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The polarisation of Italian metropolitan areas, 2000-2018:
structural change, technology and growth

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Abstract

Large cities are a key driver of technological innovation and economic growth. This paper investigates the developments of Italian metropolitan areas, building on insights from economic geography and innovation studies. The key questions to be investigated are the following:

a) Which trajectories of population and economic change can be identified for Italian metropolitan areas? Are we facing a process of economic and technological polarisation that may worsen the country's imbalances?

b) What is the role played in such developments by technological and structural change, and in particular by digital technologies and the rise of finance?

The empirical analysis investigates the patterns of technological and economic indicators for the period 2000-2018 for 14 Italian metropolitan areas – proxied by their provinces -, providing evidence of growing polarisation between Milan, where most positive developments are concentrated, and the other metropolitan zones. Rome has been losing ground in most fields; Venice and Genoa are characterised by industrial decline. Few mid-sized cities show some economic dynamism – including Bologna and Cagliari - while most southern and insular Italian cities increase their gap relative to the performances of leading metropolitan areas.

Keywords: urban economics, statistical methods, economic polarization, metropolitan areas, divergence.

Classification: C10, O14, R11.

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1. Introduction

This paper contributes to the literature of economic geography and innovation studies analysing the trends of population, technological and economic changes of Italian metropolitan areas from 2000 to 2018. The rise of the population in metropolitan zones shrinks the demography of the peripheries. The growth of income concentrates in large cities along with the decline of old manufacturing centres. High-profits corporate services cluster in few places, enlarging the disparities in wealth and opportunities. Moreover, innovation activities gather in a few urban zones, expanding geographical structural imbalances. Two are the features at the roots of these developments. First, knowledge-intensive services such as Finance and ICT benefit from agglomeration externalities and concentrate in large metropolitan cities (Diodato et al., 2019, Glaeser, 2020). Second, innovation activities take place in a few metropolitan hubs where the accumulation of capital, researchers and firms creates an especially innovative environment (Crescenzi et al., 2019, Moretti, 2012). These two developments created a new spatial order featured by a few rich urban agglomerations –“superstars cities”-, and declining territories –“places that do not matter”, overlooked by the world economy.

Are these developments affecting also Italian metropolitan areas? Do technology and corporate services polarise among Italian metropolitan zones?

The relevance of such processes in Italy has received less attention. Viesti (2021) illustrates the divergent growth of the aggregated value-added of industry and services among Italian provinces. In particular, he emphasises the strong gap between the leading provinces and the southern ones. Moreover, he witnessed a negligible weight of market-oriented services outside of a few top areas. There is, still, scarce evidence regarding the concentration of innovation, economic production and technological sectors among the Italian metropolitan territories due to their recent institution in 2014. The paper will fill this gap in the literature analysing Italian metropolitan areas- proxied by their provinces- from 2000 to 2018 in terms of innovation, income, and sectoral dynamics. Policymakers created these urban zones to stress the strong linkage between the principal city and the close commuting zones regarding economic activity, social services, and labour market pooling. Italian government considered the metropolitan territories a key tool to foster the development of the entire country and guaranteed innovative governance instruments and specific resources. Italian metropolitan cities in 2016 accounted for 36,2% of the country's population, 41% of total value added (ISTAT, 2020), and 35% of total employment (Start City, 2016).

The work finds geographical polarisation in the country concerning GDP per capita and value-added growth, as well as for the sectoral composition of metropolitan economies, focusing on three key economic sectors: Financial and Insurance Services, ICT services, and the manufacturing industry. Likewise, we witness evidence of the concentration of innovation activity in a few metropolitan cities. Indeed, the development of one global city and a few middle-sized metropolitan areas coexists with the decline of old manufacturing territories. The under-developed southern and insular metropolitan areas have not gained from the technological breakthroughs of the third technological revolution due to weak economic structure and scarce innovation capabilities (Viesti, 2021). These results suggest a structural divergent growth path among Italian metropolitan zones, increasing the country's geographical imbalances.

We performed a factor and cluster analysis to grasp the evolution of Italian metropolitan areas between 2000-2018 according to economic, sectoral and technological variables. We witness a process of polarisation feed by the growing relevance of the metropolitan area of Milan, where the advancements concentrate, while the other metropolitan zones achieved very barely improvements. These developments augment the gap across metropolitan economies. Moreover, cluster analysis results indicate no substantial modification in the group formed between the two periods, mirroring the absence of a process of convergence among the Italian metropolitan economies. Instead, we found that cluster score differences enlarged in 2018, suggesting a growing polarisation across metropolitan economies due to divergent growth trajectories.

The remainder of the paper proceeds as follow. Section two concentrates on the relevance of metropolitan areas from the economic point of view. Section three reviews the international literature concerning the concentration of innovation and economic dynamism in large cities as drivers of divergent regional growth. Section four reviews the main drivers of technological and economic polarisation among cities following an evolutionary point of view. Section five investigates the Italian case, with a brief survey of the country's urban structure and evolution and the definition of metropolitan cities as the focus of the analysis. Section six documents the trends of the last 18 years in key economic, sectoral, and technological variables – such as GDP per capita, growth of sectoral value-added and patents. Section seven develops a factor and a cluster analysis exploring the links between such variables and identifying the main clusters that emerge from factor analysis exercise. Finally, section 8 will conclude by summing up the developments of Italian metropolitan areas, affecting by technological and economic polarisation.

2 The dynamics of metropolitan growth

Around the world, largest cities are the geographical centre of capitalist economic growth, fostering the accumulation process and technological development (Sassen 1991, Glaeser 2020). They hold the major portion of the population, wealth, and technologies. In advanced countries, cities and their commuting zone accommodate 55% of the total OECD population, 59% of employed, and around 60% of the total GDP in 2016 (OECD, 2018, p. 102). In European countries, metropolitan areas are home to 59% of the population and grew more than rural and small-medium cities between 2000 and 2015. In 2013, they accounted for 68% of total GDP produced and 62% of total employment (EC, 2016, p. 58).

Today, large urban agglomerations are the crucial physical infrastructure of the world economy, fostering unequal geographical development within countries (Harvey, 2018). They draw technology, capital, advanced services, and finance, providing essential intermediate inputs to spread production globally (Sassen 2018, p. 6). Knowledge-intensive services, such as corporate, financial, legal, and accounting consulting, marketing and communication, advertising, gather in large urban zones where high-skilled workers and new technologies flow (Glaeser, 2020). ICT services are deeply localised in large metropolitan centres where the demand for their functions is high. Financial industry locates in a few wealthy cities accumulating large inflows of global capital, profits, and investments (Ascani and Iammarino, 2019, Ioannou and Wójcik, 2021). The structural shift towards a service-led economy driven by information technologies and the global spread of financial markets changed the geography of production. The specialisation in services of the advanced countries, indeed, is highly correlated with the massive growth of large metropolitan areas (OECD/EC, 2020, p. 79), fostering territorial inequality and uneven geographical development (Harvey, 2018).

On the one hand, the spread of production worldwide enlarges the demand of firms for management, control, and servicing activities that are highly clustered in metropolitan zones. Actually, these knowledge-intensive and creative occupations are still partially place-bound and hugely require face-to-face interaction and social connectivity, concentrating high-skilled workers and new technologies (Glaeser, 2020, p 7, Sassen, 2018). Market-oriented services production require a multiplicity of inputs and feedbacks from different services activities, gaining enormously from the agglomeration externalities. Moreover, the complementarity between high-tech manufacturing productions and these activities accumulates sophisticated industries in metropolitan zones (Ascani and Iammarino, 2019, Bogliacino et al., 2013, Glaeser, 2020, Gervais et al., 2021), causing increasing geographical inequality (Ehrlich and Overman, 2020).

On the other hand, information and telecommunication technologies allow remote control of factories and production globally dispersed, but require massive physical and social infrastructures, located in

the cities. Indeed, alongside the global spread of the production process and the new knowledge-economy, cities and their commuting zones became core centres of the global economy, providing “material facilities and organisational arrangements necessary for the implementation of the global network of factories, services, and markets” (Sassen, 2018, p. 6). These technologies, indeed, require vast material structures and dense urban environments to fully develop their potential.

The geography of innovation activities is also highly urban-centred. Between 2011-13, 70% of all patent applications were granted in metropolitan areas for the 19 OECD countries (OECD, 2016, p. 92). The concentration of innovation activities in large urban agglomerations has led many authors to speak about a “concentrated dispersion” system (Crescenzi et al., 2020). The concentration of innovation activity and technologies in a few zones mirrors the structural imbalances among territories (Iammarino et al., 2018, Sassen, 2018). Technologies, capital, and wealth concentrate in some urban territories, neglecting many others. The socio-economic performances of these areas determine the development of the overall region, generating geographical disparities within high-income countries (Clark et al., 2018, Crescenzi et al., 2020, OECD/EC, 2020, Viesti, 2021, p. 139). These patterns have led to a divergence in economic growth, skills, and life opportunity among a few “superstars cities” and the “places that do not matter” (Kenemy and Storper, 2020, Sassen, 1991). The firsts are global trade networks, financial and economic centres, key nodes of knowledge-intensive production and players of globalisation and knowledge-economy. The seconds are “left behind places”, declining territories with weak economic structure and low economic growth (Crescenzi et al., 2020, Rodríguez-Pose, 2018, Viesti, 2021). This issue is known as “the great inversion”, the divergent developments that occurred since 1980 among prosper centres and declining peripheries (Iammarino et al. 2018, Kenemy and Storper, 2020, Rosés and Wolf, 2019, Viesti, 2021). These tendencies have critical socio-economic consequences boosting housing costs, skilled-bias geographical allocation of workers, uneven educational and learning opportunities between metropolitan territories and inequality within them (De la Roca and Puga, 2017, Sassen, 2018). Moreover, growing inequality makes the population of the “places that do not matter” unsatisfied of the current cycle of accumulation, increasing differences and segregation in what has been called a “new urban crisis” (Di Matteo, Mariotti, 2021, Florida, 2017, Rodríguez-Pose, 2018, Viesti, 2021).

3. A survey of the literature

The growing territorial inequality is a leading issue of economic debates today due to its huge social, political, and economic consequences (Iammarino et al., 2018, OECD, 2018, OECD/EC, 2020, Rodríguez-Pose, 2018, Rosés and Wolf, 2019, 2021, Viesti, 2021). Rising regional concentration of income, advanced productions and skilled occupations increase the disparities within advanced countries, shrinking overall development and polarising economic growth (OECD/EC, 2020). The most profitable industries, namely knowledge-intensive services, concentrate in large metropolitan zones, fostering regional imbalances (Sassen, 2018, Viesti, 2020). These patterns, moreover, augment geographical and socio-economic gaps, such as in the access to basic services, in the accumulation of human capital, in job and learning opportunities, leading to the resurgence of regional cleavages (Rodríguez-Pose, 2018).

Since 1980 wealthier regions grew more than others, engendering huge structural imbalances among territories in Europe (Iammarino et al., 2018, Rosés and Wolf, 2019, 2021). These features also involve many advanced countries outside Europe. Between 2000 and 2018, the territorial gaps in GDP per capita among small regions (TL3) constantly increased in all OECD countries (OECD, 2020, p. 54). Moreover, the concentration of technological productions in a few growing regions deeply modify the demography of territories (Moretti, 2012). Leading regions attract talents, accumulating a young and educated population. In contrast, poorer regions suffer from an outflow population, affecting by a concerning demographic dynamic (Iammarino et al., 2018, Viesti, 2021).

These results are particularly striking in light of the convergence occurred from 1950 to the second half of the 1970s, suggesting a massive shift of long-run development path. The reversal trajectory has led many authors to speak about a process of "great inversion" (Iammarino et al., 2018, Kenemy and Storper, 2020, Viesti, 2021). The inversion regards the shift from a period of regional convergence in growth towards an increasing uneven development that arose since the 1980s. Top regions gather the advances in demography, technological productions, and wealth. Rural and small regions grow less than the national average and increase their gap with the leading territories. Old manufacturing areas are declining, suffering from high unemployment and a negative demographic balance (Iammarino et al., 2018, Viesti, 2021). The economic structure of these territories highly ground on low-technological productions and low-wages occupations, causing massive emigration of young and high-skilled workers. This, in turn, enlarges structural imbalances and aggravate territorial inequality.

The geographical distribution of innovative activities is also territorially polarised, leading to a system of "concentrated dispersion" (Crescenzi et al., 2020). The new technological poles born in Eastern countries changed the geography of innovation. But, these innovative hubs draw in specialised metropolitan areas more connected with the global network of knowledge-users such as global firms, multinational enterprises, and other innovative hubs than home countries (Sassen, 2018, Crescenzi et al., 2020). Hence, the geography of innovation activity reflects the concentration of wealth creation, soaring disparities in life and learning opportunities among territories (Crescenzi et al., 2020). These patterns occurred due to the progress of the service-led economy and information technologies that allow the diffusion of production globally but hugely concentrate core technologies and servicing activities in leading metropolitan centres (Sassen, 2018). Also, innovation activity today is increasingly related to a scale of intermediates services and strictly linked with headquarters of these productions. Moreover, especially in the services sector, complementarity between inputs, speed, and complexity of information exchange in the production increase the tendency to concentrate in some places innovation activity. These zones gather wealth, innovative activities, and profitable industries, causing rising territorial inequality (Rosés and Wolf, 2021 Sassen, 2018, Viesti, 2021). In the following sections, we review, without exhaustivity, literature concerning these patterns and the role of the large metropolitan areas in such developments.

3.1 The concentration of innovative activities in urban areas

Innovative activities are highly polarised in urban hotspots. In almost all OECD countries, private R&D expenditure is higher in capital regions than in the rest of the country (OECD, 2018, p. 34). The polarisation of innovative activities is more evident analysing patents filed. In some countries, the interregional difference between the most innovative regions and the last ones in the number of filed patents is very large, as in Finland, Netherlands, and the US. In others, like Germany and Italy, the difference is very slight.

Metropolitan zones are where most inventions occur (Balland et al., 2020, Crescenzi et al., 2020, Florida et al., 2017, OECD, 2016). Between 2011-13, metropolitan areas granted 70% of all patent applications in OECD countries (OECD, 2016). This matter is more evident in East Asia and North America and less heighten in Europe where, however, metropolitan territories also account for a large part of total patents filed. Indeed, in Norway and Italy, the countries with the lowest weight of patents filed by metropolitan areas in Europe, they still account for around 40% of the total patents. Moreover, metropolitan territories specialise in the development of technologies of leading economic sectors (OECD, 2016, Sassen, 2018). In 2013, 41% of patents granted in the OECD metropolitan areas were in the ICT sector, followed by health care (15%), environment (9%), biotechnology (6%) and nanotechnology (1%) (OECD, 2016, p. 94).

Crescenzi et al. (2020) draw the geographical distribution of innovation as a global system of localised hotspots around the world, more connected among them than with the home country. Indeed,

notwithstanding the spread of innovative hubs globally, particularly in Eastern countries, the diffusion of innovative activities localises in few functional and specialised areas, largely metropolitan, without relevant gains for other regions of the home country (Bottazzi and Peri, 2003). This has led the authors to speak about a "concentrated dispersion" system concerning the geography of innovation. Indeed, from 2016 to 2020, just five regions account for 35% of global patent filing and the top region for 10 % (Crescenzi et al., 2020, p. 18).

Graph 1.B in the appendix mirrors the divergent global patterns in innovation among regions and is explicative for many reasons. First, among the top forty patenters between 1990-1994, the most come from advanced countries, and among the first top ten around the world, nine come from the US and Europe, with the only exception of Southern-Kanto from Japan. If we compare this evidence with the 2010s in the second graph, the spatial shift is consistent. In the second figure, Southern-Kanto overcomes California, and Guangdong prominently becomes the second patenters around the world. Overall, the geographical distribution witnesses the massive jump of the Asian economies in terms of technology capabilities. Second, this data reflects the intense concentration of innovation among a few connected global hotspots worldwide. Indeed, the last regions have a very significant difference in patenting activity with respect to leaders, and the concentration of patents among the five core regions is very outstanding. The third worthy matter regards the declining role of the historical manufacturing hub in favour of the rise of the IT producers.

Many are the evidence of these patterns for the US (Florida et al., 2017, Glaeser, 2011). Balland et al. (2020) contend that the concentration of economic activities in large urban agglomerations increases with the complexity of economic processes. In particular, complex technological patents – measured by the number of newer technologies utilised- are hugely correlated with increasing population density and concentrates in large metropolitan agglomerations. So, cities become the coordination platforms to accumulate dispersed complex knowledge facilitating input matching and innovation productivity. The correlation increases with the complexity of the technologies. Moreover, they show that the increasing concentration of patents in large cities peaked after the third industrial revolution, with ICT development. These patterns, in turn, has led to a new spatial distribution where highly complex and digital innovations are more concentrated in cities and less complex increasing dispersed. These results align with the descriptive analysis of Forman and Goldfarb (2020), which witnessed an increasing concentration of patents among US counties from 1970 to 2010, especially in the computer and communication class.

These results contrast with the finding of Fritsch and Wyrwich (2021). They examine the concentration of patents in large metropolitan areas, with more than 1,5 million inhabitants, among a selected sample of advanced and developing countries finding no systematic evidence of increasing concentration. Indeed, the authors highlight the strong heterogeneity in the sample in terms of the share of metropolitan patents. While the concentration of patents in major metropolitan areas of some countries, such as the US and Korea, is high, other countries, such as Italy and Poland, have low concentration. Moreover, heterogeneity appears also analysing the trends from 2000 to 2015. In some countries, the intensity of innovative activities in large agglomeration slightly increases; in others, it decreases, without suggesting a general pattern. So that, they conclude: "the rather pronounced heterogeneity across countries suggests that the largest metropolitan areas do not necessarily host a more than proportional share of innovative activity and that the largest agglomerations did not increase in importance over the 2000 to 2015 period" (Fritsch and Wyrwich, 2021 p. 5). However, these results may hold for the largest metropolitan area, with more than 1,5 million inhabitants, not for all types of metropolitan areas. The choice of this type of urban zones could tend to overestimate the weight of metropolitan patents for countries with large cities, such as the US, or with an intense concentration of population in one area, such as Finland or Korea, and underestimate the weight for many European countries, where cities are generally smaller, and medium-size metropolitan territories are the backbone of the urban geography (Crescenzi et al., 2020). This choice is more relevant in the case of Italy, a country that holds many small and medium-sized urban zones. However, the authors also recognised the substantial weight of large metropolitan territories in

patenting activity, ranging from about 20% to 80% in the sample. According to the data of the work, for example, in Italy, just four metropolitan territories accounted for 22% of the total patents in 2015.

3.2 The concentration of economic activities in metropolitan areas

There is a positive relationship between economic growth and urbanisation (OECD/EC, 2020, p. 75). Countries with high income, indeed, has a larger share of metropolitan population. Metropolitan territories gather economic growth, technological advancements along with a positive demographic dynamic fostering overall country development (OECD/EC, 2020). Metropolitan areas -urban areas with a population greater than 500.000- in OECD countries accounted for 55% of the total OECD population, 59% of the employed, and around 60% of the total GDP in 2018 (OECD, 2020, p. 54). In Europe, they held 68% of total GDP produced and 62% of total employment in 2013 (EC, 2016, p. 58). These areas have grown faster than the rest of the country since the turn of the new millennium (OECD, 2020, p. 54). Urban territories represent the backbone of the country's economic development nowadays, concentrating the most profitable industries, technological breakthroughs, and a larger population share. However, the concentration of economic activities in these few large agglomerations is widening territorial disparities. The largest metropolitan territories grow more in GDP per capita (OECD, 2020) and population (OECD, 2018) than other urban zones, causing growing geographical polarisation within countries (Kenemy and Storper, 2020, Sassen, 2018, Viesti, 2021).

The share of metropolitan population is a crucial determinant of inter-regional disparities. According to OECD/EC (2020), between 1990-2015, regions with a wider metropolitan population in 1990 grew more in GDP per capita than country average and other regions. On the contrary, regions with a lower share of metropolitan population growth less than the country's average. This is more true for EU and OECD countries, where, in 2015, a 1% rise in GDP per capita is associated with a 0.48% increase in the share of the metropolitan population in the region (OECD/EC, 2020, p. 89). These results suggest a kind of path dependency in the trajectory of regional development. Regions with dense metropolitan areas in 1990 were more productive and created a better environment for technological productions and productivity. This, in turn, determines a comparative advantage, attracting more capital, resources and qualified workers, exacerbating inequality and structural divergence among territories.

According to Ehrlich and Overman (2020), disparities among European metropolitan areas have increased since 2005. The authors measured the coefficient of the variation-the ratio of the standard deviation to the mean- of GDP per capita for 226 European metros. The coefficient falls from 1980 to 2000, suggesting a lower level of dispersion in the regional distribution of income. After that period, however, imbalances stagnate until 2005 and then start to rise. These patterns are also evinced by a regression analysis of the GDP per capita growth rate respect to its initial level. For the period 1995-2015, they reported significant evidence of mean-reversion from the convergence period and a clear divergent trajectory for 2005-2015. According to Kenemy and Storper (2020), these findings hold accounting for consumer price differences. They adjust nominal GDP for housing costs to take into account geographical price level imbalances. Their results confirm the diverging growth among US metropolitan territories by the middle of the 1980s.

The distribution of the metropolitan population also affects intra-regional imbalances. Indeed, an equal distribution of metropolitan cities among regions may guarantee a more equal distribution of wealth. On the contrary, an unbalanced metropolitan system may enlarge inter-regional disparities. OECD/EC (2020, p. 87) compared the percentage difference in GDP per capita of leading metropolitan regions to the least ones in the respective country, with the share of the metropolitan population in the region for two groups: the first composed by high-income and low-income countries, and the second by middle-income countries. Income gap among the top and least metropolitan regions enlarged as the metropolitan population increase for both groups.

These developments have led many authors to speak about a new “urban crisis”(Florida, 2017). On the one hand, "superstar cities", large, rich urban agglomerations, part of the global network of trade and financial transactions, specialised in high-profitable corporate services and finance, where young and talented workers flow, prosper. But, on the other hand, "lagging behind" places: medium-small cities, old manufacturing poles, and rural areas are affected by weak economic structure, high unemployment, demographic decline, and overall socio-economic performances fall. These patterns deeply enlarge territorial polarisation and geographical inequality in life and learning opportunities exacerbating structural imbalances among territories (de la Roca and Puga, 2017).

What are the roots of these developments? Structural changes have deeply affected the global value chains since the 1980s. The shift from industrial-led growth to a service-led economy driven by market-oriented facilities and the global spread of financial markets has hugely changed the geography of production. Indeed, large cities in advanced countries are today platforms for the production of leading servicing industries. Metropolitan growth, indeed, is ground on corporate and entertainment services feeding by growing companies and consumers demand (OECD/EC, 2020, p. 79, Sassen, 2018, Viesti, 2021). Complex economic activities- such as knowledge-intensive services that require multiple and instantaneous inputs- massive gain from strong agglomeration and network externalities (Balland et al., 2021). In addition, the development and use of information technologies entail physical infrastructure and material arrangements that hugely are based in large cities (Sassen, 2018). So that, large urban agglomeration become the central hotspot of the world-economy linking servicing industries localised in the cities, such as finance, legal and corporate consulting, software development, data management for firms, to the global value chains, and specialising in entertainment and consumption facilities for households.

3.3 The territorial disparities among European regions

Rosés and Wolf (2021) analyse the long-run development of European regions from 1900 to 2015. They found an intense period of sigma-convergence -the dispersion of GDP per capita over the mean- from 1950 to the second half of the 1970s. After that period, the convergence has fallen and then flattened until 2000, when started a new phase of divergence. Moreover, the estimates of beta-convergence reveal fuzzy features. They regress the growth rate of GDP per capita to its initial level in 1900. The region with a lower initial GDP per capita level should grow more than richer to achieve some level of convergence. Their findings show that a strong beta-convergence occurred in the early post-war period, but the correlation since 1980 has become very flat. According to the authors, the root of the growing divergence since 1980 in Europe and the US is the concentration of economic activity -measured throughout a Herfindahl index of GDP- due “to strong growth in densely populated metropolitan areas”(Rosés and Wolf, 2021, p. 42).

