERENCES

Antwi-Gyamfi, N.Y., Jetha, K., Lee, Y.T., Rauch, M.S., Stratton, C., Su, N. (2022), Work and collaboration across and between the global south and global north. Academy of Management Proceedings, 2022(1), 16810.

Badli, S. (2020), Investigating the efficiency of government expenditure on energy consumption (fuel) subsidy policy in Indonesia: An application of stochastic frontier model. International Journal of Energy Economics and Policy, 10, 161-165.

Beloglazov, A., Abawajy, J., Buyya, R. (2012), Energy-aware resource allocation heuristics for efficient management of data centers for cloud computing. Future Generation Computer Systems, 28(5), 755-768.

Ben Sta H., (2018), Organisational structure for the e-government coordination and interoperability framework: A case study of Tunisia, Electronic Government an International Journal, 14(1), 51-77.

Bertot J., Estevez E., Janowski T. (2016), Universal and contextualized public services: Digital public service innovation framework. Government Information Quarterly, 33(2), 211-222.

Ceriani, L., Verme, P. (2012), The origins of the Gini index: Extracts from Variabilita e Mutabilita (1912) by Corrado Gini. The Journal of Economic Inequality, 10, 421-443.

Chakraborty, J., Bosman, M.M. (2002), Race, income, and home PC ownership: A regional analysis of the digital divide. Race and Society, 5(2), 163-177.

Chakraborty, J., Bosman, M.M. (2005), Measuring the digital divide in the United States: Race, income and personel computer ownership. The Professional Geographer, 57(3), 395-410.

Chuvakhina, L.G., Yarygina, I.Z., Ustinova, O.E., Mironova, VN., Ivanovskaya, Z.V. (2022), The impact of Covid-19 on pricing in the global oil market. International Journal of Energy Economics and Policy, 12(5), 370-377.

Dekker, R., Bekkers, V, (2015). The contingency of governments' responsiveness to the virtual public sphere: A systematic literature review and meta-synthesis. Government Information Quarterly, 32(4), 496-505.

Dias, G.P., Gomes, H., Zúquete, A. (2016), Privacy policies and practices in portuguese local e-government. Electronic Government, an International Journal, 12, (4), 301-318.

Dimopoulos, A. (2013), PIGS and pearls: State of economic emergency, right to resistance and constitutional review in the context of the eurozone crisis. ICL Journal, 7(4), 501-520.

Fankhauser, S., Jotzo, F. (2018), Economic growth and development with low□carbon energy. Wiley Interdisciplinary Reviews: Climate Change, 9(1), e495.

Gharami, S., Prabadevi, B., Bhimnath, A. (2019), Semantic analysis-internet of things, study of past, present and future of IoT. Electronic government, an International Journal, 15(2), 144-165.

Gunadi, G. (2019), Qualitative system dynamics modelling of the impacts of maintenance, effort, competence and collaboration on e-government website availability. Electronic Government, an International Journal, 15(2), 189-212.

Hoseinzadeh, S., Garcia, D.A. (2022), Techno-economic assessment of hybrid energy flexibility systems for islands' decarbonization: A case study in Italy. Sustainable Energy Technologies and Assessments, 51, 101929.

ISTAT. (2022), Available from: https://www.istat.it/it/archivio/occupati

Italia Domani. (2021), Available from: https://www.italiadomani.gov.it/it/strumenti/documenti/archivio-documenti/le-slide-dell-iniziativa--i-comuni-e-le-citta-nel-pnrr--le-risor.html. [Last accessed on 2023 May 28].

Kakwani, N.C. (1977), Applications of lorenz curves in economic analysis. Econometrica, 45(3), 719-728

Karoly, L.A. (1992), Changes in the distribution of individual earnings in the United States: 1967-1986. The Review of Economics and Statistics, 74(1), 107-115.

Koomey, J. (2011), Growth in Data Center Electricity Use 2005 to 2010. A Report by Analytical Press, Completed at the Request. New York: The New York Times, 9(2011), 161.

Lee, J.H., Hsu, C., Silva, L. (2020), What lies beneath: Unraveling the generative mechanisms of smart technology and service design. Journal of the Association for Information Systems, 21(6), 3.

Li, D., Jia, F., Schoenherr, T., Liu, G. (2022), How do platforms improve social capital within sharing economy-based service triads: An information processing perspective. Production Planning and Control, 1-18. Doi: 10.1080/09537287.2022.2101959

Liu, F., Zhou, Z., Jin, H., Li, B., Li, B., Jiang, H. (2013), On arbitrating the power-performance tradeoff in SaaS clouds. IEEE Transactions on Parallel and Distributed Systems, 25(10), 2648-2658.

Maclachlan, I., Sawada, R. (1997), Measures of income inequality and social polarization in Canadian metropolitan areas. The Canadian Geographer/Le Ceographe Canadien, 41(4), 377-397.

Mangset, M., Asdal, K. (2019), Bureaucratic power in note□writing: Authoritative expertise within the state. The British Journal of Sociology, 70(2), 569-588.

Marino, A., Pariso, P. (2020), From digital divide to e-Government: Re-engineering process and bureaucracy in public service delivery. Electronic Government, an International Journal, 16, 314.

Marino, A., Pariso, P. (2020a), Value Governance, Digital Divided and Economic Inequality in Italy During the Covid 19 Emergency. In: The 4th International Conference on E-Commerce, E-Business and E-Government. p45-53.

