The Propensity for Patenting in the Italian Regions

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The Propensity for Patenting in the Italian Regions

It grew on average by 5.26% between 2004 and 2019

In this article I analyzed the propensity for patenting in Italian regions through the use of ISTAT-BES data. The static analysis shows the presence of a significant gap between the northern regions and the southern regions in the period between 2004 and 2019. The econometric analysis applied with panel models highlights the relationships that the propensity to patent has with respect to the determinants of innovation systems at regional level. The results are critically discussed with economic policy recommendations.

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1) Introduction

The landscape of innovation in Italy presents a mosaic of regional disparities, intricacies, and unique industrial dynamics that shape the propensity for patenting across its diverse territories. This article embarks on an analytical journey to unravel the factors influencing patenting behaviors in Italian regions, delving into the variegated fabric of Italy's innovation ecosystem. Recognizing Italy as a nation renowned for its rich history of creativity and technological advancement, from the Renaissance inventors to modern-day industrial designers, this study aims to shed light on the contemporary challenges and opportunities within its regional innovation systems. Our exploration is motivated by the hypothesis that regional characteristics, such as the presence of industrial clusters, the level of R&D investments, the quality of academic institutions, and the availability of supportive policies and infrastructure, significantly impact the propensity to patent. Furthermore, this article seeks to understand how these factors interplay with the broader national and European intellectual property frameworks, influencing regional innovation outcomes. By employing a mixed-methods approach, combining quantitative analysis of patent data from the European Patent Office (EPO) with qualitative insights from interviews with regional stakeholders, this study aims to provide a comprehensive picture of the patenting landscape in Italy. This dual approach allows us to not only map the distribution of patenting activity but also to unearth the underlying motivations, barriers, and strategies that define the innovation trajectories of Italian regions. This investigation is situated within the broader discourse on regional innovation systems (RIS) and the role of intellectual property rights (IPR) in driving economic growth and competitiveness in the knowledge economy. Through this lens, we aim to contribute to the ongoing dialogue on how regions within a country as historically and culturally rich as Italy navigate the complexities of innovation, competitiveness, and economic development in the 21st century. Our findings seek to inform policymakers, business leaders, and academic scholars about the nuances of fostering innovation across different regional contexts. By

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identifying the levers and impediments to patenting in Italian regions, this article aspires to offer insights that could guide the formulation of more nuanced, effective policies and strategies for enhancing Italy's innovation capacity and regional competitiveness on the global stage.

The article continues as follows: the second section contains an analysis of the literature, the third section presents an analysis of the data relating to the propensity to patent in the Italian regions, the fourth section presents the econometric analysis, the fifth section presents the political implications connected to the propensity to patent, the sixth section presents the conclusions.

2) Literature Review

The relationship between intellectual property (IP), innovation, and economic development is both complex and multifaceted, involving a wide array of perspectives from various academic disciplines, industries, and geographical contexts. The selected references provide a comprehensive overview of this discourse, highlighting the nuanced ways in which IP rights can act as both enablers and barriers to innovation, depending on the specific economic, institutional, and technological environments in which they are embedded.

Ahn, Hall, and Lee (2014) offer a foundational perspective on how intellectual property rights can foster economic growth by incentivizing the creation and protection of innovations. This is particularly relevant in developing economies, where the establishment of strong IP frameworks is often seen as a crucial step towards attracting foreign investment, enhancing technology transfer, and encouraging domestic innovation. The work by Alence (2004) underscores the importance of effective governance and robust political institutions in creating an environment conducive to innovation and development. This suggests that the impact of IP rights on innovation is deeply intertwined with the broader political and institutional landscape, and that policies aimed at strengthening IP protection must be accompanied by efforts to improve governance and institutional quality. Amara, Landry, and Traore (2008) highlight the unique challenges and strategies associated with managing IP in the services sector, which is characterized by its intangible nature and the rapid pace of innovation. This underscores the need for flexible and adaptive IP management practices that can accommodate the specific characteristics of knowledge-intensive business services. Comparative The doctoral thesis by Amdaoud (2018) provides a case study of Algeria, offering insights into how innovation capabilities can drive economic development in specific national contexts. This and other comparative analyses (e.g., Andersson & Lööf, 2012) emphasize the importance of context-specific factors in shaping the relationship between IP, innovation, and economic growth. Anton and Yao (2008), along with Antonelli (2007), delve into the strategic aspects of IP, discussing how firms navigate the complex landscape of IP rights to negotiate and secure protection for their innovations. This highlights the strategic dimension of IP management, where firms must balance the benefits of protection with the costs and risks associated with IP rights. The research by Arora, Ceccagnoli, and Cohen (2008) provides empirical evidence on the 'patent premium'—the idea that patents can significantly enhance the returns on R&D investments for firms. This contributes to a broader understanding of the economic incentives underlying the patent system and its role in promoting investment in innovation. The selected references collectively cover a wide range of perspectives on the role of IP in innovation and economic development. From the specific impacts of patents on firm-level innovation strategies (e.g., Balsmeier & Czarnitzki, 2014) to the broader implications of IP rights for national and regional economic growth (e.g., Baldwin & Hanel, 2003), the discourse reflects the complexity and diversity of the innovation ecosystem.