Iammarino et al. (2018) divided European regions into four groups according to their GDP per head respect to the EU average to study regional inequality. They witnessed for the period from 2000 to 2014 a very divergent development in population, employment and productivity of regions according to the gradient of income. The wealthier regions, hosting large cities, grow more than poorer, and the poorest group declines in many economic and demographic indicators, suggesting a strong ongoing territorial polarisation. Moreover, the weight of sectoral employment to GDP indicates structural imbalances among groups. On the one hand, economic growth localises in high-tech manufacturing production and service specialised areas, where the patenting activity is high. On the other hand, regions with routine-based productions have low patenting activity and falling employment due to the decreasing weight of the manufacturing industry in the economy. These results indicate a strong heterogeneity in the recent regional developments in the EU, posing “the regional question at the heart of Europe economic future” (Iammarino et al., 2018, p. 279).

Viesti (2021, ch. 4) investigated the long period patterns of inequality of the twentieth century - measured by Theil index- for many European countries. Despite the peculiarity of each country and the historical matters that determine each specific development, he recognised some common features. Regional inequality in most European countries declines after the second world conflict until the 1970s. However, this trend has stopped around the last twenty years of the century, and since 2000, territorial disparities have enlarged again.

At the beginning of the twenty-century regional disparities were high in many countries, but they declined between the world conflicts, with the only exception of Italy. Early industrialisation initially increased regional divergences, but then, the diffusion of manufacturing productions to the continental and Mediterranean countries boosted overall growth (Viesti, 2021). After the IIWW, between 1950 and 1980, the territorial inequality among European regions declines everywhere. According to the author, the spread of technological production, strong public mission-oriented policies, and the diffusion of essential public services fostered economic growth and reduced territorial disparities. However, after the 1980s, the convergence ceased until the new century, when gaps widened in many territories.

These authors recognised as drivers of these developments the growing relevance of the metropolitan areas and their crucial role for economic development (Iammarino et al., 2018, OECD/EC, 2020, Viesti, p. 138, Rosés and Wolf, 2021, p. 42). This is due to the strong role assumed by market-oriented services and information technologies since the 1980s. The structural shift to the services economy and the vast scale application of digital and information technologies in the production process feeds the concentration of economic activities in large cities and capitals along with a decreasing weight of small and middle town and rural zones.

4. Technology and structural change as drivers of growth

Innovation is the root of economic growth. Indeed, historically, advanced economies have developed technological novelties and applied them to the production process to increase productivity, minimise the cost of production, augment output. Since the first industrial revolution, cities and regions where technological breakthroughs localised had grown much more than other places, engaging in positive development trajectories. The development process has not been even, but it has moved faster in some places, slowly in others, and it has been completely absent in still others. Material and social progress of the recent economic history affected some regions overlooking others, revealing different geographical configurations for each technological long waves of development. Each industrial revolution, rooted in a set of clustered innovations, shaped its own economic geography. Some regions and cities gathered technological advancements, wealth, and industrial sites. Others are empty of the fundamental economic structure to foster development. These patterns mirror the uneven geographical development of capitalism in the last few centuries (Harvey, 2018).

A long economic tradition tried to explain the source of innovation and its impact on society without a clear-cut conclusion. What is clear is that innovation activity is the main source of technological change, the shift from a production technique to another that ensures better outcomes. Once that the shift from one production technique to a better one is generalised among economic sectors, far-reaching consequences occur in terms of economic structure. Technological change deeply affects the path of development of the economy, modifying the industrial structure. Indeed, once that technological change is diffused among the economy, the sectors able to use the new technologies attract employment and investment, new skills are required to the workers, profits in these industries are higher and new top firms emerge as the core source of economic growth.

In contrast, sectors with lower productivity become obsolete, wages decline, and unemployment rise, firms bust, and outmoded production processes become out of the market (Freeman, Louçã, 2001). However, technological change is a complex and socially embedded activity influenced by historical

and social dynamics rather than a straightforward process. Indeed, many factors affect its outcome: institutional framework, market power, demand patterns, and labour market regulation deeply determine how innovation affects the economy (Pasinetti 1981, Pianta 2020).

In addition, technological change is not evenly spread geographically among countries, regions and city, but reshape the economic geography of its own time, generating new spatial orders. Some places have comparative advantages and economic structures able to capture better the gains of the breakthroughs and shape a virtuous cycle of growth. Others lagging behind and have not been able to catch up with technological frontiers. As well as evolutionary economics pointed out, even structural change is a path-dependent process where “previous technological or organisational endowments have a strong role in shaping subsequent capture or creation innovation” (Crescenzi et al., p. 18, Nelson and Winter, 1982). Therefore, in each long growth cycle rooted in new innovative technologies, some places perform better than others, creating a divergent development path. It is the law of capitalistic economic development (Harvey, 2018). Instrumental in this view is the concept of National Innovation System (NIS) (Freeman, 1987, Lundvall, 2010, Nelson, 1993), the set of public and private institutions, heterogeneous individual, clusters and networks, investments and strategies, that together drive innovation of countries and regions towards distinctive pathways of specialisation. As Pianta (2020, p. 10) noted, indeed: “The process of structural change, with countries’ different abilities to contract declining industries and expand production and employment in emerging ones, plays a major role in explaining employment performances. Better outcomes are found in countries with greater activity in sectors with fast-growing (at the world level) demand and output and with greater ability to reshape their economic structures. Worse outcomes are found where a larger part of employment is in industries more exposed to the negative impact of labour-saving technological change and globalisation and where more rigidities exist in the economic structure”. These dynamics, in turn, generate massive transformation in terms of social and work relationships and power mechanisms, shaping the long-period economic trajectory.

The analysis of the long-run growth dynamics reveals cyclical patterns of burn and boost driven by the major Industrial Revolutions enduring 50-60 years, where phases of surges alternate periods of breakdown (Freeman and Louçã, 2001). These recurrent dynamics are known as “Long Waves”: periods of sustained growth of production, capital accumulation and trade lasting about 25 –30 years followed by periods of slow or stagnating growth of a similar extent. Analogous variations also affect prices and other monetary variables (Reati, 2014). Each long wave starts with a core cluster of innovations that “transform the way of producing and living and generate specific physical systems, each related to a concrete form of work, management and use of capital” (Louçã, 2019: 5). Indeed, every industrial revolution is rooted in a “technological paradigm” (Dosi, 1982, Freeman and Louçã, 2001, Perez, 2002), a constellation of radical and incremental innovations that change the production process structurally. Each “technological paradigm” constitutes a new spatial configuration of economic production, favouring the movement of capital and labour towards some places. This reconfiguration fosters the development of some areas, such as occurred in the last two decades in the Silicon Valley and the leading financial centres, where wealth, innovations and advanced sectors crowded and made obsolete the industrial structure of other zones, as many old manufacturing centres today. These movements reshape the geography of wealth and production. The diffusion and the complete employment of the new technological paradigm required 30-40 years, and the contrast with the preference for routines in the society creates a process of turbulent adjustment. In the meaning of the diffusion period, institutional framework, labour market regulation, accumulation mechanism, and world power hierarchy need to change suddenly, and these adjustments generate the ground for increasing turbulence in the society.

4.1 Structural change and territorial dynamics in the first two industrial revolution

The first Industrial Revolution of the late 18th century was based on the water-powered mechanisation of the industry and the extensive innovations in the use of iron and coal for the production process that made great the British empire and spread throughout ships cotton-raw manufacturing products around the world. In this period, manufacturing cities became the most productive economic forces, and big plants in growing centres captured the increasing supply of labour deriving from agriculture. The tendency towards the spatial concentration of capital to gain from the agglomeration externalities gather in large, big cities, industrial plants, a vast mass of workers, raw materials and physical infrastructure reshaping the geography of the cities, that become the “workshop of capitalist production” (Harvey, 2018). The first industrialisation process occurred hand in hand with urbanisation and the growth of the big industrial towns. This period established a deep hierarchy among a few industrialised and crowded places, like Manchester in the UK and some cities around the world (Crescenzi et al., 2020). The concentration of the productive structure around a few industrial centres worldwide enlarges the geographical disparities among territories. Moreover, increasing investment in transportation and infrastructure to allow an easier circulation of raw materials and final commodities for trade increased the dichotomy between industrialised urban centres and rural zones.

The second industrial revolution was an intense period of economic and social transformation that occurred between the late 19th and the early 20th century. It was shaped by a large number of innovations in the electronic-mechanical branches with the extensive use of steam and oil, the golden age of the chemical industries and the diffusion of railways across the world that profoundly affected the production process and the entire society. Electric equipment, heavy chemical, and engineering industries quickly became the productivity leaders, and manufacturing production developed into the leading sector of the economy in terms of employment and productivity. The consistent cut of transportation costs reduced the “tyranny of distance” (Glaeser, 2020, p. 5). The tendency of the accumulation process to cut production costs dispersed industrial productions in many overlooked territories, spreading the population towards middle cities and suburbs (Harvey, 2018). Improvements in transportation for both people and raw materials, the spread of scientific knowledge, the diffusion of standardised production methods, the low cost of wages and houses, and new unexplored markets attract investment and industrial productions. The assembly line encouraged the mass shift of unskilled workers from agriculture to the manufacturing industry in many advanced countries, and economic growth allowed the rise of both low-skills and high-skills wages until the 1970s. The second industrialisation was a wide-ranging process affecting the geography of advanced countries deeply. Vertically integrated firms co-locate in sectoral specialised productive clusters to capture input-output externalities, gaining from easy access to customers, suppliers, and knowledge spillovers (Diodato et al., 2018, Marshall, 1920). These centrifugal forces boosted the employment toward medium and small sectoral specialised districts, where local-embedded knowledge prompted the widening industrialisation of European territories. In this phase, the governments made a considerable effort in the diffusion of essential services and core industrial productions. Alongside the direct control of enterprises in strategic economic sectors, a significant effort in industrial strategies, economic planning, and a vast plan of infrastructure constructions, were made in all western countries. These efforts also contributed to the geographical spread of production into provincial territories (Viesti, 2021). The cities were, for the most, administrative centres and the infrastructural node of the transportation system for trade and commerce. Meanwhile, innovation took place in the manufacturing industry or in national research units.

4.2 *Information technologies and metropolitan growth*

The last industrial revolution occurred around 1970, boosted by the diffusion of Information and Communication Technologies (ICT). The advent of the Intel microprocessor in 1972 spread the computerisation of the economy, the diffusion of sectors as informatics, telecommunication, software, biotechnology, and financial engineering as leading innovative branches. To capture the strength of these changes, we can see how much the sectoral composition of the top ten patenters changes in the US from 1975, concentrating on Information Technologies.

According to Forman and Goldfarb (2020), between 1976 and 1981, just two of the top ten patenters in the US specialised in information technologies. In less than forty years, in 2010, seven of the ten are defined by the “Computer and Communication Technology” category, and one of the remaining three produces computer memory commodities. These changes mirror the central role of Information Technologies in the current long cycle of accumulation and the concentration of the activity of R&D in this branch. Quickly, ICTs deeply affected the entire mode of production of the economy and moved a large part of the skilled labour supply in these more productive and remunerative sectors (Pianta 2020).

Indeed, notwithstanding the global dispersal of production, the service and financial sectors gather in large cities, where also capital, income, labour, and technological breakthroughs concentrate. These patterns are changing again the geography of production, in which “Global Cities” today constitutes infrastructural nodes (Sassen, 2018). These urban zones can be defined as: node of global knowledge and trade networks, with a combination of economic and technological resources, leaders in the supply of financial and business services, host of headquarters of multinational enterprises, with an open and multicultural mindset in term of social and political attitudes able to influence the regional and global trajectory of development (Iammarino et al., 2018). Indeed, knowledge-intensive services have become the backbone of the growth of many leading metropolitan areas such as London and Milan, San Francisco, and New York, specialising in the supply of services such as R&D, marketing, telecommunication and computer services, scientific and technical consulting, accounting, and financial and insurance advice (Glaeser, 2020). The service-led economy, alongside the globalisation of productions and the fragmentation of the value chains, deepened the agglomeration toward a few big and interconnected cities worldwide, strengthening the spatial polarisation of wealth, skills, and innovation activity. What does explain these matters?

The rise of cities as strategic economic places is the effect of a deep structural transformation affecting developed economies. At the roots of the new urban geography and the prominent role of the cities, there is since the mid-1980s an increasing demand for market-oriented specialised services and financial transactions that require a huge amount of physical and social arrangements, which are localised in large urban agglomerations (Sassen, 2018). The concentration of high-tech production in big cities is the result, on the one hand, of the globalisation of production, the spreading of factories, offices, and the fragmentation of the value chains that feed the demand for financial advice and specialised services. On the other hand, the increasing need for management and control functions through information technologies has contributed to a strategic role for certain major cities. The production of these intermediate services indeed involves a multiplicity of inputs that massively require the concentration of these industries in large cities making the production process partly place-bound and localised in large urban agglomerations (Glaeser, 2020, Sassen, 2018). Despite the possibility for a customer to be located everywhere, the production of these services entails a huge amount of complementarity among different producers, social connection, fast exchange of information among experts, face-to-face communication among workers, labour pooling of high-skilled and talented workers, a vast amount of physical infrastructures, and capital, that feed their concentration in few major cities. Also, from the side of household consumption and entertainment, the massive growth of service intermediation for many activities -such as buying food or flowers- accrues the concentration of these industries. In addition, time is a crucial component in the

production process of these industries, where a few seconds can determine a relevant change in the result of a financial transaction or in the management of an affiliate in a foreign country. The need to foster the speed of the production feeds the concentration of these sectors in the downtown of large cities. The combination of high complexity and the speed of economic transactions has created new forces for the agglomeration of high-tech services and finance in large urban agglomerations, becoming the platforms for producing these sectors. According to Sassen (2018, p. 35), global cities in the new geography of production become the material infrastructure of the world economy, performing three core functions summarised in the following points:

- (1) The function of command and coordination. Cities gained a strategic role in the current phase of the world economy due to the combination of geographic dispersal of economic activities, economic globalisation, and the rise of global financial transactions. They become the centres of command-and-control functions, where high complex managerial functions, the specialised financial and consulting services, localise to manage the dispersal of production. For this reason, headquarter complex tasks of management, top financial and services industries, gathered together in these places, gaining from the proximity of other specialised service producers.
- (2) Cities are post-industrial production sites for the leading industries of this period—finance and specialised services. Global cities worldwide specialise in certain types of services and markets, becoming strategic global inputs to these industries. They are the place where complex social and physical facilities and capital gather, overcoming the enormous amount of investment needed to realise these material infrastructures. In addition, innovative social environment, labour market pooling, and technological hyperconnection make cities a core production site for these industries.
- (3) Cities are transnational marketplaces where firms and governments from all over the world can buy financial instruments and specialised services. Thus, there is not only one “Global City”, but each specialises in a niche of these activities, according to their history and recent development, attracting flows of a determined type of capital in a growing global division of labour. Hierarchical division of labour also occurs at the geographical level, with some cities performing this role at the regional scale.

In the next section, we will highlight two of the most prominent mechanisms that increased the relevance of cities in the world economy. The first is the rise of financial transactions and financial weight in the management of all industries. The second is the increasing demand for specialised services from all production processes, fostered by the worldwide fragmentation of production. Together these matters contribute to the concentration of these sectors in the cities.

4.2.1 The new metropolitan economy: finance and business services

The diffusion of ICT goes hand in hand with the expansion of the financial sector and the rise of market-oriented services as leading economic industries (Sassen, 2018). ICT technologies indeed revolutionise the communication concept, definitively breaking the barrier of distance.

Despite the diffusion of ICT technologies and the massive fall in transportation costs that these technologies entails, enhancing enormously the possibility of interaction without physical constraints, the third industrial revolution was a centripetal era inspired by the return to the big cities (Iammarino et al., 2018, Glaeser, 2020). Metropolitan areas have become the backbone of the country’s growth, enormously concentrating market-oriented services and financial industry (Sassen, 2018). Nowadays,

leading metropolitan areas are sectoral specialised financial and services producers attracting capital, technologies, and high-skilled workers.

Two processes are determinants in the concentration of leading profitable sectors in the cities nowadays, which become the strategic infrastructures of the global economy. These interconnected developments started in the mid-1980s, alongside the sharp rise of financial weight in the economies, the growth of the service sector and the spread of globalisation boosted by the development of information technologies.

First, ICT technologies enormously enhanced capital mobility, increasing both the volume and the geographical spread of global financial transactions (Sassen, 2018). Since the 1980s financial sector has grown massively, becoming a leading economic sector in many developed economies. The possibility of instantaneous and electronic financial exchanges, along with a massive increment of financial innovations and the development of new financial institutions, boosted the volume of financial profits, becoming among the most profitable economic industry (Vercelli, 2018). Financial motives also become a consistent part of the management of non-listed enterprises working on different businesses, feeding the demand for financial services worldwide through the increasing practices of inter-firm financial loans, banking lends, and a large number of mergers and acquisitions (Duménil and Lévy, 2004, Lapavitsas, 2013). The shareholder maximisation principle to enlarge the short-run value of dividends and equities turns into a managerial strategy for the US enterprises and many OECD countries (Forges Davanzati et al., 2019, Lazonick and O'Sullivan, 2000). The global spread of production also increases the volume of financial transactions through the massive growth of foreign direct investments and the rise of financial transactions between intermediaries of multinational corporations. The diffusion of a new form of financial investments with collateral of each type attached, such as raw materials, agricultural commodities, housing, and student loans, are examples of the vast amount of financial exchanges that today strongly overcome the volume of material trade (Sassen, 2018). The sharp rise of financial transactions consistently increases the geographical spread of this market, involving new local financial markets and new investors worldwide. More than a dispersion of regional financial markets, many authors witnessed an increasing integration of local financial markets into the global network of a few financial centres. In sum, the growing spatial dimension and the number of financial exchanges went hand in hand with the concentration in ownership and location of these markets around a few global places.

Indeed, the integration of local and regional financial markets into the global financial system boosts the centralisation of the financial industry in the network of leading global centres. The number of major banks of the top three countries had increased from 2009 to 2016, strengthening the power of the US, China, and Japan. The concentration in financial transactions is witnessed by the growing importance of a few leading stock markets worldwide. These reveal, then, a disproportionate concentration of worldwide capitalisation in a few cities and of national capitalisation typically in one city in each country (Sassen, 2018, p. 37), as the case of Milan in Italy suggest.

Second, the growing service intensity in the organisation of all production processes feeds the role of corporate services within advanced urban economies. The spread of economic productions worldwide has contributed to the massive growth in the demand for services by firms in all industries. The global dispersion of production sites, the offshoring of many physical productions, rather than make obsolete the cities, increase their strategic role as command-and-control sites of the global economy, where new essential intermediate, high specialised, corporate services are produced. The fragmentation of economic productions along with the increasing complexity and volume of international transactions feed the demand for services across all geographical dimensions -global, national, or regional- that is nowadays a consistent part of the management of any material productions. Firms need to centralise the control, management, and organisation functions demanding intermediates knowledge-intensive services of all sorts. Firms use more legal, financial, advertising, consulting, accounting, transport, communications, and security services, among the others, whatever in manufacturing, wholesale distribution, entertainment, or consumer industries. Hence, today cities

are a core marketplace for services for firms, becoming essential infrastructures to organise and control the production in the global economy (Sassen, 2018).

These services are the backbone of urban economies since they facilitate adjustments to the economic cycle, develop a mechanism that organises and optimises economic exchange, facilitate the complex management of economic activities, allow the diffusion in the space of economic activity. The service production-complex gathers in the global cities, where enterprises are able to take advantage of the sectoral variety of the interactions and capture horizontal knowledge spillovers that make these places among the prominent innovation centres (Diodato et al., 2019, Duraton and Puga, 2004, Jacobs, 1970). All the production of these services, even if they can be located everywhere, disproportionately concentrates in costly and crowded cities. The growing complexity, diversity, and specialisation of the services make their production more efficient in specialised clusters. Actually, these complex productions require the proximity of multiple simultaneous inputs and feedback of other specialised services, especially in the leading and most innovative sectors of these industries (Sassen, 2018).

Moreover, despite the process of tertiarisation of the economy, many empirical works show the complementarity between advanced manufacturing productions and services. The demand of manufacturing industries for the most innovative and knowledge-intensive business services stimulates a virtuous cycle of “growth of output, employment, and international competitiveness both within the tertiary sector and in user manufacturing industries “ (Ascani and Iammarino, 2018, p. 1587, Bogliacino et al., 2013; Evangelista et al., 2013). For these reasons, recent contributions tried to overcome the classic contraposition between vertical and sectoral specialised externalities (Marshall, 1920) and horizontal intra-sectoral knowledge spillovers (Jacobs, 1970) with the more blurred concepts of “functional specialisation”(Gervais et al., 2021). These authors contend that many global cities specialise in some corporate activities such as R&D, engineering, financial services, legal and advertising, software, and hardware assistance, which are highly complementary in the production process with a wide range of economic sectors. Economies of scale in the third industrial revolution built on functional specialised clusters, where firms innovate using related technologies involving many different sectoral inputs (Crescenzi et al., 2020). This process, in turn, boosts the overall agglomeration tendency and the concentration of high-skilled workers and innovation activities in a few global centres (O’Sullivan and Strange, 2018; Iammarino and McCann, 2018).

This contradiction between diminishing cost of interaction and tradable services and the increasing role of few top global cities shaped structural patterns of polarisation of per capita income, wages, social mobility, and technological trajectories exacerbating spatial divergence among these growing centres and lagged behind territories, overlooked by the global economy.

The complementarity between the manufacturing industry and services, particularly for knowledge-intensive service, fosters the concentration of high-tech sectors in global cities (Glaeser, 2020). This pattern of co-agglomeration strengthens the advantage position of top regions, where also international players, like multinational enterprises, accrue capital inflows and polarise regional economic structure (Ascani and Iammarino, 2018)

5. The analysis of Italian metropolitan areas

Metropolitan areas are high-density urban territories with strong integration in economic activities, essential services, social life, cultural relations, and territorial features (art. 22, law n. 267/2000). Figure 1 shows the geographical settlement of Italian metropolitan areas.

Figure 1: Italian metropolitan areas, map of the provinces



Source: Vinci (2019). Notes: The figure depicts the institutional boundaries of the 14 Italian metropolitan areas. In dark grey, the perimeters of the 20 regions.

These zones act as a strategic hub for the development of the territories, involving functional and economic integration of the municipalities that encompass. They ground on their provincial territories (law n. 65/2014), which includes 1278 municipalities, 16% of the country, accounting for 15,4% of the Italian territory.

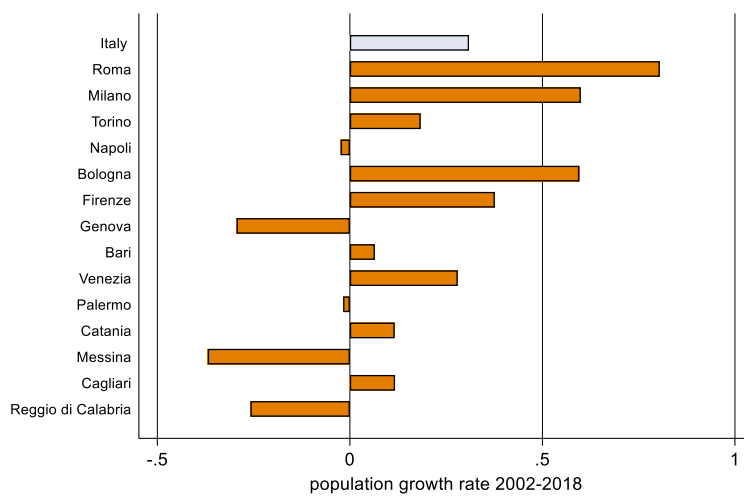
Italian metropolitan areas are crucial zone for the development of the overall national economy, holding 36,2% of the country's population, 41 % of total value added (ISTAT, 2020), 35% of total employment in 2016, and accounting also for the large share of innovative patents applications (Start City, 2016). These data mirror the huge impact of metropolitan economies on the overall country's development. Table A.1 in the appendix lists the Italian metropolitan areas according to the average population over the sample period and territorial macro-areas, witnessing the equal geographical distribution of these zones between Centre-North and South-Islands.