Marino, A., Pariso, P. (2021), Digital economy: Technological, organizational and cultural contexts for the development of cooperation in Europe. Entrepreneurship and Sustainability Issues, 9(2), 363-383.

Marino, A., Pariso, P. (2021a), The global macroeconomic impacts of COVID□19: Four European scenarios. Academy of Strategic Management Journal, 20(2), 1□21.

Marino, A., Pariso, P. (2022), The digital platform experience of a leading country in wine tourism: From COVID-19 to the New Era. International Journal of Innovation and Technology Management, 19(07), 2250021.

Marino, A., Pariso, P. (2022), The impact of ICT on the tourist economy of a Southern Italian region. International Journal of Services Technology and Management, 28(1-2), 68-85.

Marino, A., Pariso, P., Picariello, M. (2021), E-government and Italian local Government: Managerial Approach in Two Macro Areas to Improve Manager's Culture and Services. In: Advanced Information Networking and Applications: In: Proceedings of the 35th International Conference on Advanced Information Networking and Applications (AINA-2021). Vol. 3. Cham: Springer International Publishing. p107-116.

Marino, A., Pariso, P., Picariello, M. (2021), The influence of digital levers on the growth of social contexts and economic development within European countries. In: The 5th International Conference on E-Commerce, E-Business and E-Government, p141-146.

Marino, A., Pariso, P., Picariello, M. (2022), Digital platforms in health care: Evaluating workers' expectations and profiles during pandemic time. Entrepreneurship and Sustainability Issues, 10(1), 226-241.

Marino, A., Pariso, P., Picariello, M. (2022b), Information Networking and e-Government in United Nations and Europe. In: Advanced Information Networking and Applications: Proceedings of the 36th International Conference on Advanced Information Networking and Applications (AINA-2022), Vol 3. Cham: Springer International Publishing.

Marino, A., Pariso, P., Picariello, M. (2022c), A systematic literature review on e-health implementation and policies. Entrepreneurship and Sustainability Issues, 10(2), 43.

Marino, A., Pariso, P., Picariello, M. (2022d), Digital platforms and entrepreneurship in tourism sector. Entrepreneurship and Sustainability Issues, 9(4), 282.

Marino, A., Pariso, P., Picariello, M. (2022e), Transition towards the artificial intelligence via re-engineering of digital platforms: Comparing European Member States. Entrepreneurship and Sustainability Issues, 9(3), 350.

Marino, A., Pariso, P., Picariello, M. (2023), Disruptive technologies: The spread of eGovernment in the European union and its bottlenecks. In: Intelligent Sustainable Systems: Selected Papers of World S4 2022, Vol. 2. Singapore: Springer Nature Singapore. p205-213.

Matthew, O.A. (2019), Electricity consumption, government expenditure and sustainable development in Nigeria: A co-integration approach. International Journal of Energy Economics and Policy, 9, 74-80.

Orgerie, A.C., De Assuncao, M.D., Lefevre, L. (2014), A survey on techniques for improving the energy efficiency of large-scale distributed systems. ACM Computing Surveys (CSUR), 46(4), 1-31.

Osuntuyi, B.V., Lean, H.H. (2022), Economic growth, energy consumption and environmental degradation nexus in heterogeneous countries: Does education matter? Environmental Sciences Europe, 34(1), 1-16.

Pérez-Morote, R., Pontones□Rosa, C., Núñez□Chicharro, M. (2020), The effects of e□government valuation, trust and the digital divide in the levels of e□government use in European countries. Technological Forecasting and Social Change, 154, 119973.

Porumbescu, G.A. (2016), Linking public sector social media and e-government website use to trust in government. Government Information Quarterly, 33(2), 291-304.

Qureshi, I., Pan, S.L., Zheng, Y. (2021), Digital social innovation: An overview and research framework. Information Systems Journal, 31(5), 647-671.

Shankar, R., Shah, A. (2003), Bridging the economic divide within countries: A scorecard on the performance of regional policies in reducing regional income disparities. World Development, 31(8), 1421-1441.

Singh, V., Gupta, I., Jana, P.K. (2020), An energy efficient algorithm for workflow scheduling in IAAS cloud. Journal of Grid Computing, 18, 357-376.

Solc, M. (2020), Patients and privacy: GDPR compliance for healthcare organizations in the Czech republic. European Journal of Privacy Law and Technologies, ???, 51.

Taddeo, M., Floridi, L. (2016), The debate on the moral responsibilities of online service providers. Science and Engineering Ethics, 22, 1575-1603.

TERNA. (2021), Available from: https://download.terna.it/terna/Terna_Annuario_Statistico_2021_8dafd2a9a68989c.pdf. [Last accessed 2023 May 28].

Wang, S. (2022), Differences between energy consumption and regional economic growth under the energy environment. Energy Reports, 8, 10017-10024.

Welby, B. (2019), The Impact of Digital Government on Citizen Well-Being. OECD Working Papers on Public Governance, No. 32. Paris: OECD Publishing.

White, J. (2015), Authority after emergency rule. The Modern Law Review, 78(4), 585-610.

Zhang, D., Li, G., Zheng, K., Ming, X., Pan, Z.H. (2013), An energy-balanced routing method based on forward-aware factor for wireless sensor networks. IEEE Transactions on Industrial Informatics, 10(1), 766-773.