Instead, the population average depicts some sample heterogeneity, ranging from metropolitan zones with 250.000 to 4 million inhabitants. The four most populated metropolitan areas are home to more than 2 million inhabitants, and, among them, only Naples is in the South. The most populated, Rome, has a population average near to 4 million. Three big urban agglomerations of Southern and Insular Italy follow the first group, holding more than 1 million dwellers over the period. After these, a group of three middle-size northern metropolitan cities, core places of the manufacturing productions of the

last century, accommodates between 700.000 and 900.000 inhabitants. Then the smaller metropolitan cities, with a population between 500.000 and 700.000, include three southern and insular metropolitan zones. Overall, just the first three metropolitan territories, Rome, Milan and Naples, account for 17% of the country's population in 2016, underlining the crucial weight of the metropolitan territories (Istat, 2020).

Figure 2 shows the growth rate of the population between 2002-2018. The population grew more in centre-northern metropolitan cities than in southern and insular, where in some cases dropped. Just three metropolitan areas, Roma, Milano, and Bologna, signed an increase of more than 0.5%. Centre-northern metropolitan cities, with the exception of Genova, increased population more or just below the country average. Instead, in all southern and insular metropolitan areas, the population grew less than the national average, reflecting the concerning demographic trend affecting these territories (Viesti, 2021).

Figure 2: the population growth rate between 2002-2018



Source: author's elaboration on ISTAT data. Note: the graph depicts for the period 2002-2018 the compound annual growth rate of the population of the fourteen Italian metropolitan areas compared to the country.

The polarisation of demography follows the GDP per capita dynamic. Figure 2.B in the appendix presents the average growth rate of GDP per capita and population for both macro-zones. In the first group, population and GDP per capita rise, driving a virtuous cycle of growth. Conversely, a lower increase of GDP per capita and declining population dynamic suggests a damaging development trajectory for the southern and insular metropolitan areas.

These results are in line with the analysis of Iammarino et al. (2018), which found a polarisation among top-income European regions, where value-added and population increase, and lagging regions, with negative demographic balance and declining economic performance. Metropolitan zones, a crucial source of the regional development in the knowledge-economy, contribute to the rising territorial polarisation, concentrating income, technologies, and advanced economic sectors. The recent diverging growth of Italian metropolitan areas seem to follow the historical macro-regional imbalances among centre-northern metropolitan zones, where population and wealth increase and southern and insular zones, affected by negative demographic balance and weaker economic structure. This trajectory may exacerbate the geographical disparities in the country, suggesting structural differences in local economies.

The creation of Italian metropolitan areas, which occurred through law number 56 in 2014, followed a long fuzzy debate. According to the constitutive law, these urban types emphasise the strong linkage between the principal city and the close commuting zones regarding economic activity, social services, and labour market pooling. In the eye of the legislators, metropolitan territories should be

the key players of "the strategic development of territories" (art. 1, law 56/2014), ensuring the competitiveness of cities, enlarging networking and innovative spillovers in the territories, attracting foreign investments and advanced technological productions, but also guaranteeing social cohesion and the even geographical development (Longo and Mobilio, 2016, Vetrutto, 2019).

In sum, the metropolitan territories are the places where high value-added and innovative productions, digital infrastructures, and the leading economic sectors concentrate on fostering the country's productivity (Vetrutto, 2019).

To achieve these ambitious outcomes, 56/2014 law assigns innovative governance structure to metropolitan cities. The mayor of metropolitan cities is the mayor of the principal city. Along with the metropolitan mayor, two forms of collegial assembly were created to guarantee territorial governance representativeness. First, with many deliberative functions, the Metropolitan council is an indirect elective assembly where metropolitan mayors and town council members can be elected. Second, the Metropolitan Conference, composed by all metropolitan mayors, should promote territorial representativeness and guarantee the collaboration of the local authorities. According to Pioletti and Soriani (2016), the creation of these urban forms of governance in Italy is different from the other European experiences. Informal ed integrated model of metropolitan governances in other countries, such as the Netherlands, takes place over time after an intense process of networking and cooperation among big and small municipalities around strategic issues of the territories. Despite the process of formal institutionalisation, as occurred for France and Germany metropolitan territories, foreign experiences of urban metropolitan governances are not the result of the top-down process but the sum of the strategic planning and legal and material infrastructures able to foster the functional and connected governance of the territories linking together a plurality of social and economic stakeholders (Pioletti and Soriani, 2016).

The creation of Italian metropolitan areas instead seems the result of the coalescence of the old province territories. This initial deficiency created heterogeneity in the development of metropolitan areas, determining two relevant issues. The first regards the effective application of innovative metropolitan governance. Only a virtuous minority adopted innovative strategic planning of the territories, such as Bologna, where the metropolitan conference acquired legislative power. However, many of them have not been able to implement the collegial governance inspired by the law 56/2014 conserving with slight modification the governance adopted by the old provinces (Longo and Mobilio, 2016). The second matter regards the scarce adherence of the functional dimension of metropolitan territories with their administrative local units. As Istat (2014, 2017) maintains, the functional partition of territories is fundamental to grasp the socio-economic developments of the local economies. The creation of the metropolitan cities, however, has neglected the functional boundaries of territories indicated, resulting in a fuzzy adherence between the legal-political metropolitan territory and the actual integrated area. In some cases, this has led to a political-administrative unit that boundaries and governance contain geographical areas with different socio-economic dynamics.

5.1 The territorial unit of analysis

Another issue regards the statistical analysis of Italian metropolitan areas. In this work, we follow the legislative definition of Italian metropolitan areas, considering the political-administrative local boundaries of the old provincial areas as a unit of measurement to proxy metropolitan territories. We recognise the limitation of such an approach that may underrate the functional dimension of these territories, including zones with different economic and social integration. This choice is due to the aim of the analysis. We provide evidence upon the recent development of the "effective" metropolitan territories, affected by polarisation of economic activities and growing territorial imbalances among leading cities and lagging behind zones. These elements should revive the debate on Italian urban

growth, suggesting economic policies oriented to a more even geographical development and placed-based programs to support lagging behind territories. So that, the metropolitan cities, as local units, has the material and immaterial facilities to implement effective strategies and measure their impact on the local economy. Moreover, the statistical measurement of urban zones is a matter nothing short of remarkable. Often, the administrative boundaries of the urban zones do not fit with the effective economic and social integration of these territories. Indeed, many statistical measures of the urban area consider the commuting flows to account for the overall relationship among municipalities (Istat, 2017, Dijkstra et al., 2019). This approach is useful to grasp the effective interconnections between municipalities reflecting the functional integration of the territories. This matter is particularly crucial in the classification of metropolitan territories, which by definition involve a vast urban area with large governance facilities. National and international institutions adopted various approaches to cluster cities and their commuting zones. In table A.2 in the appendix, we review the definition and the methodology of the Functional Urban Areas, elaborated by OECD-Eurostat (Dijkstra et al., 2019, OECD, 2012) and Local Labour System, individuated by Istat (2014, 2017).

On the one hand, the definition of OECD (2012), updated and harmonised with EU institution and Eurostat by Dijkstra et al. (2019), identifies 74 functional urban areas and 13 metropolitan cities in Italy. The city and their commuting zones form the Functional Urban Areas according to a people-based target of population density and commuting flow towards the core urban centre. Metropolitan regions are NUTS level 3 approximations of Functional Urban Areas with at least 250000 inhabitants. This approach tries to connect the morphology of the urban territory (population density), their governance (local unit), and the socio-economic features (commuting flows) starting from the distribution of population in the grid (Dijkstra et al., 2019). The principal discrepancy with the Italian definition concerns the metropolitan area of Reggio Calabria, which is excluded by the OECD and Eurostat databases.

On the other hand, many analyses on the Italian urban system, such as Accetturo et al. (2019), Lamorgese and Petrella (2019), Viesti (2021), ground on the Local Labour Systems defined by Istat (2012), that differs respect OECD's definition in the methodology adopted to cluster areas. Local Labor Systems are territorial units whose boundaries are defined using the flows of daily home/work travel according to specific criteria of the demand and supply of work, regardless of the administrative articulation of the territory (Istat, 2017). The main differences between the two approaches are the following. Functional Urban Areas are clustered starting from a population grid according to a resident density. They include only the most developed urban areas and consider exclusively the commuting inflows towards the major urban centre. Moreover, they tend to be identified according to the closer local unit, connecting morphological and functional features of the territories with their political institutions. Local Labour System, instead, denote the overall geographical extension of the country, analysing the integration among territories throughout the reciprocal commuting flows of each municipality. In this way, they overcome the administrative boundaries focusing on the areas' socio-economic dynamics.

Our analysis proxies metropolitan cities with their province territories, creating a new dataset from many sources. There are several reasons for this choice. First, the Local Labour System accentuates too much the labour market element and, in particular, the role of the workplace. These statistical units are very useful to evince the territories' industrial structure, study the local labour market and the overall socio-economic dynamics, but do not refer to the political-administrative unit. Therefore, they are a less suitable tool for operative economic policy (Istat, 2014). Second, metropolitan cities, gathering material and immaterial infrastructures, became hubs for the broad territorial development fostering local innovation and widespread territorial entrepreneurship. So that, provincial data can better capture the overall economic performance of these territories. Moreover, principal cities often draw cultural and social services, such as health, universities, and cultural amenities, becoming strategic centres for more people than commuters. All in all, this paper aims to provide novel evidence on the ongoing structural polarisation in the recent developments of Italian metropolitan areas, encouraging a policy approach inspired by a balanced geographical urban growth. Hence, considering

the economic performances of the "effective" metropolitan territories can shed light on the current disparities and suggest local-based operative policies. So that, political-administrative governance is required to implement programs and measure their effects. Finally, excluding less developed places as Reggio Calabria, a metropolitan territory in one of the more impoverished southern regions, with strong regional relevance for economic and social matters, may bias the analysis towards a sample of leading territories unable to capture the Italian geographical deficiencies. Notwithstanding the discrepancy in the definition of statistical units, it should be noted that differences in practice are not so wide. For example, in Viesti (2021, p. 185), among the leading Local Labour System appear twelve metropolitan territories that are also component of the 21 Italian "principal urban areas" individuated by Istat (2017). In addition, the only absence of Reggio Calabria in Eurostat and OECD datasets differs from our list of Italian metropolitan areas. Finally, Istat's report (2020) maintains the dynamism of all metropolitan cities among urban types and their vast relevance for the country.

Table 1: Description of variables

name	Metadata	Source
Population rate of change	Compound annual growth rate of population 2002-2018	ISTAT- Ricostruzione intercensuaria della popolazione residente, 1991-2001, 2002-2019
Growth rate GDP per capita	Compound annual growth rate of GDP per capita	ISTAT-Conti economici territoriali- valori pro capite
Growth rate productivity	Compound annual growth rate of productivity	ISTAT-Conti economici territoriali- valori pro capite
Growth rate value-added	Compound annual growth rate of total value-added	ISTAT-Conti economici territoriali- Valore aggiunto per branca di attività (Nace Rev. 2- one digit)
Manufacturing value-added average share	Manufacturing value-added average share over the period	ISTAT-Conti economici territoriali- Valore aggiunto per branca di attività (Nace Rev, 2)
Manufacturing growth rate	Compound annual growth rate of Manufacturing value-added 2000-2018	ISTAT-Conti economici territoriali- Valore aggiunto per branca di attività (Nace Rev.2- one digit)
Financial and Insurance Services value-added share	Fin. and Insurance value-added average share over the period	ISTAT-Conti economici territoriali- Valore aggiunto per branca di attività (Nace Rev, 2)
Growth rate Financial and Insurance Services	Compound annual growth rate of Fin. and Insurance value-added 2000-2018	ISTAT-Conti economici territoriali- Valore aggiunto per branca di attività (Nace Rev.2 – one digit)
ICT Services value-added average	ICT value-added average share over the period	ISTAT-Conti economici territoriali- Valore aggiunto per branca di attività (Nace Rev, 2)
ICT Services growth rate	Compound annual growth rate of ICT value-added 2000-2018	ISTAT-Conti economici territoriali- Valore aggiunto per branca di attività (Nace Rev, 2)
Patent applications/grants ratio	Number of patent applications/grants for 100000 inhabitants	UIBM- Ufficio Italiano Brevetti e Marchi- I numeri della proprietà intellettuale
Patent grants/applications rate of change	Compound annual growth rate of patent grants/applications over the period of the number of patents for 100000 inhabitants	UIBM- Ufficio Italiano Brevetti e Marchi- I numeri della proprietà intellettuale
Mobile banking services users	mobile banking services users for one thousand inhabitants	Banca d'Italia- Base dati Statistica-Servizi di home e corporate banking: numero di utenti

Source: author's elaboration. Notes: the table describes the list of variables computed in this paper, their description and their sources.

In table 1, we define the list of variables and the sources of the data collected to analyse the economic developments of Italian metropolitan areas, their economic structure and their innovation performances using patenting activity as a proxy. We compute the compounded annual growth rate between 2000-2018 of population, productivity, GDP per capita and technological indicators such as patent grants and applications. We also compute the average share and the growth rate of value-added for three key economic sectors: ICT Services, Financial and Insurance Services and the manufacturing industry. These sectors, suggested by the literature, are considered to show how metropolitan economies modified their economic structure in the last two decades. Indeed, we expect that top metropolitan economies have a larger share of financial, insurance and ICT services. Meanwhile, their weight in lagging metropolitan economies should be minor.

5.2 Historical features of the Italian urban system

Two historical features characterise the Italian urban system. First, the size of the cities is smaller compared to other European countries. Second, Italian economic geography is affected by historical territorial imbalances among Centre-North and South and Islands macro areas. In this section, we are going to discuss the literature about the determinants of the small size of the Italian Urban system. In the next, we are presenting the evolution of the Italian urban system in light of the development waves of the country.

Notwithstanding the weight of metropolitan areas in Italy's economy, the metropolitan population is lower than the other European countries (Accetturo et al., 2019). The population living in the biggest urban agglomeration, the urban primacy, is comparable only with Germany, around 7%, but lower than Spain, France, and the UK. The difference is less pronounced considering the population living in most eight urban agglomerations, but the share of the Italian metropolitan population is still.

The small and medium size of the Italian cities, often distant from another, may affect the productivity of the urban system and the contribution to the country's growth (Frick and Rodríguez-Pose 2018, Accetturo et al., 2019, Viesti, 2021). Therefore, many analyses tried to indagate the causes of the tiny size of Italian urban zones, stressing geographical characteristics, historical and political matters.

Geographical features may explain between 30% and 50% of the size of Italian cities (Accetturo and Mocetti, 2019). Locational fundamentals may have had a decisive role in the first phase of urbanisation, concentrating population in small villages, due to the geomorphologic composition of the territory, but the weight of these factors on the urban growth, in the long run, declined (Accetturo et al., 2019). Thus, economic motives have become the principal source of population migration.

Many explanations are ground on historical contingencies. Accetturo et al. (2018) show that pirate attacks of the 19th century pushed the population to inner areas, mainly mountainous, where morphology and resources determined the growth of small centres. This happened mainly in the South, where the local economy was based on subsistence agriculture, and land endowments determined the diffusion of small centres. Pirate attacks, moreover, shrink the population of urban primacy, leading residents to move toward more impervious places. According to the counterfactual simulation exercise of the authors, without threats, in 1951, urban primacy would have been a half percentage point more. In the Centre-North, military conflicts among European regions may have had affected the development of large urban centres, smoothing the population towards smaller towns to escape from army assaults (Dincecco and Onorato, 2016).

Political fragmentation also played an important role in the size of the Italian urban system. Cervellati et al. (2018) estimate a correlation between the size of the country and the growth of cities' population, finding a positive correlation. Italian political history is characterised by strong political

fragmentation. The diffusion of a multiplicity of regional states until the XIX century, often in conflict among them, curbed the expansion of their cities with respect to other countries with older unitary history determining a smaller dimension of cities. Moreover, the federal tradition of governance of the Italian state, along with strong regional cleavages, may have supported the spread of economic activities among local territories, favouring the formation of middle-urban centres (Fritsch and Wyrwich, 2021). Despite the complementarity of many of these analyses, more research is needed to understand the determinants of the smaller size of Italian cities compared with other similar countries.

5.3 The recent evolution of the Italian urban system

The recent evolution of the Italian urban system mirrors the waves of economic development of the country marked by historical imbalances among Centre-North and South and Islands macro-zones. Overall, between 1951-2011 there has been a shift of population from tiny to bigger urban zones and from non-urban to urban territories (Accetturo et al., 2018). This, however, happened more in the Centre-North, where cities enlarged, absorbing close small towns, and the demographic trend witnessed a positive dynamic supported by foreign and southern immigrant inflow (Lamorgese and Petrella, 2019).

During the 1950s and 1960s, populations moved toward large industrial agglomerations and bigger cities growth more than small and intermediate centres in all the country (Accetturo and Mocetti, 2019). These flows result from a huge process of structural change in the Italian economy (Viesti, 2021). The vast spread of manufacturing industries in the central and northern regions attracted young workers from the South. These flows enlarged the population of industrial cities where large plants were localised. In the South, the massive shift from agriculture to manufacturing and public services occupations increased the population of the cities. These patterns changed the urban geography of the country, moving the population from rural to urban zones and from the southern regions to large manufacturing poles (Accetturo and Mocetti, 2019, Viesti, 2021, p 50).

Instead, from the 1970s to the turn of the century, middle-size cities attracted relatively more population than large centres. With the development of small specialised industrial clusters, the spread of industrialisation to provincial territories fostered small and medium towns growth (Becattini, 2003). The diffusion of manufacturing productions to peripheral territories supported the growth of many local economies that had not been industrialised yet in what has been called "third Italy". These experiences involved mainly the North and Centre, where geographical proximity with advanced productive structures sustained local entrepreneurship and the diffusion of specialised production networks. In the South, a weak economic structure, along with the absence of internal demand and the increasing international competition, curbed the diffusion of the industrial districts (Viesti, 2021). However, these matters occurred along with the declining weight of manufacturing employment and the advent of services and digital technologies as a source of economic growth, leading some authors to speak about a phase of "tardive industrialisation".

At the turn of the century, the increasing concentration of technologies and servicing productions in large cities changed Italian economic geography again, generating new deep imbalances between declining peripheries and large metropolitan agglomerations. From 2006 to 2018 population grew more in the larger urban zones than in the smaller ones (Viesti, 2021, p. 185). Italian metropolitan areas became the most dynamic area of the country in terms of value-added, advanced productions and population share (ISTAT, 2020). Non all metropolitan cities, however, gained from the new knowledge-economy based on market-oriented services and knowledge-intensive productions.

6. Evidence from Italian metropolitan areas

This section provides evidence on the divergent development of the Italian metropolitan areas by analysing the total and sectoral value-added growth rate index. Growing polarization emerges between metropolitan and non-metropolitan territories of the country, the non-metropolitan Italy, and within the fourteen Italian metropolitan areas due to the strong development of the leading metropolitan areas and the weaker growth of the others. Summing up, some relevant issues emerge feeding new and old territorial inequalities.

First, total value-added raises more in the metropolitan areas than in the rest of the country, concentrating economic production in these zones. Metropolitan areas, indeed, are core drivers of the country's growth, where the most value-added gains localise. However, this dynamic increases the differences between metropolitan and non-metropolitan territories, enlarging territorial imbalances.

Second, also within Italian metropolitan territories, there is a growing polarization among a few metropolitan territories, such as Milan and Bologna, in which most of the value-added increases localise, and the other metropolitan zones performing very different growth trajectories, many of them featured by economic decline or stagnant development.

Third, we also provide evidence about the strong polarization between metropolitan Italy and non-metropolitan Italy in advanced business services. These sectors- such as Finance and Insurance and ICT services- are key drivers of urban growth nowadays, and their concentration in a few metropolitan areas feed disparities across the country. Non-metropolitan territories performed worse in the value-added growth of advanced business services compared to the metropolitan territories and, since 2008, the divergent growth has deepened. These developments witness a growing polarization among metropolitan and non-metropolitan territories in knowledge-intensive service productions.

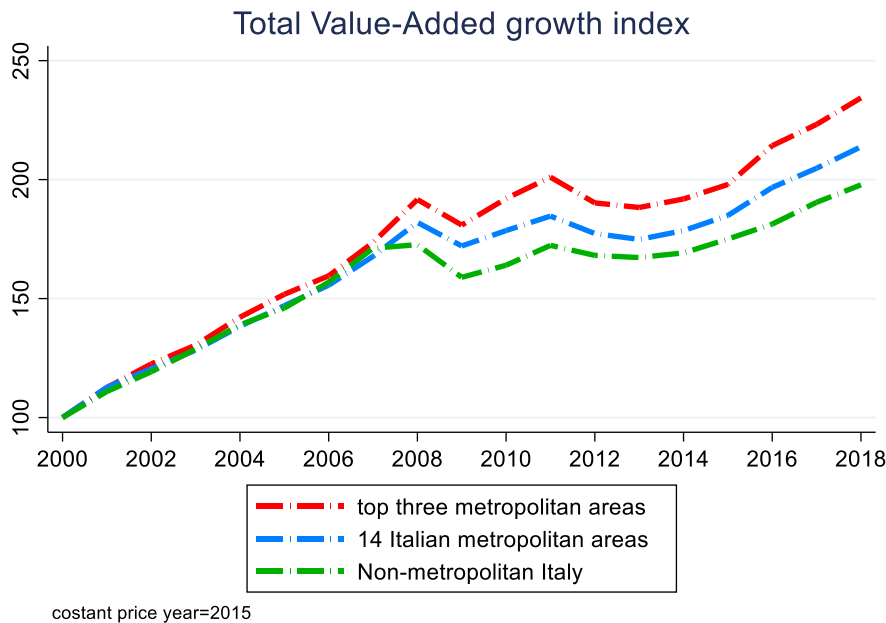
Fourth, growing territorial polarization in advanced business services takes place also among Italian metropolitan areas. Just a few territories increased the value-added of these productions, concentrating the territorial distribution of these industries. Indeed, the value-added in advanced business services of the top three metropolitan territories increased more than in the other metropolitan areas, and in many of them barely advanced between 2000-2018. These developments enlarged disparities across metropolitan territories.

Five, we show that many of these developments follow the territorial disparities across Centre-North and Southern-Insular macro areas. Indeed, the former macro-area grew more in all economic and demographic indicators that we consider, while the latter performed worse or declined. These developments increased the uneven geographical development of the country, feeding territorial inequality.

Figure 3 shows the polarization of economic production across the country and between metropolitan territories due to the concentration of the major advancements in value-added in the top three metropolitan areas.

We calculate the value-added growth index starting from 2000 for the top three Italian metropolitan areas, for the 14 metropolitan areas and for the non-metropolitan Italy. For each zone, we sum the value-added and calculate the growth index dividing each year by its value in 2000, the base year, times 100 at constant price. The value-added of the top three metropolitan areas- the red line in the graph- growth along with the other zones of the country until 2007, when it started to diverge, rising more than in the overall metropolitan areas and in non-metropolitan territories. Since 2007 indeed, the value-added in the top three metropolitan areas increased more than in the overall fourteen Italian metropolitan areas- the light blue line-, increasing divergence among metropolitan territories. Between 2008-2009 it decreased less than in the overall metropolitan and non-metropolitan Italy and quickly recovered to a higher level in 2010-2011. The gap across the top three metropolitan areas and the rest of metropolitan Italy slightly deepened in 2015 due to a further increase of the three leading metropolitan areas value-added and a slower growth of the overall metropolitan areas, mirroring the ongoing process of structural divergence.

Figure 3: the value-added polarisation

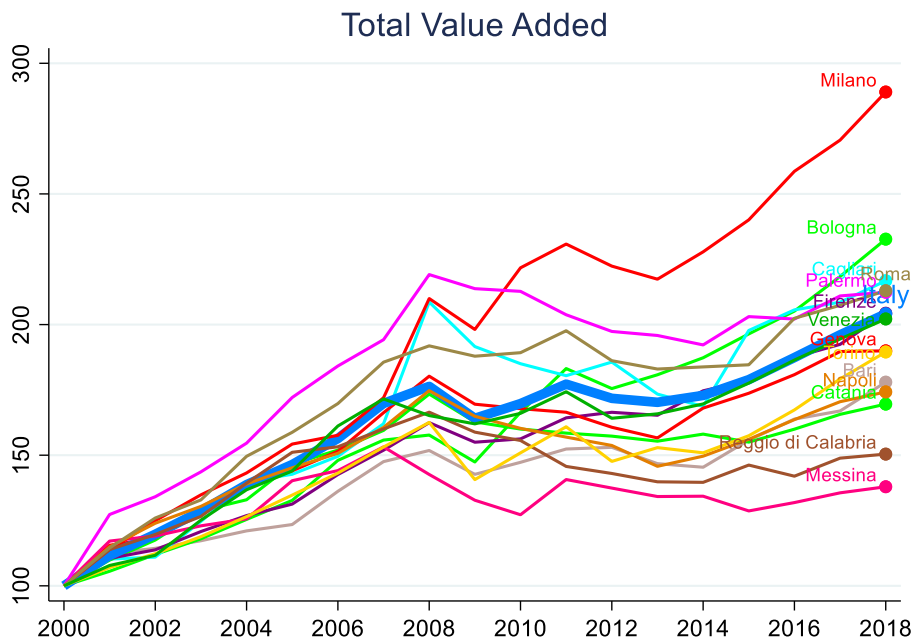


Source: author's elaboration on ISTAT data. Note: the graph depicts the growth index of total value-added. We compute the growth index dividing each year by its value in 2000, the base year, times 100. We compute this index for the top three Italian metropolitan areas- for all the period Milan, Rome and Turin-, for all the 14 Italian metropolitan areas, and for the rest of the country, the non-metropolitan Italy. For the latter, we subtract the metropolitan value-added to the country's total value-added.

The gap is even more stronger with the non-metropolitan Italy -the green line-, signed by a deep fall in 2007 and a slow recovery of its level reached only in 2015. Since 2015 it has been enlarging due to the rapid growth of the leading metropolitan zones and a weakly growth of the non-metropolitan territories. Between 2008-2015 non-metropolitan Italy value-added declined meanwhile the top three metropolitan areas increased economic production, overcoming its level of 2008. These developments deepened the difference between the leading three metropolitan territories and the non-metropolitan Italy, affected by a huge drop and slower growth.

Differences also evince between the fourteen metropolitan areas and the non-metropolitan Italy. Metropolitan territories since 2007 grew more than non-metropolitan and enlarged the difference in 2015, triggered by a more intense increment of the former. These patterns show the country's growing territorial disparities since 2007, signed by a rapid growth of the top three metropolitan zones along with a modest increase of the overall metropolitan areas and a slower development of the non-metropolitan territories. These divergent growth trajectories accrue the geographical imbalances of the countries, augmenting the gap between economic centres and lagging peripheries. Thus, a new territorial configuration emerged, featuring economic polarization within metropolitan areas and between metropolitan and non-metropolitan Italy. Polarization also evinces the development of the fourteen Italian metropolitan areas. Milan largely gains more than the other metropolitan zones, feeding the concentration of the value-added. In contrast, many metropolitan areas, such as Messina, Reggio Calabria, achieved very weak growth, performing trivial improvements in value-added. Figure 4 shows these developments, witnessing the growing divergence across metropolitan territories. We calculate the growth index of total value-added of each metropolitan area and Italy between 2000-2018. Since 2008 divergent growth has featured Italian metropolitan areas.

Figure 4: Value added in the metropolitan areas

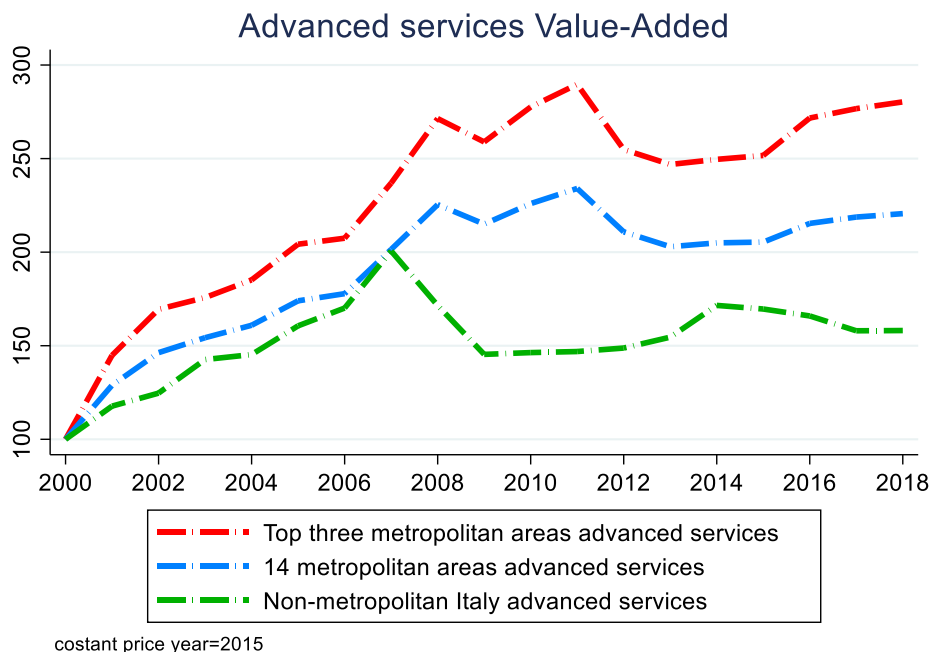


Source: author's elaboration on ISTAT data. Note: the graph depicts the growth index of total value-added of each metropolitan area and for Italy. For each metropolitan area, calculate the growth index dividing value-added of each year by its value in 2000, the base year, times 100. Prices are constant at year=2015.

Milan performed as the only global city in the country, disproportionately incrementing its value-added respect to the other metropolitan areas. Bologna also shows a consistent growth of its value-added; however, it never reaches the amount of value-added of the first three metropolitan areas. On the other side, many metropolitan territories, such as Messina and Reggio Calabria, declined, others, like Genova and Turin and Venice, show very modest growth since 2008, below the overall country value-added growth. These patterns witness the absence of convergence among the metropolitan zones, affected by economic polarization among the strong growth of the leading metropolitan territories and the modest or stagnant development of the other metropolitan zones.

At the root of the concentration of income and economic production in leading metropolitan zones, there is the tendency of the high-profitable advanced business services to localize in the downtown of the leading metropolitan centres to gain from the agglomeration externalities of capital, high-skilled workers, social and technological infrastructures (Sassen, 2018). This process also affects Italy. The polarization of the country in terms of advanced market-oriented services and finance feed structural divergence within metropolitan territories and between metropolitan and non-metropolitan Italy, as shown in figure 5. We calculate the growth index for selected advanced services- ICT and Financial and Insurance Services- starting from 2000 for the top three Italian metropolitan areas, for the 14 metropolitan areas and for the non-metropolitan Italy. For each zone, we sum the value-added of ICT and Financial and Insurance services and calculate the growth index dividing each year by its value in 2000, the base year, times 100 at constant price. Value-added of advanced services, the red line in the graph, in just three metropolitan areas-Milan, Turin and Rome- disproportionately raised more than in the other metropolitan areas and in the rest of the country since 2000, enlarging disparities in the territorial distribution of these highly profitable activities. Advanced service value-added in the top three metropolitan cities grew more for all the period than in the 14 Italian metropolitan areas- the light blue line- with enlarging divergence since 2016, when the distance between the two lines increased. These patterns witness the growing polarisation among the leading Italian metropolitan areas and the overall metropolitan Italy due to the concentration of these activities in a few leading places. Even more large is the gap with the rest of the country.

Figure 5: the polarization of advanced services

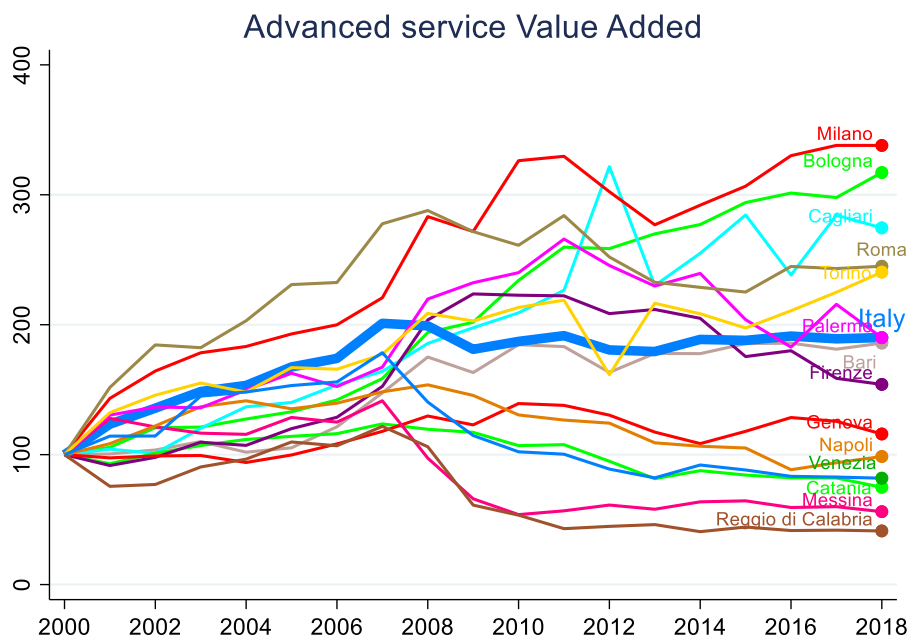


Source: author's elaboration on ISTAT data. Note: the graph depicts the growth index of selected advanced service value-added. We sum the value-added of Finance and Insurance and ICT Services and calculate the growth index dividing each year by its value in 2000, the base year, times 100. We compute this index for the top three Italian metropolitan areas- for all the period Milan, Rome and Turin-, for all the 14 Italian metropolitan areas, and for the rest of the country, the non-metropolitan Italy. For the latter, we subtract the metropolitan value-added to the country's total value-added.

The distance between the green line and the red line, the value-added of the non-metropolitan Italy and the three leading metropolitan zones, increased from 2000 to 2018. Particularly intense is the divergent growth after 2007, due to the fall of the green line until 2010 when started a stagnant trend. Since 2014, the gap has deepened due to the rapid growth of advanced services value-added in the top three metropolitan zones, and its decline in the non-metropolitan Italy. These developments mirror the massive polarization of the country in terms of advanced business services as ICT and Financial and Insurance services, which largely gather in just a few metropolitan areas, overlooking the other zones. The divergence between the metropolitan Italy and the non-metropolitan Italy appears less intense and driven by the divergent evolution that occurred after 2008, with the consistent fall of the latter and a moderate increase of the former. After 2014 the gap is further enlarging, propelled by the decline of the advanced service value-added of the non-metropolitan Italy. This issue suggests a stronger disparity between the three top metropolitan zones and the rest of Italy than among metropolitan and non-metropolitan zones in advanced business services and finance. A few metropolitan zones increased their performances, meanwhile, most of the metropolitan areas lag behind, often declining in the production of these activities at the roots of the urban growth (Glaeser, 2020, Sassen, 2018).

The massive concentration of the market-oriented services and finance in just a few top territories feeds the divergence between superstar territories, where high-technological productions take place and the other metropolitan and non-metropolitan territories, with a more traditional local economic structure and less profitable productions. Figure 6 shows the growth index for selected advanced business services, the sum of ICT and Financial and Insurance Services value-added for each metropolitan area.

Figure 6: advanced corporate services in metropolitan areas



Source: author's elaboration on ISTAT data. Note: the graph depicts the growth index of selected advanced service value-added. We sum the value-added of Finance and Insurance and ICT Services and calculate the growth index dividing each year by its value in 2000, the base year, times 100. We compute this index for each Italian metropolitan area.

The index is calculated by dividing each year by its value in 2000, the base year, times 100 at constant price. There is a clear divergent growth across Italian metropolitan areas.

Milan, Turin, Rome and Cagliari increased the production of advanced business services between 2000-2018, growing more than the overall country. On the other side, many southern and insular metropolitan areas, such as Reggio Calabria, Messina, Catania, Naples, alongside many old manufacturing centres like Genova and Venezia, performed weakly or declined. These developments mirror the divergent growth across the Italian metropolitan territories in advanced business services, suggesting consistent differences in the local structure of the metropolitan economies.

Table 2 and table A.3 in the appendix shows the sectoral evolution of the Italian metropolitan areas. Milan is the only “Global City” (Sassen, 2018) in the country, gathering technological advances and high value-added productions. Its local economy is based on a high share of manufacturing activities, financial and ICT corporate facilities, along with dynamic innovation activity. GDP per capita and value-added growth rates are much higher than all other units in the sample, feeding the concentration of economic activity in this territory. On the opposite, Rome has losing ground in the last two decades, undertaking a concerning development trajectory

There are some exceptions in the South. Some places, like Palermo and Cagliari- starting from a very low amount of the services valued-added, considerably increment the production of these services over the period. However, the weight of these sectors on the local economy is still not comparable to the centre-northern metropolitan areas. Even more concerning is the decline in ICT services value-added of many southern and insular metropolitan areas, which, along with weak performances in Finance and Insurance services, mirrors the growing territorial divergence in knowledge-intensive economic sectors of the country.

Table 2: the sectoral developments in metropolitan areas

Metropolitan City	Financial and Insurance value-added growth rate	ICT value-added growth rate	Manufacturing value-added growth rate
Roma	1.07	3.40	-1.27
Milano	3.70	2.93	0.71
Napoli	2.05	-0.99	0.56
Torino	3.40	1.68	0.71
Bari	1.73	1.57	0.13
Palermo	4.78	0.46	-1.09
Catania	1.66	-2.39	-0.78
Firenze	2.14	0.11	0.27
Bologna	3.36	2.86	1.57
Genova	1.10	-0.35	0.85
Venezia	-0.88	0.003	1.31
Messina	0.09	-3.26	-1.30
Reggio di Calabria	0.01	-4.78	1.52
Cagliari	1.34	3.90	-0.93

Source: author's elaboration. Notes: the table depicts the sectoral dynamics of the Italian metropolitan areas. We computed the compound annual growth rate between 2000 and 2018 for three economic sectors: ICT, Financial and Insurance services and the manufacturing industry.

Uneven dynamics also arise among the centre-northern metropolitan cities due to the challenges posed by the new emerging global paradigm of the knowledge-economy as evinced by table 2. Some places, like Bologna and Turin, performed a consistent growth of ICT and financial sectors along with a sustained GDP per capita rise, undertaking a process of structural transformation driven by the local diffusion of market-oriented corporate services.

Others, like Genova and Venice, old core manufacturing areas, associate weak growth in service with a stagnant trend in innovation performances, resulting in a concerning development trajectory in light also of the consistent decrease of the residents. Overall, the heterogeneity in the development trajectories of the centre-northern Italian metropolitan areas witnesses the far-reaching consequences of the process of technological change on the Italian metropolitan economies.

Structural differences of recent growth trajectories reflect historical territorial disparities of the country. We witness a concentration of population, income, and technological productions in centre-northern metropolitan areas, while southern and insular metropolitan zones lagging-behind. These developments may exacerbate territorial inequalities polarising wealth, employment structure and life opportunities in the country. For this reason, we divided metropolitan cities into two groups according to macro-territorial localisation in table 3.

The old regional imbalances among centre-northern and southern and insular metropolitan zones increased, reflecting structural differences in their local economies. The centre-northern metropolitan areas advanced more in patent application density and GDP per capita. Instead, southern and insular metropolitan cities stagnate, performing weak economic growth and scarce propensity to innovate.

These developments augment historical territorial gaps, echoing the geographical imbalances of the country. Northern metropolitan territories specialise in high-tech activities and knowledge-intensive sectors, gaining from the spread of digital technologies. In the South and Islands, metropolitan economies ground on traditional productions and low-profitable activities, employing low-skilled occupations and scarce technological breakthroughs.

Table 3: the economic performances of Italian metropolitan areas clustered in macro-areas

	patent applications growth rate	GDP per capita growth rate	productivity growth rate	Average ICT value-added	Average manufacturing value-added	Average Financial and Insurance value-added	ICT value-added growth rate	Manufacturing value-added growth	Financial and Insurance value-added
Centre-North	.005	1.74	1.33	5.37	17.01	5.63	1.20	.90	2.13
South-Islands	-.003	1.4	1.19	4.14	7.24	3.81	-.26	-.39	1.59

Source: author's elaboration. Notes: the table clusters metropolitan cities according to geographical macro-area. We computed the compound annual growth rate between 2000 and 2018 for patents application, GDP per capita productivity and value-added of three economic sectors: ICT services, Financial and Insurance services and manufacturing industry. Moreover, we compute for the same sectors the value-added average share over the sample.

The difference in the value-added average share of knowledge-intensive services - such as ICT and Financial activities- among the two groups confirm these trends, underlining the lower presence of market-oriented services in southern and insular metropolitan zones. Moreover, the deep gap in the share of manufacturing value-added -about 10 per cent points- witness the geographical disparities of the process of industrialisation of the country that largely concentrates around centre-northern metropolitan zones (Viesti, 2021). Disparities among these zones increased in the last two decades, in which southern and insular metropolitan zones grew less in all technological and economic indicators selected.

Second, table 3 witnesses the general decline of the manufacturing industry in all metropolitan economies favouring the services, mirroring the structural changes of Italian metropolitan areas. Manufacturing value-added, indeed, grows less than the other sectors, and in many southern metropolitan zones, it decreases. However, the shift towards services presents lopsided geographical features. The old centre-northern manufacturing centres have performed better than other areas, increasing the weight of the service industries in their economies. In the southern and insular metropolitan zones, financial and insurance value-added increased just by 1.59%, compared to the rise of 2.38% of the centre-northern cities. The gap in ICT services is even greater, indicating the stagnant dynamic of the southern-insular metropolitan areas in one of the most advanced technological activities.

6.1 The innovation performances

The innovation dynamics analysis of Italian metropolitan areas is conducted measuring the intensity of patent applications each year for a hundred thousand inhabitants. There are many ways to measure innovation and a long outstanding debate about the issue. We adopted this approach for two main reasons. First, recent literature stresses the ongoing increasing concentration of patents and innovation activities around leading metropolitan territories where, research centres, innovative enterprises, and high-risk capital concentrates. Metropolitan zones are, indeed, nowadays the place where the massive amount of patents and technological breakthroughs localise (Balland et al., 2021, Crescenzi et al., 2019, Florida, 2017 OECD, 2016). Second, the availability of the data. We collect the number of patent applications for Italian metropolitan areas from the statistical office of UIMB-Ufficio Italiano Marchi e Brevetti. The localization of patent data at the provincial level is abundant and allows a relatively long analysis period ranging from 2000 to 2018. Instead, many more accurate measures of

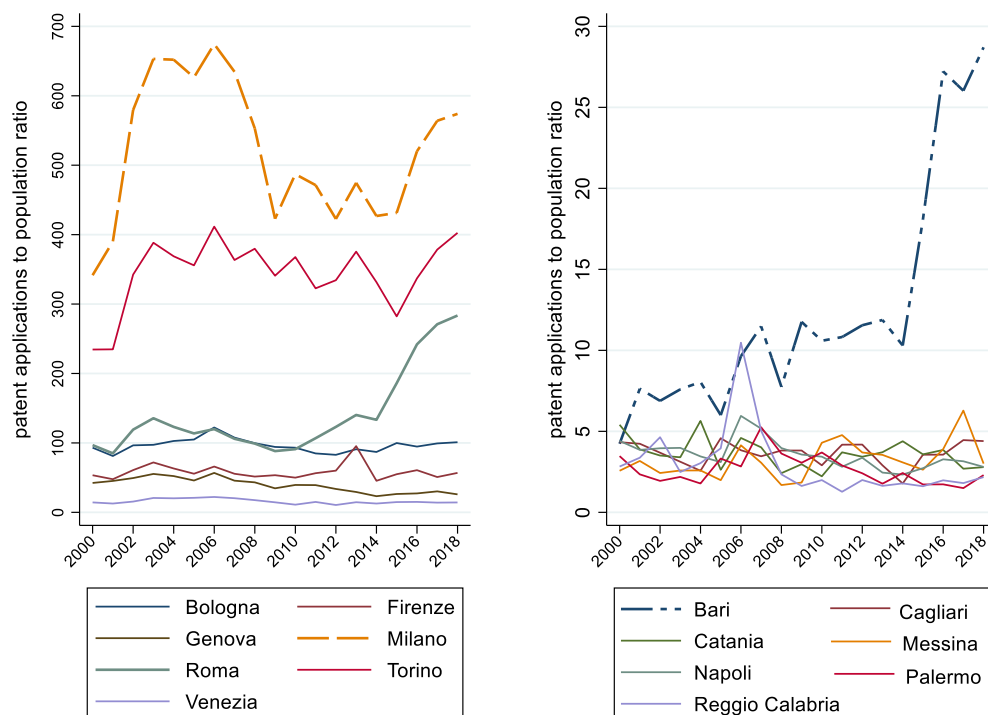
innovation activities are based on temporal and short-run surveys that allow limited time span and scarce territorial localisation.

Our index is a weighted measure of the number of patent applications with respect to the metropolitan territories' population able to compare territories of different sizes. We define the patent application to population ratios of a metropolitan territory following Fritsch and Wyrwich (2021) as:

$$InnDensity_{i,t} = 10^5 \left(\frac{h_{it}}{pop_{it}} \right)$$

In the formula, h_{it} is the number of patent applications for each of the fourteen Italian metropolitan areas i , in time t , from 2000 to 2018 and pop_{it} is the number of the population of the metropolitan territory i in each year for the same period. Therefore $InnDensity_{i,t}$, defines the patent applications to population ratio, measuring the intensity of innovation of the metropolitan territories according to a common population scale. Figure 7 plot the developments of the index between 2000-2018.

Figure 7: the evolution of the patent application to population ratio between 2000-2018



Source: own elaboration on UIMB-Ufficio Italiano Marchi e Brevetti dataset. Notes: the graph depicts the evolution of the patent to population ratio for the Italian metropolitan areas between 2000 and 2018.

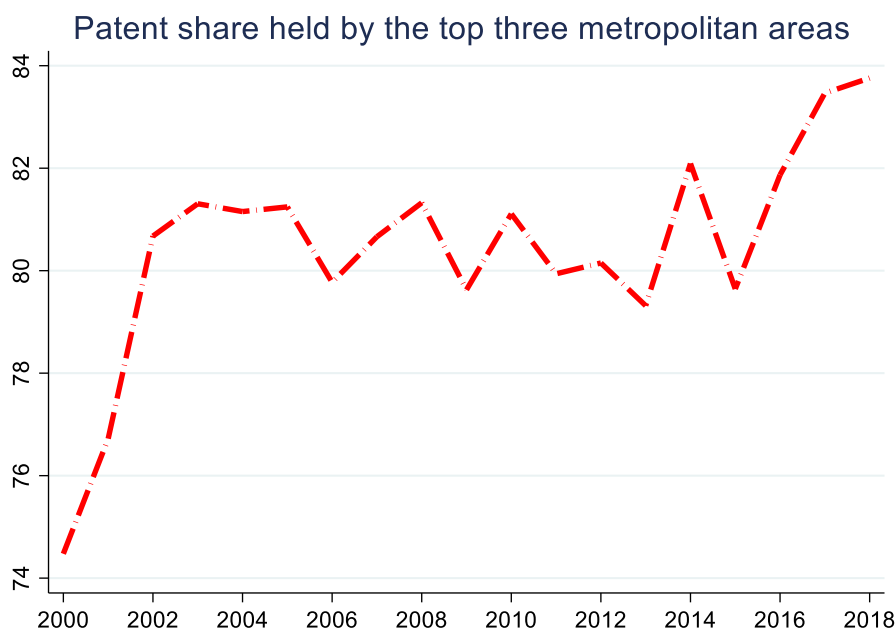
We divide the figures according to the regional macro-areas of the metropolitan cities, showing the considerable imbalances in the geographical localization of innovation activities in the country. There is a massive difference in the volumes of patent application density between the two macro-regions. Southern and insular metropolitan cities have a lower patent population ratio, ranging between 0 and 5 patent requests for hundred thousand of inhabitants during the sample period. Only the metropolitan area of Bari in this group performed a considerable increment of patent density, shifting from a 2.69 patent application to 27.11, the most significant boost among metropolitan territories. The rest of the southern and insular metropolitan areas, however, achieved trivial increments, showing a stagnant trend. This pattern mirrors the scarce development of the metropolitan areas of these zones, which enlarge the gap with the centre-northern ones. Instead, the right side of the graph shows the higher

volume of the patent to population ratios of the centre-northern metropolitan territories, where most innovation activity is located in the country. Overall, Centre-North's innovation activity is considerably higher than the southern and insular metropolitan territories, both at the beginning and at the end of the period. Moreover, the figure suggests a process of concentration of the innovation activities among Italian metropolitan areas. Milan, alone, accounted for 43% of total patents in 2018. Besides, the first three metropolitan cities in 2000, namely Milan, Turin and Rome, account for above 80% of the total patents according to UIMB-Ufficio Italiano Marchi e Brevetti. This percentage rose to 94,36% in 2018. Indeed, polarization also emerges among this group. Bologna follows the country's three leading most innovative areas, raising the patent application density by 7.4%. But the remaining centre-northern metropolitan cities do not follow this trend, performing stagnant or declining performances. In addition, the development of centre-northern metropolitan cities in innovative activities undertook a divergent trajectory, particularly after the great financial crisis of 2008-2010, suggesting the difficult revival of these territories in terms of innovation performances. These results mirror the geographical concentration of innovative hubs around a few territories, which also occurred among Italian metropolitan territories, where capitals, researchers, knowledge institutions and innovative firms gather (Viesti, 2021).

To test the hypothesis of the growing concentration of innovation activities, we construct a concentration index, calculating the patent quote of the leading three metropolitan areas. Figure 8 shows the share of patent application ratio held by the top three metropolitan territories between 2000-2018.

The share of patent applications of the top three Italian metropolitan territories increased between 2000 and 2018, mirroring the concentration of the patent to population ratio in very few metropolitan territories. The first rise occurred between 2000-2002 when the red line jumped from 74% to 81%. A second increase in the quote held by the top three metropolitan areas took place in 2015, reaching 84%. As suggested by the trend analysis, these developments mirror the polarization of patenting activity among Italian metropolitan areas due to their concentration in few metropolitan areas.

Figure 8: the share of patent applications held by the top three metropolitan areas



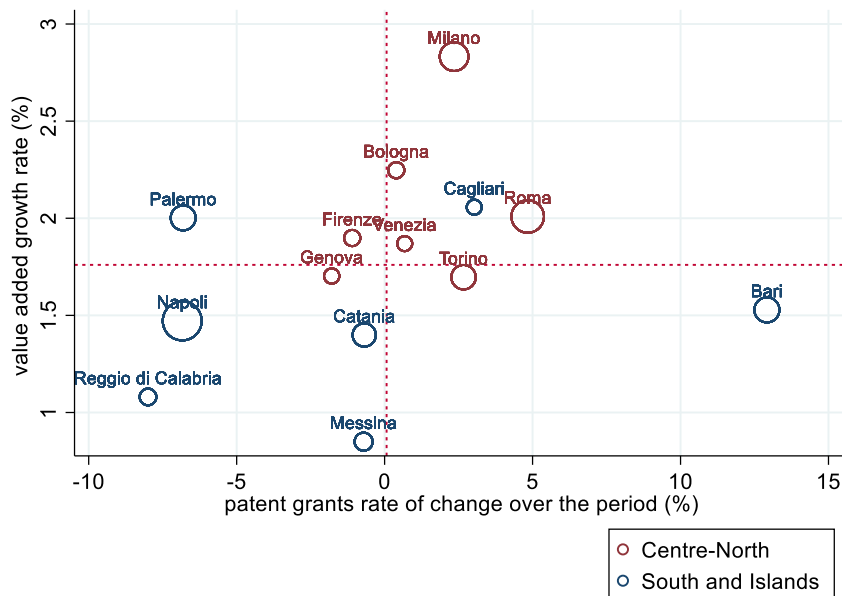
Source: own elaboration on UIMB-Ufficio Italiano Marchi e Brevetti dataset. Notes: the graph depicts the share of patent applications held by the top three metropolitan areas. The top three metropolitan areas are Milan, Rome and Turin for the sample period.

6.2 Innovation and economic development

Value-added advancements in metropolitan cities in Italy between 2000 and 2018 show polarization, indicating divergent growth paths. Two main features emerge from the study of the recent developments of Italian metropolitan areas. First, value-added gains concentrate in a few leading metropolitan zones in the Centre and North of the country, where also innovation activities gather. Southern and insular urban territories, starting from a lower economic activity level, have lost ground, performing weakly than the other group. These results indicate divergent growth trajectories among macro-areas, reflecting increasing territorial inequality among economic centres and new peripheries in the country (Viesti, 2021). Second, territorial heterogeneity evinces also among centre-northern metropolitan cities. Leading metropolitan cities, such as Milano and Bologna, shows strong economic dynamism sustained by advancement in patent grants. Instead, many old industrial metropolitan territories perform a more modest growth, suffering from the shift towards market-oriented service and the declining weight of industrial productions. They performed scarce increases in value-added and show stagnant or declining change in the number of patent grants localized in their metropolitan territories.

The compound annual growth rate of the number of patent grants to population ratio - our proxy to measure innovation - seems to mirror the dynamics of total value-added growth, reflecting the territorial imbalances among Italian metropolitan areas. Indeed, as figure 9 shows, metropolitan territories with consistent growth in value-added also increase territorial patent grants. This result confirms the positive relationship between economic prosperity and innovation advancements in metropolitan economies (Florida, 2017).

Figure 9: Value-added and patents



Source: author's elaboration on ISTAT data. I Conti Regionali Territoriali database and UIMB-Ufficio Italiano Marchi e Brevetti data. Notes: the graph depicts the compound annual growth rate of value-added and patent grants between 2000 and 2018. The size of the bubble is weighted to the population average of the metropolitan areas over the sample period.

The group of metropolitan cities that growth more than 1.76% in value-added -the mean growth rate of the sample drawn by the red dot line in the graph- also performed positively in patenting activity. On the other side, metropolitan cities with decreasing trend in the number of patent applications signed a modest growth of value-added, below the average.

Few Italian metropolitan territories do not follow this pattern. The first exception regards the metropolitan area of Bari, the outlier in the graph. The considerable increase in the number of

patents, the strongest among all metropolitan cities, is associated with a value-added growth rate just below the mean. However, this trend is biased by the very low level of patenting in 2000. Indeed, even with the sharp increase in innovation activity, Bari's patent share on the total remains still below 1% in 2018. Furthermore, the gains deriving from the innovation activity are sometimes uncertain and require a long time to affect economic performances; they could not yet be visible in value-added performances. A different case regards the metropolitan territory of Palermo, where the soar in value-added of 2% is associated with a strong declining performance in innovation activity.

These patterns indicate a local economy based on low-tech productions and mainly supported by traditional sectors. Palermo, indeed, shows a considerable rise in the share of financial and insurance services value-added, however, specialized in basic and low innovative activities.

Figure 9, moreover, reveals a consistent territorial heterogeneity in the sample reflecting the geographical concentration of value-added gains and innovation activity among a few centre-northern metropolitan cities. The group of metropolitan territories with a positive rate of change in both patenting and total value-added is formed by centre-northern metropolitan cities, with the only exception of Cagliari. This metropolitan territory has undertaken a positive growth trajectory and advanced as the capital centre in the region. It combines a growth of more than 2% in value-added with an increase in patent grants of 3%. These findings are in line with the Icity-rank report (2018), highlighting the prominent role of Cagliari among the southern metropolitan areas and its economic dynamism.

In contrast, all the other southern and insular metropolitan cities performed a slight value-added increase along with scarce performance in patenting activity. These patterns suggest a concerning development trajectory enlarging disparities with the centre-northern ones.

The spatial concentration of economic production evinces also among centre-northern metropolitan territories, affected by heterogeneous dynamics of developments between top metropolitan areas and old manufacturing poles. The firsts, such as the areas of Bologna and Milan, perform a high growth rate in patenting activity and value-added. Many other centre-northern metropolitan cities, instead, associate a modest augment of value-added with a constant or declining trend in innovation activity, like the territory of Genova and Venezia. These patterns mirror the shift they face from a manufacture-based territorial economy towards a services-integrated local economy. Genova performs a declining trend in innovation activities and the worst growth of value-added in the macro area. Venezia increases its value-added along with stagnant activity in patenting. Turin, on the opposite, associates a positive dynamic of innovation with a scarce growth in value-added. Besides a slight decline in patents applications, Firenze performed well in value-added, sustained by the smart use of the rich cultural heritage and tourism-based services (Icity-rank, 2018). The metropolitan cities of Rome, the more extensive in the sample, realized the second-biggest jump in the number of patent grants in the sample, but along with a value-added growth very slight for the size of its metropolitan territory. Overall, these trends witness the ongoing divergent growth trajectories of Italian metropolitan territories. On one side, strong macro-areas imbalances arise among the metropolitan territories. On the other side, also among the centre-north group, Milano largely overcame in economic performance all other territories. The modest economic results of the other territories witness a different growth trajectory among metropolitan cities of this macro-area, enlarging geographical inequality and economic concentration in the country.

6.3 Innovation and income dynamics

Even the distribution of wealth increments presents geographical polarization among Italian metropolitan areas. Figure 3.B in the appendix plots the trend of GDP per capita associated with patenting activity between 2000-2018. It points out the links between the technological competitiveness, demography, and income evolution of metropolitan economies, reflecting structural features. This picture, again, confirms the two issues concerning the recent developments of Italian metropolitan areas. First, centre-northern metropolitan territories grew more than southern and insular ones, which started with a lower income level at the beginning of the period. These developments enlarged territorial inequality among metropolitan territories generating strong geographical income imbalances. These matters are even more gravest considering the worst demographic balance of these urban zones compared to the centre-northern metropolitan cities.

Second, among the top group, some leading metropolitan territories gather the advances in demography, technological endowments, and GDP per capita. At the same time, other metropolitan cities performed a stagnant development trajectory.

Concerning the first issue, more innovative metropolitan areas show higher growth of GDP per capita in Centre-North. Lower GDP per capita increase, weak demographic balance, and declining innovation performances reflect a concerning growth path in the southern and insular macro-area. Indeed, the growth rate of GDP per capita of Palermo and Naples of 1.92% and 1.41%, respectively, the highest in this area, followed a consistent decline in patenting activity. These features suggest an economic structure based mainly on traditional economic activities, with a scarce use of high-tech inputs and productions far from the technological frontier. Even more challenging is the position of Messina, Catania and Reggio Calabria, where the decline in patenting activity is associated with the lowest rate of growth in GDP per capita. Different patterns emerge for Cagliari and Bari, performing a modest increase in income per capita along with a rise in patent grants.

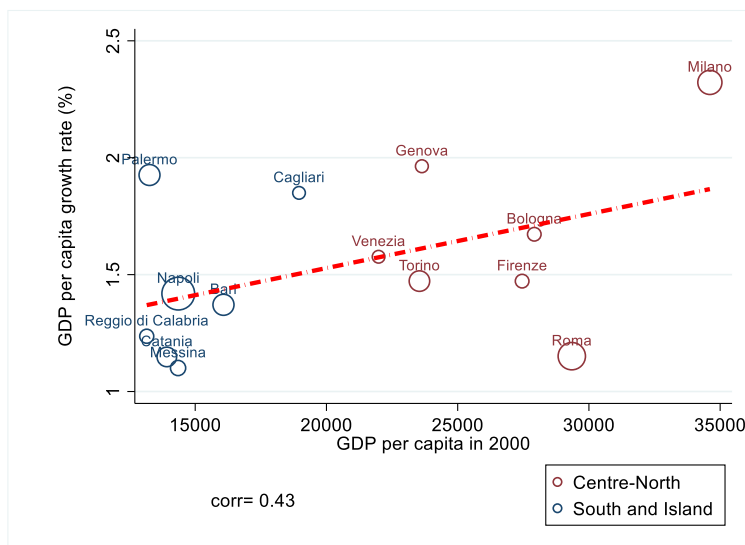
The second matter concerns the concentration of income advancements in the centre-northern metropolitan cities. Milano and Bologna gather the most growth in population, patent grants and income. These metropolitan territories, the centre of the second technological revolution based on manufacturing production, exploited the gains deriving from the new technological waves based on ICT, adapting formal and informal knowledge networks, endowments of physical and human capital and skilled employment. On the opposite, worthy is the case of Rome, performing a high increase in patent grants but the worst rise in GDP per capita. Here, some issues must be noted. First, this metropolitan area is affected by a substantial reduction in manufacturing employment, which has been a fundamental source of growth in the past. Second, the increasing specialization in ICT services exacerbated the dynamic of polarisation among wages and the spread of unpaid jobs. Third, the low GDP per capita growth is also affected by the considerable rise in population of 0.85%, the biggest one in the sample. The strong increase in GDP per capita of the metropolitan areas of Genova, instead, must be read in light of the strong reduction of the population that affected this area.

Such results suggest a divergent trajectory in the recent development of Italian metropolitan areas. Places with a higher level of GDP per capita in 2000 have grown more than the others, and territories with a lower initial level of GDP per capita performed worse.

So that, we present in figure 10 a graphical inspection of this hypothesis, drawing the red line of beta convergence for Italian metropolitan areas.

We plot on the y-axis the compound annual growth rate of GDP per capita and on the x-axis its initial level in 2000. The graphical inspection seems to confirm the hypothesis of the divergence. A high level of GDP per capita in 2000 seems to be correlated for 43% to a higher GDP per capita growth rate in the last two decades. Unfortunately, the sample size of Italian metropolitan areas and the short period does not allow an econometric estimate of this process.

Figure 10: the relation between the initial level of GDP per Capita and its growth rate.



Source: author's elaboration on ISTAT data, I Conti Regionali Territoriali database and UIMB-Ufficio Italiano Marchi e Brevetti data. Notes: the graph depicts the compound annual growth rate of GDP per capita and its initial level in 2000. The size of the bubble is weighted to the population average of the metropolitan areas over the sample period.

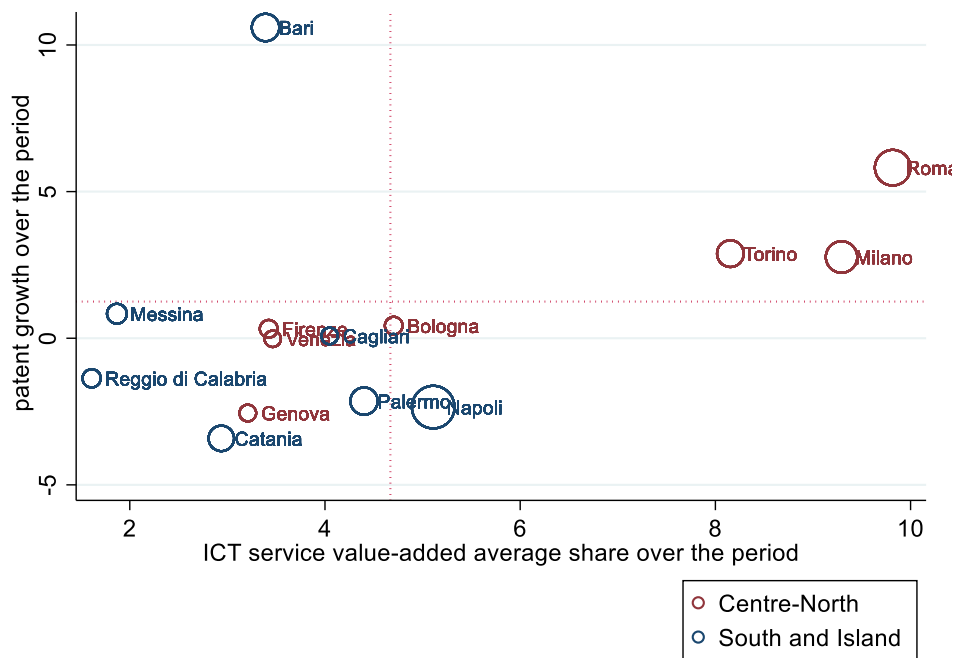
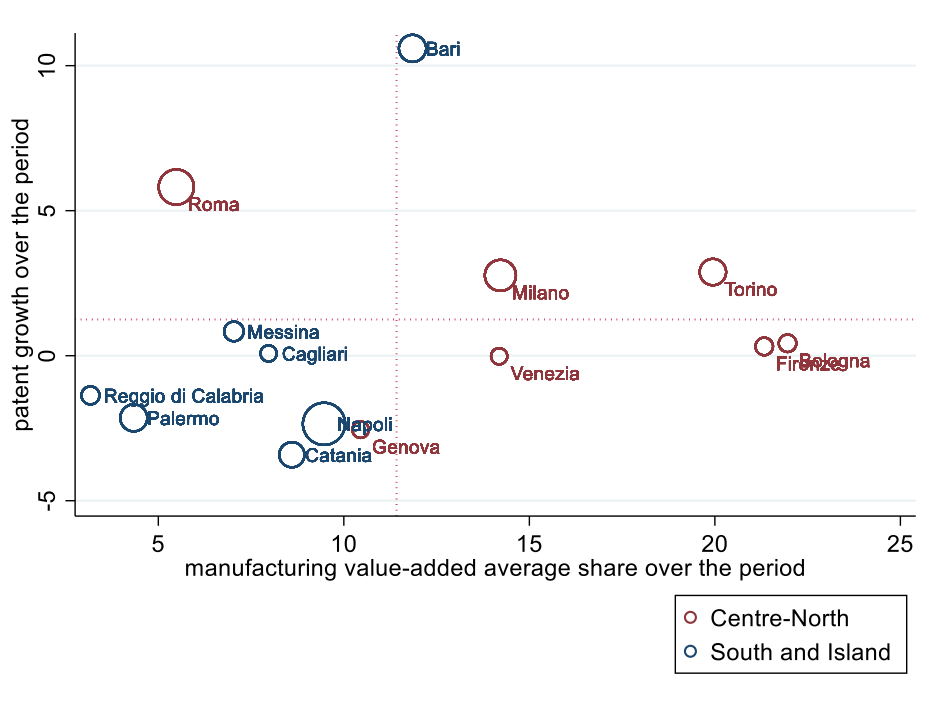
6.4 Innovation and sectoral dynamics

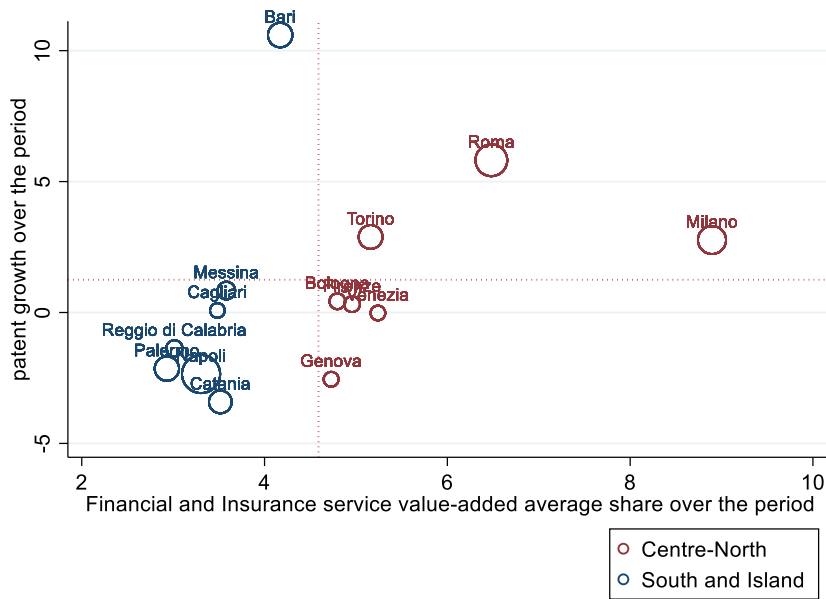
A deeper assessment of the sectoral dynamics is needed to analyze further the spatial distribution of the value-added and GDP per capita growth across Italian metropolitan areas. High-tech productions and knowledge-intensive services shape a virtuous cycle of growth, fostering income and innovation. In contrast, low patent grants and low manufacturing and corporate services value-added could explain a stagnant development path. We analyze the divergent growth of the advanced business services- the sum of ICT and Financial and Insurance services for each metropolitan area- in figure 10, highlighting the rising polarization of these activities across Italian metropolitan areas. Then, in figures 11 and 4.B in the appendix, we connect the average value-added share of three key economic sectors in one-digit Nace rev.2 with their growth rate. We analyse the developments of Financial and Insurance Services, ICT services and manufacturing industry, three core drivers of urban growth today (Glaeser, 2020, Harvey, 2012, Moretti, 2012, Sassen, 2018). This would help to explain how Italian metropolitan areas changed their economic structure in the last two decades. The root of the growing divergence between "superstar cities" and "lagging-behind territories" is the concentration of technologically advanced and profit-making services in the firsts, which attract capital, resources, and talents, while traditional productions feature the seconds.

Looking at the more aggregated level, we recognized some relevant issues that feature the recent sectoral development of the Italian metropolitan zones.

First, hi-tech industries localize in Centre-North. In many southern and insular metropolitan areas, technological productions and patenting activity are lower. Indeed, these economies present a lower share of corporate services and manufacturing value-added, as figure 11 clearly shows.

Figure 11: the structural features of Italian metropolitan areas





Source: Source: author’s elaboration on ISTAT data. I Conti Regionali Territoriali database and UIMB-Ufficio Italiano Marchi e Brevetti data. Notes: the graph depicts the compound annual growth rate of patent grants and the value-added of three economic sectors: ICT services, Financial and Insurance Services and Manufacturing Industry between 2000 and 2018. The size of the bubble is weighted to the population average of the metropolitan areas over the sample period.

In addition, also the growth of these sectors is worse compared to the centre-northern metropolitan areas, augmenting territorial disparities as figure 4.B in the appendix witness. These patterns suggest still a consistent weight of low-tech productions and low-skills occupations in these metropolitan economies. A growing structural divergence between macro-areas affects the recent evolution of Italian metropolitan areas. Key high technological sectors concentrate in few centre-northern metropolitan areas, witnessing the uneven geographical development of the country.

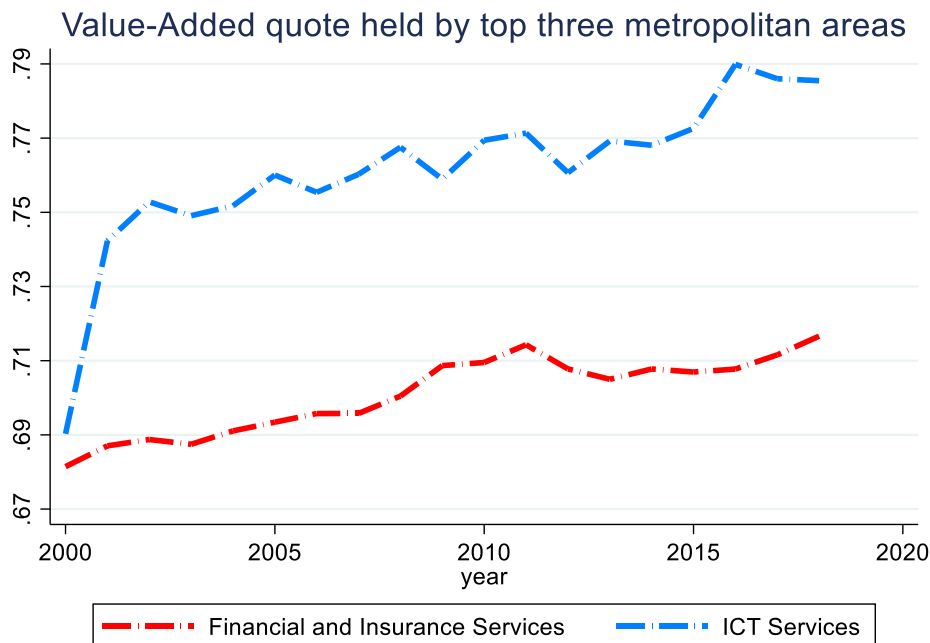
Second, the growth of the metropolitan territories of Bari and Cagliari, the exceptions in the south and insular metropolitan zones, is fostered by a consistent rise in ICT services, along with a modest increase in financial and insurance facilities. These developments suggest a growth trajectory based on knowledge-intensive services that support higher income and higher innovation activities. Conversely, scarce value-added increases and weak innovation activity affect the development of the other southern and insular metropolitan areas, exacerbating territorial polarization.

Third, among the three economic sectors, the manufacturing industry increases less than others, as pointed out by figure 4.B in the appendix, mirroring the generalized declining weight of this sector in the context of the urban economy, even more, turned on the paradigm of the “platform economy” (Sassen, 2018). However, as the distribution of the average value-added share witnessed, manufacturing production hugely concentrated in centre-northern zones, mirroring the geographical heterogeneity of the industrialization of the country, which was localised mainly in these territories (Viesti, 2021).

Fourth, only a few of the centre-northern metropolitan cities grew in advanced services, while many other zones performed stagnant growth or decline in these sectors. Indeed, the advancements in ICT and Financial and Insurance services concentrate in a few leading territories such as Bologna, Milan and Turin, with the specialization of Roma in ICT. Other old industrial poles face the difficult shift toward a corporate integrated local economy, affected by the decreasing weight of manufacturing productions. These developments expand the lopsided geographical allocation of core economic sectors among centre-northern metropolitan territories.

Figure 12 shows the value-added share held by the top three metropolitan areas for ICT and Financial and Insurance services among Italian metropolitan territories, mirroring the growing concentration of these activities rather than their diffusion among Italian metropolitan territories.

Figure 12 Share of value-added in advanced services in the top three metropolitan areas



Source: author’s elaboration on ISTAT data. I Conti Regionali Territoriali database. Notes: The graph depicts the Herfindahl-Hirschman concentration index between 2000-2018 for ICT and Financial and Insurance Services. Both increase their concentration among Italian metropolitan zones.

The quote of value-added held of Financial and Insurance Services increased between 2000-2018, reaching more than 70%. The concentration is even stronger for ICT Services, whose production largely localises in Rome, Milan, and Turin.

7. A statistical analysis on Italian metropolitan areas

We performed a statistical analysis to group Italian metropolitan areas according to their structural and economic features to shed light on the development of these zones between 2000-2018. We constructed two indicators based on economic, sectoral and technological variables and grouped the metropolitan areas according to their score in such indexes in 2000 and in 2018. The idea is to test whether the leading metropolitan areas in 2000 are the same as in 2018 or if the lagging metropolitan areas changed their growth trajectories, achieving the same economic and structural performances of the leading ones. This case will reflect a convergence process between Italian metropolitan areas in which lagging territories reach higher levels of income, productivity, and value-added share of advanced business services or manufacturing production, closer to the leading zones. Hence, we expect a closer group’s performances in 2018 compared to 2000, reducing the distance between the leading and lasting groups, or a shift from one group to another of a metropolitan area across the period, reaching higher scores. In contrast, the formation of the same groups between the initial year of the sample and the final year will witness no consistent modification in the growth trajectories of the metropolitan territories, suggesting the absence of a process of convergence. Moreover, a larger gap between top and lasting groups will mirror divergent growth trajectories driven by structural

polarization across metropolitan areas. The leading economic territories, growing more than others, enlarge the gap with the lasting ones, exacerbating the uneven metropolitan development of the country. To accomplish this analysis, we performed a factor analysis to discover synthetic indicators that sum up the economic and structural features of the metropolitan economies. Then we perform a k-mean algorithm adopting such indicators to cluster metropolitan areas between 2000 and 2018. Factor analysis, indeed, helps to find meaningful and simplified common factors able to explain complex features of the observations. Cluster analysis groups observations according to the score of the factors, maximizing the variance between groups and minimizing the variance within the groups.

7.1 Factor Analysis

Factor analysis is a powerful tool for reducing original data into a more compacted index, called factors, able to explain latent features of the observations. It reduces the number of variables by describing their linear combination, guaranteeing no information loss. Thus, factors are unobserved features that account for the original data, although in a different proportion. This statistical technique is widely used in many fields. Among others, the contribution of Río-Casasola (2021) stressed the complementarity of the use of factor and cluster analysis to group variables according to specific characteristics. He adopted this useful method to address structural division between peripheral and central countries of the European Union, analysing their developments. The selection of the variables is a crucial stage of this statistical method. We performed a factor analysis with eight variables. The list of variables adopted is shown in table 4.

Table 4: List of factor analysis variables

name	Explanation
GDP per capita	GDP per capita, millions
Productivity	Value-added/total employment
Manufacturing employment share	Sectoral employment
Manufacturing Value-added share	Sectoral value-added
Financial and Insurance Value-Added share	Sectoral value-added
ICT Value-Added share	Sectoral value-added
Patents grants	Number of patent grants for 100000 inhabitants
Banking Service Users	mobile banking services users for one thousand inhabitants

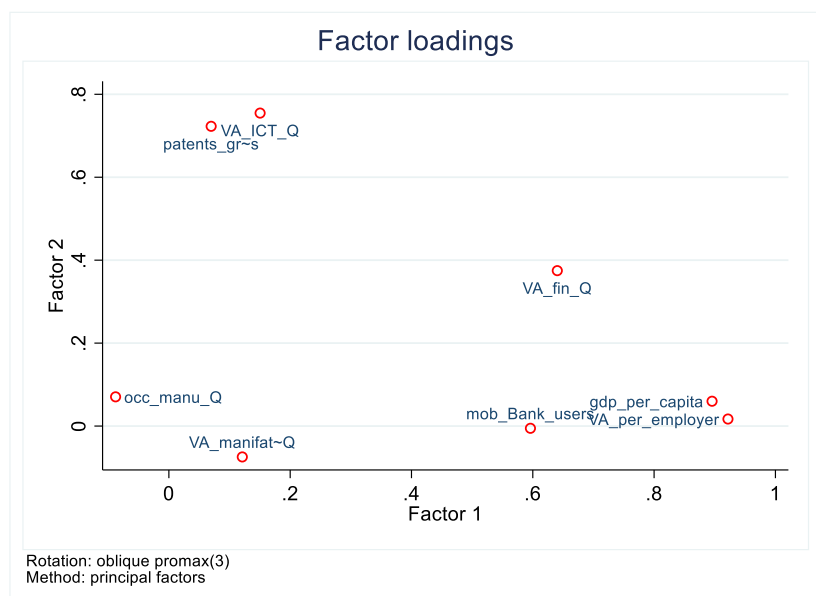
Source: author's elaboration. Notes: the table list and describe the variables utilized for the Factor Analysis.

Many are the motivation for the choice of these variables. The first reason is the meaningful economic sense of these indicators. Indeed, GDP per capita is a key variable for the local economies, linking income distribution with demographic performances. Productivity and sectoral value-added of ICT Services, Financial and Insurance Services and manufacturing industry depict structural features of the metropolitan economies, mirroring the main drivers of urban growth today. The share of manufacturing employment accounts for the labour market dynamics and is strictly linked with the historical development of these territories. A balanced territorial growth should be driven by an

increase in both occupation and productivity. In contrast, growth in productivity along with a decline in occupation suggest a concerning dynamic. The number of patent grants to population ratio mirrors the technological capabilities of the metropolitan territory, accounting for the innovation performances of these zones. The number of mobile banking service users is a further proxy of the digital development of these local economies.

The second motivation is econometric. Almost all these variables show moderate-high correlation, more than 0.3 and 0.5, as shown in table A.4, indicating a good sample for the factor analysis. Moreover, we obtain a significative result in the Kaiser-Meyer-Olkin test for the adequacy of the variables, as shown in table A.5. All the values, indeed, are greater than 0.5, the widespread benchmark in this test. Overall, the value of 0.75 indicates the appropriateness of the model to perform factor analysis. We then performed factor analysis using Kaiser Criterion to decide the number of factors selected. As evident in figure 5.B, just two eigenvalues overcome the value of 1, the target of the Kaiser Criterion. Moreover, there is a very considerable difference between the second and the third eigenvalue, meaning that the right choice is to select the first two factors that together explain 94% of the total variance. In figure 13, we plot the factor loadings of each variable.

Figure 13: Factor loading

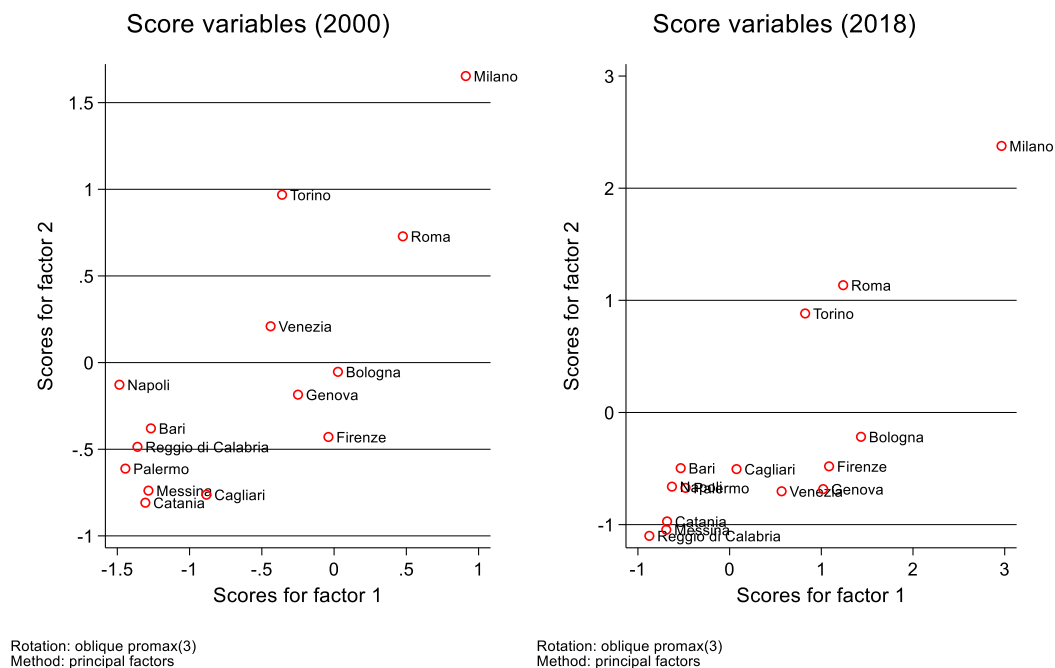


Source: author’s elaboration. Notes: the graph depicts the loads of the first two factors for each variable.

We applied the oblique promax rotation to a better economic interpretation of the factors. Factor 1 accounts more for GDP per capita, productivity, number of mobile banking service users, and for a considerable Financial and Insurance value-added share on the value-added. Thus, it seems to be related to the economic and financial features of the metropolitan economy. Factor 2 instead, loads more on structural variables like sectoral value-added of ICT services and patent grants to population ratio, reflecting technological matters of the territories.

Figure 14 shows the observation factor scores at the beginning and at the end of the sample period, suggesting some interesting considerations.

Figure 14: observation scores for selected years



Source: author's elaboration. Notes: the graph plot the factor scores of Italian metropolitan areas in 2000 and 2018.

Much of the observations shift between 2000-2018 is due to factor 2 intense modification that consistently enlarged the score range in 2018. In particular upper bound increased due to the jump of Milan, which peaks the highest value of more than 2 points. Southern and insular metropolitan zones instead have the lowest value in both the years, performing trivial advancements, except the tiny improvements of Cagliari and Bari. But, also the other centre-northern metropolitan areas performed weakly, increasing the polarisation scores across observations. Overall, these results suggest an increasing territorial divergence in the technological structure of the Italian metropolitan areas, feeding by the considerable advancements of Milan and the stagnant performances of almost all other metropolitan zones.

Increasing polarization evinces from the score changes between the two periods in Factor 1, mirroring disparities in economic and financial performances among metropolitan zones. Southern and insular metropolitan zones do not increase their score consistently, except for the jump of Cagliari above 0. Milan performed better than all the sample also in Factor 1, reaching the highest score of 3 points. Meanwhile, Rome, the second-highest score in 2000, is overcome by Bologna in 2018, witnessing the decline of this metropolitan city. Overall, in both periods, the graph evinces the territorial macro-areas imbalances of the country, where centre-northern metropolitan zones - starting from higher scores- performed better than southern ones but achieved slight advancements. The strong growth of Milan, in addition, feeds the concentration of economic and technological activities.

There are two interesting exceptions. First, Turin is in the middle of both the plots, with a high value of Factor 2 with respect to the other centre-northern metropolitan areas but performing a modest growth. Cagliari, instead, signed the highest score advancements across southern and insular zones in both factors scores, whereas it remains far from the top metropolitan areas.

7.2 Cluster Analysis

We then conducted two cluster analyses based on factors between 2000-2018 to shed light on the development of metropolitan areas across the period. Different results from the clustering algorithm may indicate changes in the structural characteristics of Italian metropolitan areas. Less heterogeneity among groups in 2018 may mirror a process of convergence across metropolitan territories. On the opposite, equal groups resulting from the clustering process between 2000 and 2018 may indicate not consistently modification in the growth trajectories of Italian metropolitan areas, reinforcing their structural differences in the last two decades.

Cluster analysis is a powerful tool for finding groups in data (Kaufman and Rousseeuw, 1990) and is widely used to group cities according to some socio-economic, demographic, and morphologic features (Akande et al., 2019, Ingrams et al., 2020, Piekut et al., 2012). Indeed, according to Everitt et al. (2011), the cities classification in clusters based on some specific features is one of the most prominent uses of this method. Whatever the procedure used, this analysis aims to group observations according to some characteristics minimising the within-group variance and generating clusters as different as possible between them.

To implement cluster analysis of Italian metropolitan areas, we adopted a K-means algorithm- an unsupervised learning procedure - very diffused among clustering partition methods. In the K-means procedure, the researcher specifies the number of clusters to be created before the analysis. An iterative process assigns each observation to the group with the closest mean. Then for each cluster generated, a new group mean is calculated. These steps continue until no observations change groups, and there is no possibility of associating an observation to a more similar group.

The decision of the first number of clusters can affect the result and the replicability of the analysis. It may produce different results for each selected starting point. We then employed a random starting seed as initial cluster averages to partially overcome this issue.

To decide the number of clusters, we plot in figure 6.B in the appendix the total within variance of each cluster solution as a function of the number of groups. Following the procedure suggested by Makles (2012, p.1), we: "search for a kink in the curve generated from the within sum of squares (WSS) for all cluster solutions". This procedure is commonly known as the "elbow method", and it is very diffused to select cluster numbers in an iterative process like K-mean. The solution required that the point with the strongest shift in the inclination, a bend, or a knee, can be considered as the one that minimises intra-cluster variation. In other words, it is the point where adding a new cluster do not increase the heterogeneity between the clusters. We then decided to select four groups for both the clustering process as suggested by figure 6.B in the appendix, which is the point with very low within sum of squared for both the periods. Four clusters are indeed the best solution for both years, ensuring comparable results.

No modification occurred in the cluster's members, suggesting barely advancements in the development path of these territories, as the list of the member of each cluster in table 5 shows. In both years, the first cluster, South and Islands, is formed by all the southern and insular metropolitan areas performing worst of the other groups. This result indicates a deep historical gap between the country's macro-regions, which is confirmed by analysing metropolitan territories. These metropolitan areas have the closest similarity in factor scores in both years, suggesting no radical change in their growth trajectories. The second cluster, Centre-North, holds many but not all centre-northern metropolitan areas of the country. They usually performed better than the first group in economic performances and in structural matters. Within this cluster, there are consistent differences in the growth rate of the metropolitan zones and in their local structure, even if they maintain their factor scores similarity between the two years. Cluster three, Milan, is formed by the only superstar city of the country, which overperforming in economic and structural and technological matters, following a different growth trajectory respect all other metropolitan areas. In addition, from the leading position in 2000, it realized the highest growth in both indicators, augmenting the gap with

the other metropolitan areas. The fourth cluster, Rome-Turin, holds two metropolitan zones in the middle position between Milan and the Centre-North cluster.

Table 5: The list of clusters in 2000 and 2018

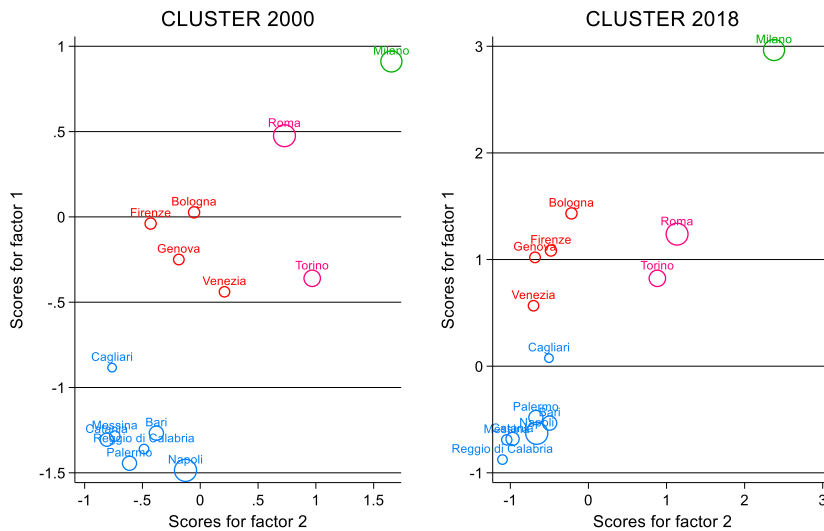
Metropolitan area	Cluster name (number)
Cagliari	South and Islands (1)
Bari	South and Islands (1)
Reggio di Calabria	South and Islands (1)
Messina	South and Islands (1)
Napoli	South and Islands (1)
Catania	South and Islands (1)
Palermo	South and Islands (1)
Genova	Centre-North (2)
Venezia	Centre-North (2)
Bologna	Centre-North (2)
Firenze	Centre-North (2)
Milano	Milan (3)
Roma	Rome-Turin(4)
Torino	Rome-Turin(4)

Source: author's elaboration. Notes: the table depicts the list of metropolitan areas according to the result of the K-mean algorithm for both years.

The cluster algorithm output is depicted in figure 15, revealing interesting issues about metropolitan areas developments. The South and Islands cluster, the pink bubble in the figure, is the same between 2000-2018, mirroring irrelevant changes in the structural and economic performances of these territories. In each year, they perform worse than other groups, suggesting tiny modifications in the development of the cluster members. This result confirmed the lower level of income, productivity and presence of technological industries of these territories compared to the others, along with a lower patenting activity propensity. Cluster 2, the red circles, is featured by a higher level of Factor 1 performances. This matter suggests a higher level of income, productivity and Financial and Insurance activities compared to the South-Islands cluster. However, the score in factor two is far from the leading two clusters, and there are barely any advancements between the two periods. The third cluster, the metropolitan area of Milan, the green bubble, generates its own cluster in both periods, confirming its different growth trajectory as the only leading zone in the country. It reaches the highest level in both years for both factor scores, and it is very far from the other metropolitan areas of the country. Moreover, it also realized a consistent increment of the factor scores, augmenting the gap with the other groups. The fourth cluster, Rome-Turin, is characterized by a high factor 2 score in both periods, second only to Milan and a factor 1 score close to the Centre-North group. This

result suggests a high-level income, in line with the Centre-North cluster, but a stronger share of ICT services, along with a greater propensity to innovate than the Centre-North group. However, the Rome-Turin cluster achieved very trivial advancements between the two periods, suggesting a weak development of these two metropolitan areas. Overall, this exercise testifies the absence of convergence among Italian metropolitan territories, in which polarization increases due to the strong growth of Milan and the modest growth of all others.

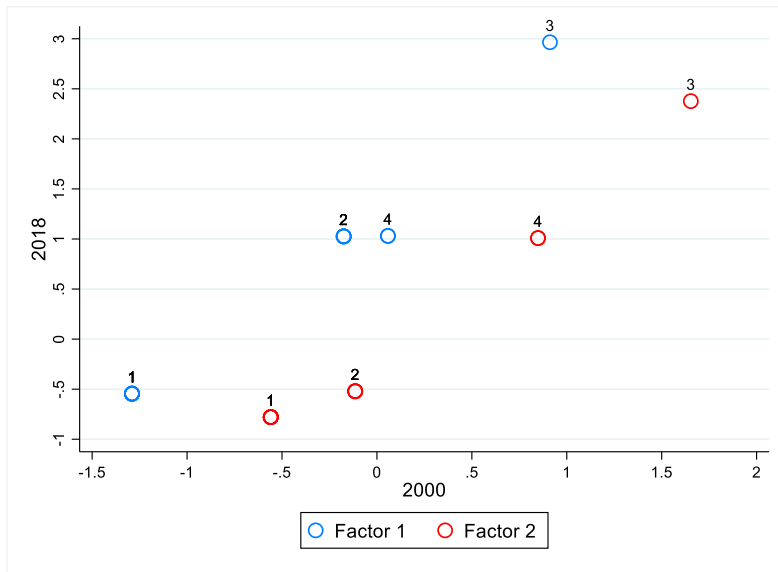
Figure 15: clusters according to factor scores



Source: author's elaboration. Notes: the graph plots the result of the clustering process using the K-mean algorithm in 2000 and 2018. Groups formed by K-mean algorithm are the same. The size of the bubble is weighted to the population average of the metropolitan areas over the sample period.

We plot in figure 16 the average score of each clustering solution for both factors in 2000 and 2018. Overall, the score variance among groups is greater in 2018 than in 2000, as summarized by table A.6 in the appendix, suggesting divergent growth trajectories across metropolitan territories. Polarization evinces by measuring the distance between clusters' factor scores in 2000, on the x-axis, and in 2018, along the y-axis. The gap across clusters is greater along the y-axis than the x-axis. These results are due to Milan's massive shift, which jumps in both factors and the immobilism of the others. Cluster one, the worst for both the indicators, expands its gap between 2000-2018 in factor 1 from all other groups. This development evinces the growing imbalances in income and financial services, especially for southern and insular metropolitan areas that developed very slowly. Cluster two and four that group centre-northern metropolitan territories achieves the same average score value for factor 1 in 2018, even starting with a slightly different position. However, both clusters hugely amplify their distance with Milan, which triplicates its score, reaching a difference of 1.96 points in 2018. These results mirror the growing polarization among the Italian metropolitan areas due to the growth of one global city in income and technological performances while the other metropolitan territories lagging behind.

Figure 16: average cluster scores

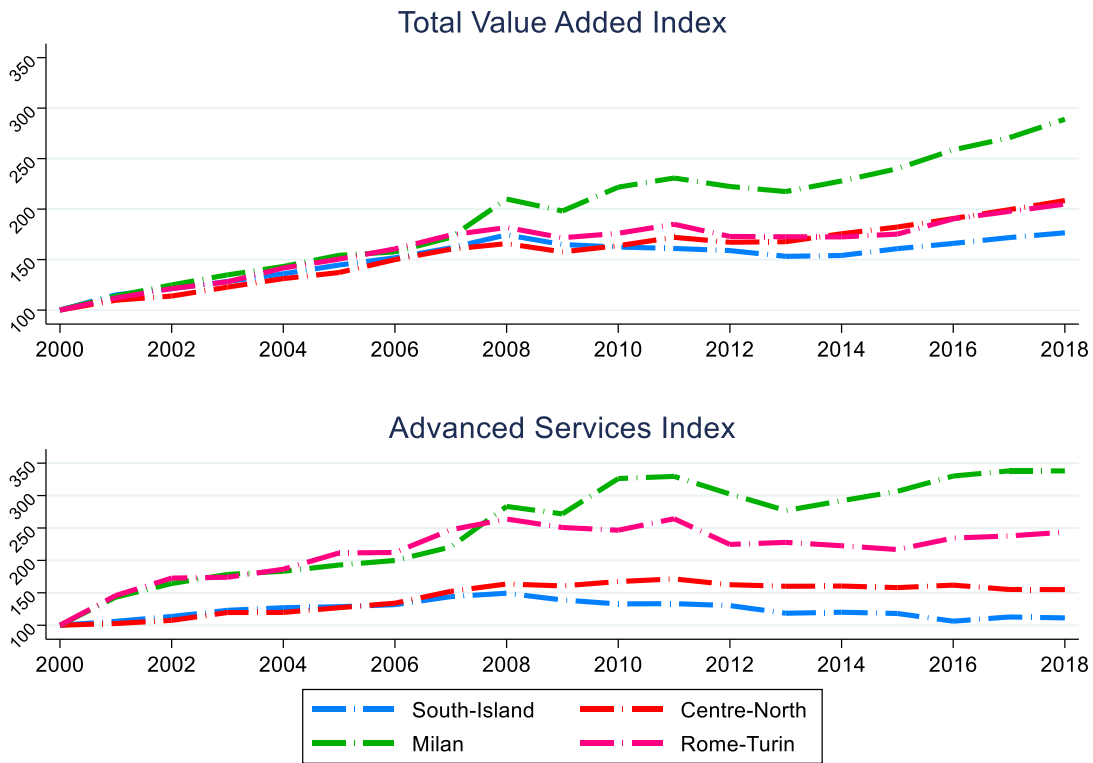


Source: author's elaboration. Notes: the graph depicts the cluster average of each group for both factors in 2000 and 2018. Distance between clusters increased in 2018, mirroring growing polarisation among metropolitan areas. The numbers indicate the clusters. Polarization evinces by measuring the distance between clusters' factor scores in 2000, on the x-axis, and in 2018, along the y-axis. The gap across clusters is greater along the y-axis than the x-axis.

Factor 2 shows very similar patterns, witnessing the polarization in technological activities and ICT services. The first two clusters deepen the gap with the third and fourth groups, reflecting the concentration of patenting activity and ICT services in just a few metropolitan territories. These results mirror the stagnation of many Italian metropolitan areas regarding innovation and ICT services. In addition, also between top performers, there is increasing heterogeneity. Cluster three, Milan, reaches the highest increases augmenting its distance from cluster fourth, which performed only very tiny improvements since 2000, affected by the immobilism of Turin and the decline of Rome. Cluster method allowed to summarize the developments of the last two decades of the Italian metropolitan areas, grouping them according to economic and structural features. Milan, cluster three, shows a positive development path regarding income, productivity, high-tech corporate services, and patent grants. Cluster fourth, formed by the metropolitan areas of Rome and Turin, performed modestly in economic indicators and stagnated in ICT and patenting activity, witnessing their scarce growth. Cluster two, containing the other centre-northern metropolitan areas, increased the score slightly in economic indicator but augmented the gap with the leading territories in factor 2. Finally, cluster 1, holding southern and insular metropolitan areas, have the worst performance in both years. It modestly increased in economic features and Financial and Insurance services, but less than all other groups, and worsened in factor 2. Figure 17 illustrates these trends by creating growth rate indexes for advanced business services and total value-added for each cluster.

During 2000-2018 imbalances increased among Italian metropolitan territories due to the divergent growth in technological productions and economic advancements. Polarization evinces in both the indexes, highlighting structural differences in technological services and total value-added growth. Milan grows more than other zones, while centre-northern metropolitan territories stagnate, or advance slowly, increasing their gap with the leading metropolitan areas. Southern and insular metropolitan zones leave behind, augmenting the distance with all other metropolitan areas in terms of total production and advanced business services. The result shows an increasing territorial inequality among Italian metropolitan areas in the last two decades, in economic performance as well as in innovation activity and advanced business service productions.

Figure 17: the polarization among clusters



Source: author's elaboration on ISTAT data. Note: the graph depicts the growth index of selected business advanced services- the sum of Finance and Insurance and ICT Services – and for the total value-added. We calculate the growth index dividing each year by its value in 2000, the base year, times 100 for each cluster.

8. Conclusion

Large cities are a core driver of technological innovation and economic growth. The process of structural change shaped by the third Industrial revolution- rooted in the spread of information technologies- boosted the weight of finance and corporate service in all production processes, redrawing the current economic geography. The dispersal of economic production, the massive rise of global financial transactions and the concentration of physical and social arrangements in a few metropolitan areas changed the territorial configuration of the world economy. As a result, uneven geographical development arises between “Superstars Cities” and “places that do not matter”. The firsts are hotspots of the economic production and trade, material infrastructures of the global economy, where wealth, capital, advanced technological sectors, and high-skilled workers gather. The seconds are territories affected by deindustrialization, low productivity, weak economic structure and negative demographic balance, facing declining trajectories. This has led many authors to speak about a “new urban crisis” in which few global cities gather economic and social prosperity, meanwhile peripheric metropolitan zones fall, increasing impoverishment and social discontent. As Glaeser contends: “cities should be judged on whatever they are turning poor children into rich adults, and many apparently are failing in this fundamental task” (Glaeser, 2020, p. 13).

This paper investigates the developments of Italian metropolitan areas between 2000-2018, building on insights from economic geography and innovation studies. We witness a concentration of wealth, economic production, technological industries, and innovation activities among Italian metropolitan territories that may worsen the country's territorial inequality. Divergences arise between one leading place, Milan, where income, population and technological productions concentrate, and lagging-behind metropolitan zones, mainly in South and Islands of the country, declining territories overlooked by the world economy. Moreover, centre-northern old manufacturing metropolitan areas are losing ground, signed by a stagnant development.

We evinced an increasing process of structural polarisation among Italian metropolitan economies concerning the growth rate of GDP per capita, total and sectoral value-added and innovation propensity. Centre-northern metropolitan cities, which started from a higher level of population, GDP per capita, productivity, patenting activity, increased their gap with the southern and insular metropolitan areas between 2000-2018. Furthermore, differences in knowledge-intensive services value-added - such as ICT and Financial and Insurance activities- among the two groups mirrors the lower presence of hi-tech sectors in southern and insular metropolitan zones. These results echo the historical territorial imbalances of the economic development of the country.

Moreover, polarization dynamics also arise among the centre-northern metropolitan areas due to the challenges posed by the new emerging global paradigm of the knowledge-economy. Milan is the only "Global City" in the country, while the other centre-northern zones lagging behind. At a more disaggregated level, some places are increasing the weight of ICT and Financial and Insurance services in their metropolitan economies, fostering a growth path based on advanced corporate services and technological manufacturing productions, like Bologna, undertaking a process of structural transformation driven by the local diffusion of market-oriented corporate services. Some metropolitan economies instead, like Genova and Venice, old core manufacturing areas, associate weak growth in service with a stagnant trend in innovation performances, resulting in a worsening development trajectory in light also of the consistent decrease of the residents. Turin performed a slow growth in the last two decades, enlarging the gap with Milan. We also provide evidence of a growing divide between Milan and Rome, which has losing ground in most fields, affected by industrial decline. This picture mirrors the heterogeneity in the development trajectories of these zones witnessing the far-reaching consequences of the process of technological change affecting Italian metropolitan economies.

Polarisation also evinces in terms of innovation activities. The study on the patent dynamics reveals an increasing concentration of the number of patents to population ratio among Italian metropolitan areas. Again, structural imbalances among macro-areas emerged, with centre-northern metropolitan areas performing better. But, overall, patenting activity, enormously concentrates in just three metropolitan territories with an increasing trend, mirroring the massive localization of innovative activities around a few hi-tech hotspots.

We performed factor analysis using many economic indicators- such as GDP per capita and productivity-, structural variables, like the sectoral value-added share of Financial and Insurance Services, ICT Services, and value-added and employment share of manufacturing industry to grasp the economic and structural development of Italian metropolitan areas. Moreover, we proxied digital performances with the number of patents and the number of mobile banking service users weighted by population. Factor analysis helped to reduce complex data in more suitable factors regarding structural, technological and economic features of these territories, witnessing an increasing gap between Milan and the other metropolitan zones. We then implemented a cluster analysis based on these factors. Two are the results of this exercise.

First, the equal clustering output between 2000 and 2018 suggests no consistent modifications in the development path of these territories. Clusters are formed for both the years by the same metropolitan areas, grouped according to average factor score similarity. No signs of convergence occurred across Italian metropolitan areas during the last two decades. In particular, southern and insular zones performed worse than others in both years. The centre-northern metropolitan zones achieved a slight

growth, but very far from the consistent jump of Milan, the other cluster. Overall, lagging-behind metropolitan areas grow less than the leading ones, increasing territorial polarization. In the case of factor 2, linked with the quote of ICT Service and patent granted weighted to population, all groups increased their score less than the cluster formed by Milan, expanding territorial divergence in technological endowments.

Second, in 2018, we witnessed more variance between group average factor scores, suggesting a growing polarization. The growth of the metropolitan area of Milan takes place alongside a substantial immobilism of the other Italian metropolitan areas, feeding the concentration of income and high-tech economic activities. The decline of Rome and Turin, alongside a modest growth of the other centre-northern metropolitan areas in factor 1 scores- related to GDP per capita, financial and insurance value-added, productivity- diminishes the distance between these two middle groups. But, both increased the gap with the leading and the latest group.

The results suggest the need for a new approach to urban planning inspired by placed-based policies to foster the growth of the lagging-behind territories. The growing mobility of capital, along with the rapid concentration of high-skilled workers in a few zones, massively foster inequality among territories. The concentration of technological and economic endowments in a few places augment the disparities in life opportunities and socio-economic performances. These patterns may exacerbate political division and social discontent. The work has some limitations. Due to the sample size, it has not been possible to apply more sophisticated econometric tools to better understand the development process. Moreover, a deep analysis of the technological class of patents is required to accurately assess the technological structure of territories. Finally, a broader analysis of sectoral dynamics is needed due to the strong specialization of many Italian metropolitan areas in specific economic activities - such as Tourism- that should be taken into account in future works.

References

- Accetturo, A Lamorgese, R., Mocetti, S., Pellegrino, D., Housing supply elasticity and growth: evidence from Italian cities, *Journal of Economic Geography*, 2020.
- Akande, A., Cabral, P., & Casteleyn, S. (2019). Assessing the gap between technology and the environmental sustainability of European cities. *Information systems frontiers*, 21(3), 581-604.
- Ascani, A., & Iammarino, S. (2018). Multinational enterprises, service outsourcing and regional structural change. *Cambridge Journal of Economics*, 42(6), 1585-1611.
- Beccatini, G. (2002). Industrial sectors and industrial districts: Tools for industrial analysis. *European planning studies*, 10(4), 483-493.
- Bloise, F., Chironi, D., & Pianta, M. (2020). Inequality and voting in Italy's regions. *Territory, Politics, Governance*, 1-26.
- Bogliacino, F., Lucchese, M. and Pianta, M. (2013). Job creation in business services: innovation, demand, and polarisation, *Structural Change and Economic Dynamics*, vol. 25, 95–109.
- Cantwell, J., & Iammarino, S. (2001). EU regions and multinational corporations: change, stability and strengthening of technological comparative advantages. *Industrial and Corporate Change*, 10(4), 1007-1037.
- Celi, G., Ginzburg, A., Guarascio, D., & Simonazzi, A. (2017). *Crisis in the European Monetary Union: A core-periphery perspective*. Routledge.
- Clark, J. Harrison, J. & Miguelez, E. (2018) Connecting cities, revitalizing regions: the centrality of cities to regional development, *Regional Studies*, 52:8, 1025-1028 .
- Crescenzi, R., Iammarino, C., Rodríguez-Pose, A., & Storper, M. (2020). *The geography of innovation and development: global spread and local hotspots*. LSE WP.
- Duménil, G., & Lévy, D. (2004). The real and financial components of profitability (United States, 1952–2000). *Review of Radical Political Economics*, 36(1), 82-110.
- Di Matteo, D., & Mariotti, I. (2021). Italian discontent and right-wing populism: determinants, geographies, patterns. *Regional Science Policy & Practice*, 13(2), 371-396.
- Dijkstra, L., Poelman, H., Veneri, P., 2019. *The EU-OECD Definition of a Functional Urban Area*. OECD Publishing, OECD Regional Development Working Papers, No. 2019/11, Paris.
- Duranton, G., & Puga, D. (2004). Micro-foundations of urban agglomeration economies. In J. V. Henderson & J. F. Thisse (Eds.), *Handbook of regional and urban economics* (1th ed., Vol. 4, pp. 2063–2117, Chapter 48). Elsevier.
- EC, (2012). *Cities in Europe. The new OECD-EC definition*, RF 01/2012, *Regional and urban policies*, European Commission.
http://ec.europa.eu/regional_policy/sources/docgener/focus/2012_01_city.pdf.
- EC, (2016). *The State of European Cities: Cities leading the way to a better future. Regional and urban policies*, European Commission.
https://ec.europa.eu/regional_policy/sources/policy/themes/cities-report/state_eu_cities2016_en.pdf.

- Ehrlich, M. V., & Overman, H. G. (2020). Place-based policies and spatial disparities across European cities. *Journal of economic perspectives*, 34(3), 128-49.
- Evangelista, R., Lucchese, M. and Meliciani, V. 2013. Business services, innovation and sectoral growth, *Structural Change and Economic Dynamics*, vol. 25, 119–32.
- Everitt, B. S., S. Landau, M. Leese, and D. Stahl. 2011. *Cluster Analysis*. 5th ed. Chichester, UK: Wiley.
- Florida, R. (2017), *The New Urban Crisis*, New York, NY: Basic Books.
- Forges Davanzati, G., Pacella, A., & Salento, A. (2019). Financialisation in context: the case of Italy. *Cambridge Journal of Economics*, 43(4), 917-936.
- Forman, C., & Goldfarb, A. (2020). *Concentration and Agglomeration of IT Innovation and Entrepreneurship: Evidence from Patenting* (No. w27338). National Bureau of Economic Research.
- FPA-Forum Pubblica Amministrazione (2018). *City Rate 2018 – La classifica delle città intelligenti italiane, settima edizione*” – Ottobre 2018.
- Freeman, C., Louçã, F. (2001). *As time goes by: from the industrial revolutions to the information revolution*. Oxford University Press.
- Gervais, A., Markusen, J. R., & Venables, A. J. (2021). *Urban specialization; from sectoral to functional* (No. w28352). National Bureau of Economic Research.
- Glaeser, E. L. (2020). Urbanization and its Discontents. *Eastern Economic Journal*, 1-28.
- Hsieh, C.-T., Moretti, E. (2015) *Why Do Cities Matter? Local Growth and Aggregate Growth*. Cambridge, MA: NBER, Working paper 21154.
- Iammarino, S., Rodríguez-Pose, A., & Storper, M. (2019). Regional inequality in Europe: evidence, theory and policy implications. *Journal of economic geography*, 19(2), 273-298.
- Ingrams, A., Manoharan, A., Schmidhuber, L., & Holzer, M. (2020). Stages and determinants of e-government development: a twelve-year longitudinal study of global cities. *International Public Management Journal*, 23(6), 731-769.
- Istat. (2014). *I sistemi locali del lavoro 2011*. Statistiche report. Roma. 17 Dicembre 2014
- Istat. (2015). *La nuova geografia dei sistemi locali*. Letture statistiche - Territorio. Roma E-book: [http:// www.istat.it/it/archivio/172444](http://www.istat.it/it/archivio/172444)..
- Istat, (2017). *Forme, Livelli e Dinamiche dell’Urbanizzazione in Italia* Letture statistiche - Territorio. Roma. E-book: <https://www.istat.it/it/files/2017/05/Urbanizzazione.pdf>
- Jacobs, J. (1961), *The death and life of great American cities*, New York, NY: Random House
- Jacobs, J. (1970). *The economy of cities*. New York, NY: Vintage.
- Kaufman, L., and P. J. Rousseeuw. 1990. *Finding Groups in Data: An Introduction to Cluster Analysis*. New York: Wiley.

Kemeny, T., and Storper, M. (2020), '*Superstar cities and left-behind places: disruptive innovation, labor demand, and interregional inequality*', LSE Working Paper No. 41, International Inequalities Institute, LSE.

Lapavitsas, C. (2013). *Profiting without producing: how finance exploits us all*. Verso Books.

Lazonick, W. and O'Sullivan, M.,(2000). Maximizing Shareholder Value. A New Ideology for Corporate Governance. *Economy and society*, 29(1), pp. 13-35.

Louçã, F. (2019). *As Time Went By-Long Waves in the Light of Evolving Evolutionary Economics*. SPRU-Science Policy Research Unit, University of Sussex Business School.

Lundvall, B. Å. (Ed.). (2010). *National systems of innovation: Toward a theory of innovation and interactive learning* (Vol. 2). Anthem Press.

Makles, A. (2012). Stata tip 110: How to get the optimal k-means cluster solution. *The Stata Journal*, 12(2), 347-351.

Malerba, F., & Orsenigo, L. (1995). Schumpeterian patterns of innovation. *Cambridge journal of Economics*, 19(1), 47-65.

Marshall, A. (1920). *Principles of Economics*. London: McMillan.

Moretti, E. (2012), *The new geography of jobs*, Boston, MA: Houghton Mifflin Harcourt.

Nelson, R.R. and Winter, S.G. (1982), *An evolutionary theory of economic change*. Cambridge, MA: Belknap Press/Harvard University Press.

OECD, (2012) *Redefining "urban": A new way to measure metropolitan areas*, OECD Publishing, Paris

OECD (2018), *OECD Regions and Cities at a Glance 2018*, OECD Publishing, Paris https://doi.org/10.1787/reg_cit_glance-2018-en

OECD (2020), *OECD Regions and Cities at a Glance 2020*, OECD Publishing, Paris. <https://doi.org/10.1787/959d5ba0-en>.

OECD/European Commission (2020), *Cities in the World: A New Perspective on Urbanisation*, OECD Urban Studies, OECD Publishing, Paris, <https://doi.org/10.1787/d0efcbda-en>.

Pasinetti L (1981) *Structural change and economic growth*. Cambridge University Press. Cambridge.

Perez, C. (2002). *Technological revolutions and financial capital*. Edward Elgar Publishing.

Piekut, A., Rees, P., Valentine, G., & Kupiszewski, M. (2012). Multidimensional diversity in two European cities: thinking beyond ethnicity. *Environment and Planning A*, 44(12), 2988-3009.

Reati, A. (2014). Economic policy for structural change. *Review of Political Economy*, 26(1), 1-22.

Rosés, J. R., & Wolf, N. (Eds.). (2018). *The economic development of Europe's regions: A quantitative history since 1900*. Routledge.

Pianta, M. (2020). Technology and Work: Key Stylized Facts for the Digital Age. *Handbook of Labor, Human Resources and Population Economics*, 1-17.

- Río-Casasola, D. (2021). Centre–Periphery in the EU-20: a classification based on factor analysis and cluster analysis. *Cambridge Journal of Economics*.
- Rodríguez-Pose, A. (2018). The revenge of the places that don't matter (and what to do about it). *Cambridge journal of regions, economy and society*, 11(1), 189-209.
- Sassen, S. (1991). *The global city*. Princeton University Press.
- Sassen, S. (2018). *Cities in a world economy*. Sage Publications.
- Squicciarini, M., H. Dernis and C. Criscuolo (2013), "Measuring Patent Quality: Indicators of Technological and Economic Value", *OECD Science, Technology and Industry Working Papers*, No. 2013/03, OECD Publishing, Paris, <https://doi.org/10.1787/5k4522wkw1r8-en>.
- Viesti, G. (2021). *Centri e periferie: Europa, Italia, Mezzogiorno dal XX al XXI secolo*. Laterza & Figli Spa.
- Vinci, I. (2019). Governing the metropolitan dimension: A critical perspective on institutional reshaping and planning innovation in Italy. *European Journal of Spatial Development*, 70, 1-21.

APPENDIX A: Tables

Table A.1: The list of Italian metropolitan areas

Metropolitan Area	Population	Macro area
Roma	3998064	North and Center
Milano	3109687	North and Center
Napoli	3070139	South and Islands
Torino	2237526	North and Center
Bari	1259716	South and Islands
Palermo	1244234	South and Islands
Catania	1078977	South and Islands
Firenze	975448	North and Center
Bologna	968138	North and Center
Genova	863834	North and Center
Venezia	838317	North and Center
Messina	648753	South and Islands
Reggio Calabria	553748	South and Islands
Cagliari	447340	South and Islands

Source: author's elaboration. Notes: The table lists the Italian metropolitan areas according to their macro-area and average population over the sample period. The population refers to the resident number at the end of each year.

Table A.2: the functional approach to the definition of urban zones

Statistical Units	Local Labour System (LLS), ISTAT (2015, 2017):	Functional Urban Areas (FUA). OECD-Eurostat (Dijkstra et al., 2019, EC, OECD, 2012)
Definition.	<p>Local Labour systems are territorial units whose boundaries are defined using the flows of daily home/work travel according to specific criteria of the demand and supply of work, regardless of the administrative articulation of the territory (Istat, 2015).</p>	<p>Functional Urban Areas are people-based clusters of urban zones based on population density grid and commuting flow towards the urban centre. This approach tries to connect the morphology of the urban territory (population density), the governance (local unit, municipalities, or statistical unit), and the socio-economic features of the zones (commuting flows), starting from the distribution of population density.</p>
Method:	<p>Local Labor Systems ground on contiguous municipalities delimited throughout the entire country. They are formed by analysing the grid of commuting flows between municipalities so that, the resident population works and exercises most of their social and economic relations within the local system. The local Labour System must follow some principles (Istat 2014, p. 21):</p> <ol style="list-style-type: none"> 1. Self-containment of commuting flows. The share of movements outside the border must be limited; the most of daily flows must occur within the local labour system. 2. Integrated flows of commuters between the municipalities. The number of reciprocal commuting flows in the local system must be elevated, satisfying a pre-selected target parameter. 3. Continuity in the time of the flows. 	<p>Functional Urban Areas are integrated urban zones formed by a city and their commuting zones. Metropolitan regions are NUTS level 3 approximations of functional urban areas with at least 250 000 inhabitants.</p> <p>Functional Urban Areas are composed by:</p> <p>The city. A space covered by high population density with a minimum size of population. The definition of cities accounts only for the agglomeration of people in space using a consistent threshold of density and total population</p> <p>Commuting zones. A lower density area surrounding the city but closely linked to the latter from an economic and functional point of view. It is combined by multiple local units integrated with the city's labour market.</p>
Identification process	<p>ISTAT (2014) uses an algorithm of regionalisation to cluster municipalities according to parameters and trade-off rules about the size, the self-containment and the integration of LLS. The algorithm is based on several components.</p> <ol style="list-style-type: none"> 1) the grid of the municipalities and the commuting matrix 2) A self-containment function based on the reciprocal commuting inflows and outflows between municipalities 3) a set of parameters that identify pre-established thresholds relating to the size and the self-containment measure to define an LLS (Istat, 2014, p. 29). 4) a validity condition that establishes the criteria that must be satisfied to have a potential LLS. 5) a standardised cohesion measure that allows clustering each municipality into the most integrated LLS on the base of the reciprocal flows. 6) iterative procedure assigns each location to a cluster, through the measure of cohesion (%), until all clusters satisfy the condition of validity (4) 	<p>The individuation of the Functional Urban Areas requires the following elements (Dijkstra et al., 2019):</p> <ol style="list-style-type: none"> 1) identification of the urban centre: a set of contiguous, high density (1,500 residents per square kilometre) grid cells with a population of at least 50,000 in the adjacent cells. 2) City identification: one or more local units with at least 50% of their residents inside an urban centre. 3) Delimitate commuting zone: a set of contiguous local units that have at least 15% of their employed residents in the urban centre 4) A functional urban area is the combination of the city with its commuting zone. 5) Metropolitan regions are FUA of at least 250 000 inhabitants.

differences

Functional Urban Areas definition takes into account the functional, administrative and morphological components of the urban territories starting from the population density. It includes only the most developed urban areas and considers exclusively the commuting inflows towards the major urban centre. The count of urban core begins with a population grid and clusters cells according to a target of density.

Local Labour System instead, starting from the commuting matrix, denote the overall geographical extension of the country, analysing the integration among territories throughout the reciprocal commuting inflows and outflows of each municipality, without reference to population density.

Local Labour System boundaries fit well to grasp local labour market dynamics, the territorial network of production and industrial structure, mirroring the overall socio-economic features of these zones. However, the Local Labour System does not account for local political-administrative governance, resulting in less suitable to operative policy implementation.

The new harmonised definition of Functional Urban Area, try to connect socio-economic features to political-administrative entities. So that, it will become a key tool to territorial planning, local-based policy and their measurement.

Source: author's elaboration. Notes: the table review the definition and the principal differences among the Functional Urban Areas, a statistical unit elaborated by OECD-EC (2012, Dijkstra et al., 2019) and the Local Labour System, developed by Istat (2011,2014, 2017).

Table A.3: The structural features of Italian metropolitan areas

Metropolitan City	Average share of Financial and Insurance value-added	Average share of ICT services value-added	Average share Manufacturing value-added mean
Roma	6.41	9.81	5.48
Milano	8.89	9.29	14.22
Napoli	3.30	5.10	9.46
Torino	5.16	8.15	19.94
Bari	4.17	3.39	11.85
Palermo	2.93	4.40	4.33
Catania	3.51	2.93	8.59
Firenze	4.95	3.42	21.33
Bologna	4.79	4.70	21.95
Genova	4.72	3.20	10.45
Venezia	5.24	3.46	14.18
Messina	3.58	1.86	7.03
Reggio di Calabria	3.01	1.60	3.17
Cagliari	3.48	4.04	7.97

Source: author's elaboration. Notes: the table depicts sectoral features of the Italian metropolitan areas. We calculated the average value-added share over the sample for three economic sectors: ICT, Financial and Insurance Services, and the manufacturing industry.

Table A.4: Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) GDP per capita	1.000							
(2) VA Productivity	0.945	1.000						
(3) Manufacturing employment share	0.392	0.286	1.000					
(4) Manufacturing Value-added share	0.484	0.367	0.970	1.000				
(5) Financial and Insurance Value-Added share	0.859	0.826	0.277	0.328	1.000			
(6) ICT Value-Added	0.637	0.612	0.208	0.204	0.682	1.000		
(7) Patent grants	0.657	0.616	0.368	0.366	0.701	0.719	1.000	
(8) Mobile banking Service Users	0.726	0.764	0.227	0.280	0.570	0.380	0.552	1.000

Source: author's elaboration. Notes: the table depicts the correlation among the variables utilized for the Factor Analysis.

Table A.5: Adequacy test for the sample

Variables	Kaiser-Meyer-Olkin measure of sampling adequacy
GDP per capita	0.748
Productivity	0.827
Manufacturing employment share	0.546
Manufacturing Value-added share	0.551
Financial and Insurance Value-Added share	0.877
ICT Value-Added	0.789
Patents grants	0.833
Banking Service Users	0.806
Overall	0.751

Source: author's elaboration. Notes: the table depicts the measure of adequacy of the sample according to the Kaiser-Meyer-Olkin test.

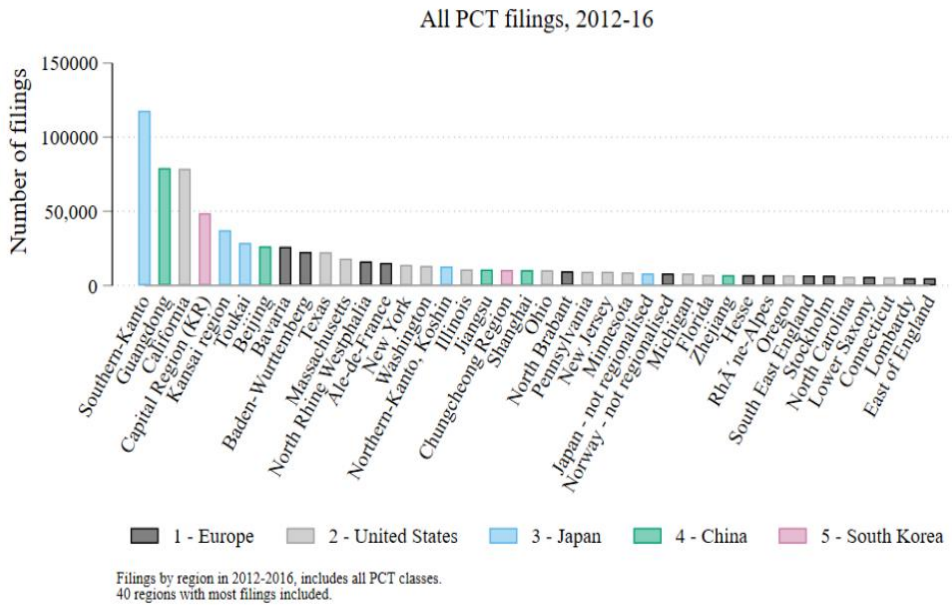
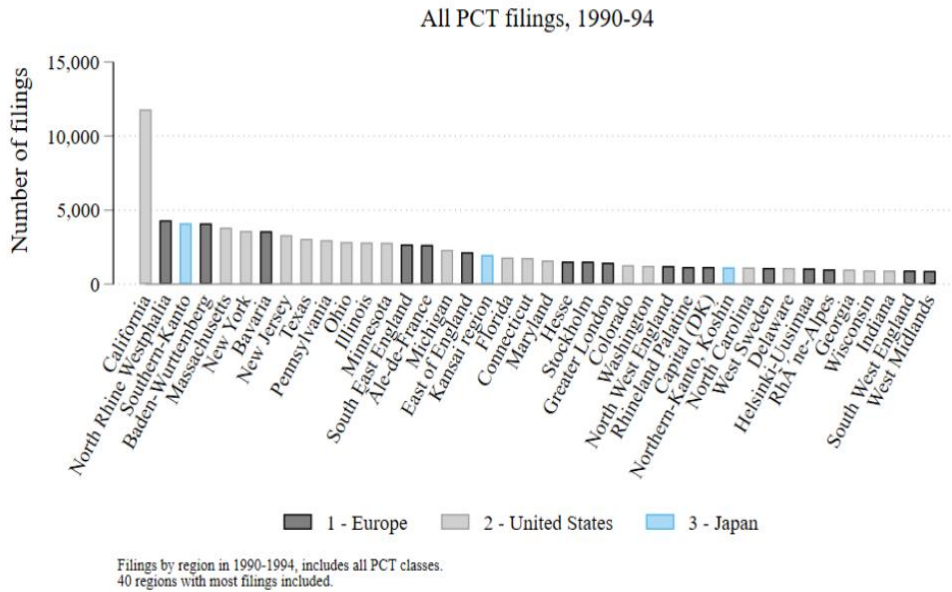
Table A.6: Factor average scores by clusters

Clusters	Factor 1 (2018)	Factor 1 (2000)	Factor 2 (2018)	Factor 2 (2000)
1	-.54	-1.29	-0.77	-.55
2	1.02	-.17	-0.52	-.11
3	2.96	.91	2.37	1.65
4	1.03	.05	1.01	.84

Source: author's elaboration. Notes: the table depicts the average score of each cluster in 2000 and 2018.

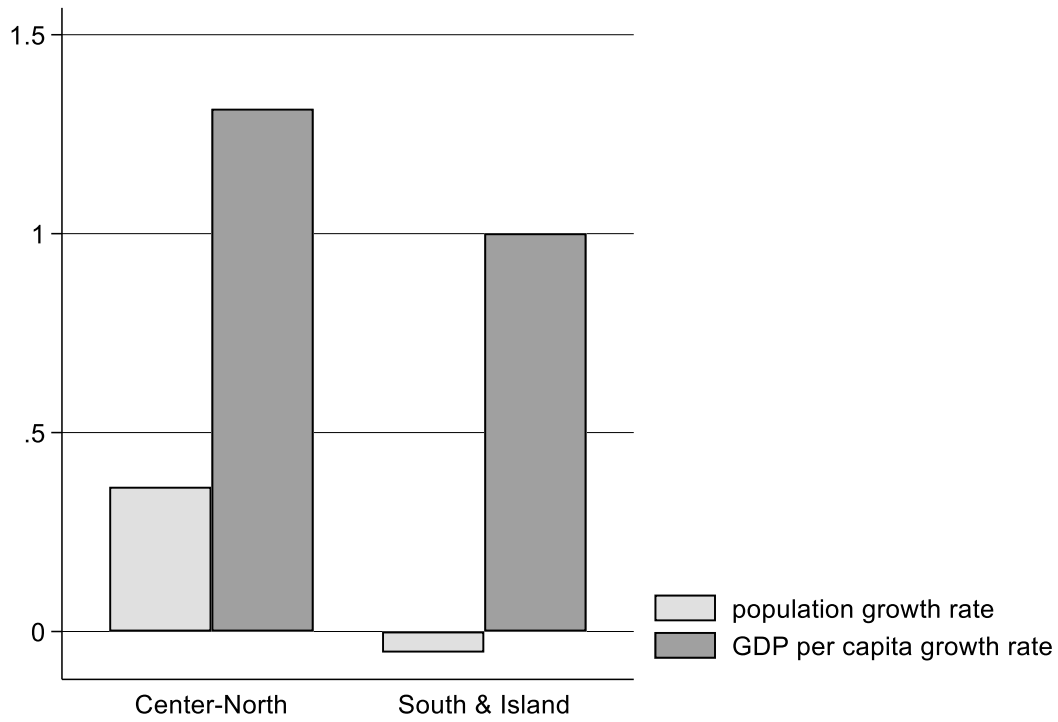
APPENDIX B: Figures

Figure 1.B: Global Innovative Hotspots



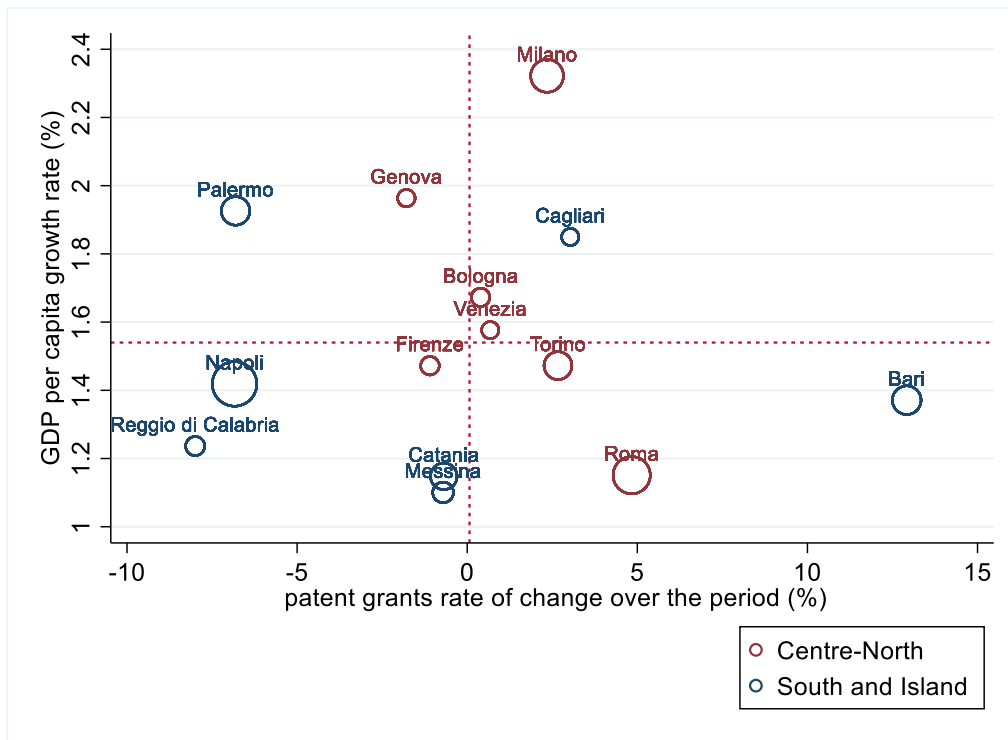
Source: Crescenzi et al, 2020, p. 25. Note: The first graph shows the number of filings by regions between 1990-1994 for all PCT classes, the forty regions with the most patents are included. The second shows the number of filings by regions between 2012-2016 for all PCT classes, the forty regions with the most patents are included.

Figure 2.B: Growth rate of GDP per capita and population of Italian metropolitan areas grouped in macro-regions



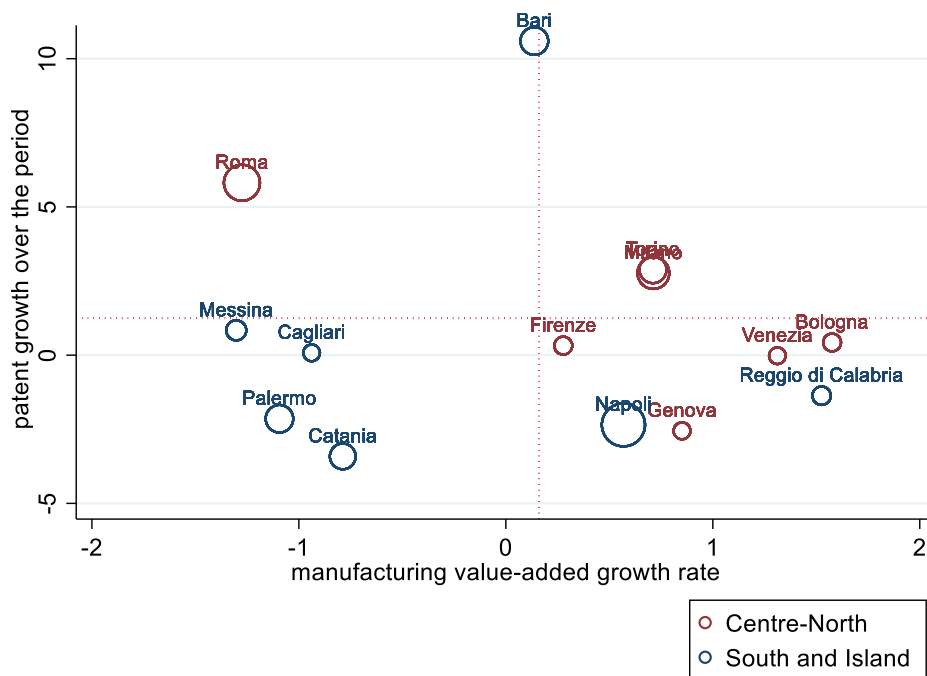
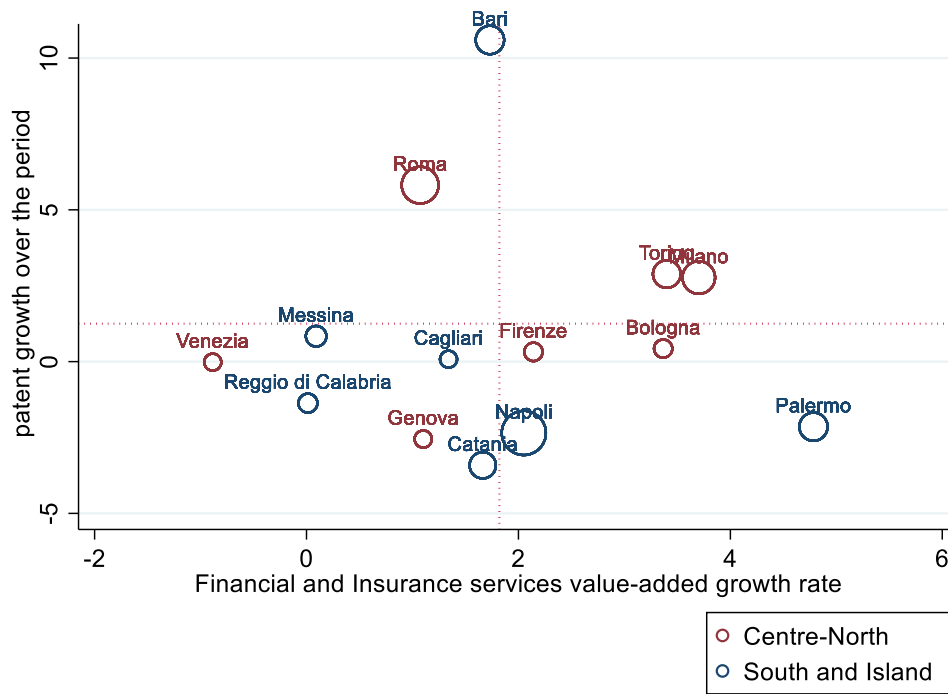
Source: Source: author's elaboration on ISTAT data. I Conti Regionali Territoriali database. Note: the graph depicts the compound annual growth rate in percentage points for the Italian metropolitan areas grouped in macro-regions. The growth rate is the average value among the growth rate of each metropolitan area for 2002-2018.

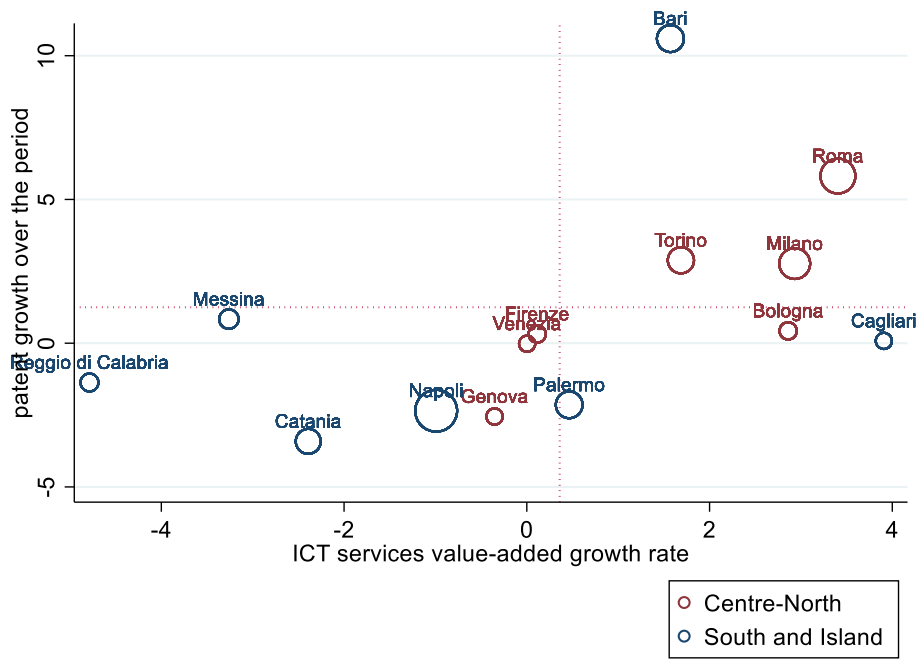
Figure 3.B: Income and innovation activity



Source: Source: author’s elaboration on ISTAT data. I Conti Regionali Territoriali database and UIMB-Ufficio Italiano Marchi e Brevetti data. Notes: the graph depicts the compound annual growth rate of GDP per capita and patent grants between 2000 and 2018. The size of the bubble is weighted to the population average of the metropolitan areas over the sample period.

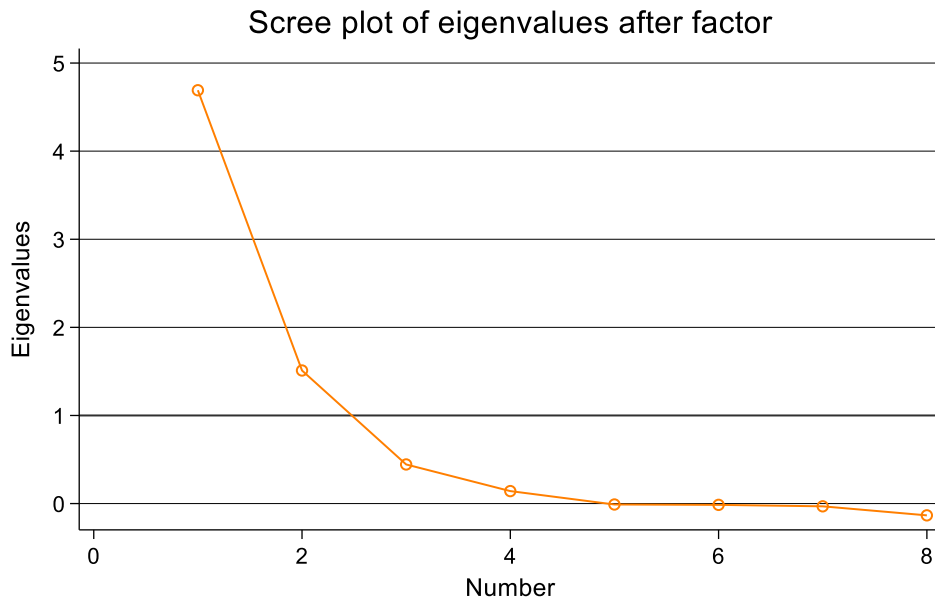
Figure 4.B: the structural dynamics





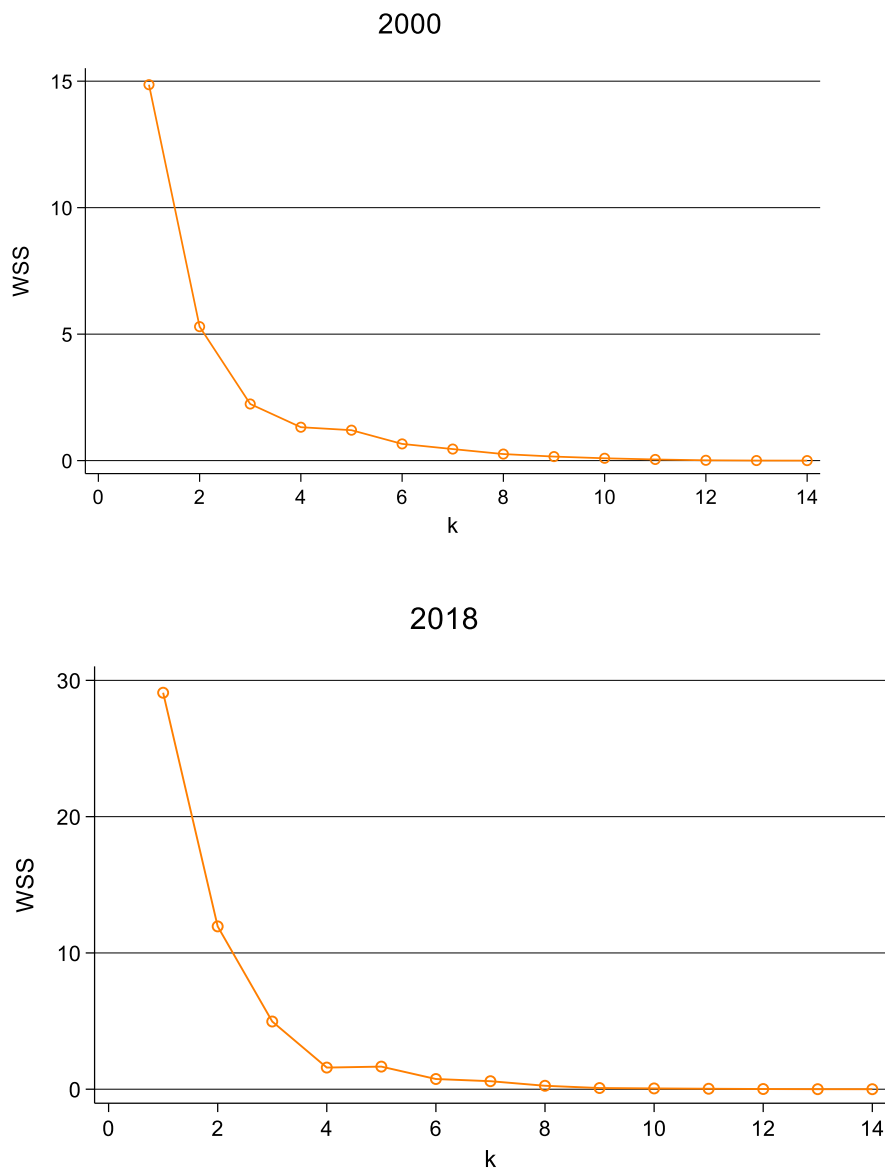
Source: Source: author's elaboration on ISTAT data, I Conti Regionali Territoriali database and UIMB-Ufficio Italiano Marchi e Brevetti data. Notes: the graph depicts the compound annual growth rate of patent grants and the average share of value-added for three economic sectors: ICT services, Financial and Insurance Services and Manufacturing Industry between 2000 and 2018. The size of the bubble is weighted to the population average of the metropolitan areas over the sample period.

Figure 5.B: Scree plot of eigenvalues



Source: author's elaboration. Notes: the graph depicts the Kaiser method to select the number of factors. It plots the value of eigenvalues according to the number of factors.

Figure 6.B: the “ Elbow method” to select the number of clusters



Source: author’s elaboration. Notes: the graphs plot the total within variance of each cluster solution as a function of the number of groups. This is a widespread procedure to select the number of clusters.