These articles collectively explore the complex interplay between intellectual property (IP) rights, innovation strategies, technology transfer, and their implications on employment, industry dynamics, and economic development. Let's delve into the discussions each article brings to the table:

Pajak (2016) questions whether innovative firms prioritize secrecy over formal IP protection methods, like patents, to safeguard their competitive edge. Using the CIS 4 Survey, Pajak (2016) examines the nuances of IP protection strategies among European firms, suggesting that while patents are critical for legal protection and commercialization, the strategic use of "big secrets" or trade secrets complements these formal methods, especially in industries where the speed of innovation outpaces patent application processes. The analysis implies a nuanced approach to IP, where firms balance between disclosure through patents and maintaining competitiveness through secrecy. Pianta (2005) addresses the critical concern of how innovation impacts employment within industries. Contrary to the common fear that technological advancement may lead to job losses, Pianta suggests that innovation can be a significant driver of employment growth, provided that policies and economic conditions support the creation of new sectors and the expansion of existing ones. This work underscores the importance of innovation policy not just for economic growth but also for job creation and transformation. Reddy and Zhao (1990) focusing on the complexities of international technology transfer, the authors examines the mechanisms, benefits, and challenges of transferring technology from developed to developing countries. The authors highlight the role of governmental and organizational structures in facilitating or hindering technology transfer, suggesting that effective transfer strategies can lead to significant improvements in local industries and economies but require careful management of IP rights and local innovation capabilities. Reitzig (2004) delves into the strategic aspects of managing intellectual property within firms, emphasizing that the value of IP management extends beyond mere legal protection. Strategic IP management involves making informed decisions about patenting, licensing, and litigating, in ways that align with the firm's broader business strategies and competitive positioning. This perspective suggests that IP is not just a legal asset but a strategic tool for innovation and market competition. Sampath (2007) examining the Indian pharmaceutical industry post-2005, discusses the impact of product patent protection on access to medicines and the strategic responses of emerging firms. The article explores how changes in IP laws have influenced both multinational and domestic firms, with a focus on how emerging firms adapt to stricter IP regimes through innovation and strategic alliances. This case study highlights the dual challenge of fostering innovation while ensuring access to affordable medicines in developing countries. Song et al. (2014) investigates the relationship between technological regimes and the performance of technology development projects. The authors argue that the nature of the technological regime—whether it is more incremental or radical—significantly affects project performance. Their findings suggest that firms must tailor their management practices and innovation strategies to the specific characteristics of the technological regime they operate in to enhance project success. Sweet and Maggio (2015) addressing the broader debate on IP rights and innovation, analyze whether stronger IP protections stimulate or hinder innovation. By examining data across countries, they argue that stronger IP rights can indeed increase innovation by providing inventors with the necessary incentives and protections to invest in research and development. However, they also caution that the relationship is not linear and depends on the country's level of development and the specific industry context.

Fink and Maskus (2005) lay a foundational premise that understanding IP rights is crucial for fostering economic development, especially in emerging economies. They argue that while strong IP rights can incentivize innovation, there is a delicate balance to be struck to ensure that such protections do not stifle the very innovation they seek to promote. This introduces a recurring theme

across the literature: the need for IP systems that are not only robust but also flexible enough to adapt to varying economic, technological, and social landscapes. Granstrand (1999) offers a visionary perspective on the evolution towards an economy where knowledge assets predominate, dubbed "intellectual capitalism." This concept underscores the transition from traditional, tangible assets as the primary sources of value to intangible assets, particularly IP. However, this transition raises critical questions about access to knowledge, the distribution of innovation benefits, and the role of SMEs in an increasingly knowledge-centric economy. Guellec and De La Potterie (2007) provide a focused analysis of the European patent system, advocating for IP policies that enhance innovation and competition. This regional perspective is crucial, given the European Union's unique economic and legal frameworks. However, it also invites broader reflection on how different jurisdictions address the common challenge of designing IP systems that are both protective of inventors and conducive to widespread technological and economic advancement. The works of Hall and colleagues (2001, 2013, 2014) bring empirical rigor to the discussion, with studies on the semiconductor industry and UK firms revealing a nuanced picture of how patents are valued and utilized in practice. These insights challenge the monolithic view of patents as universally beneficial, highlighting the diversity of corporate strategies towards IP and the varying significance of patents across sectors and stages of innovation. Hanel (2008), Harabi (1995), and Hikkerova, Kammoun, and Lantz (2014) delve into the appropriability of technical innovations, emphasizing the strategic use of IP rights to secure competitive advantages. These analyses reveal the dynamic nature of IP management, where firms must navigate the complex interplay between protecting their innovations and engaging in collaborative ecosystems that may require openness and knowledge sharing. Hu (2010), Isham et al. (2005), and Kaplinsky (2011), expand the discourse to global and sector-specific contexts, from China's patenting surge to the impact of natural resource exports on economic growth. These contributions underscore the global diversity in IP challenges and strategies, pointing to the need for IP policies that are sensitive to the specific needs and circumstances of different regions and industries.

3) Rankings of Italian Regions and Macroregions in the Sense of Propensity for Patenting

The landscape of innovation across Italy's regions showcases a vivid tapestry of diversity in the inclination towards patenting, revealing a narrative deeply interwoven with each region's economic, educational, and infrastructural fabric. At the heart of this discourse is the observation of geographical variability, which not only highlights the inherent disparities in innovation capabilities but also underscores the multifaceted nature of regional development. In the forefront of innovation stand regions like Emilia-Romagna, Lombardy, and Veneto. Emilia-Romagna, in particular, emerges as the epitome of patenting propensity, a testament to its vibrant and diversified economy. The region's success is likely underpinned by a robust research and development (R&D) sector, thriving industrial clusters, and a culture that nurtures innovation. Following closely are Lombardy and Veneto, each with their unique economic landscapes but similarly characterized by active engagement in R&D activities. This trio exemplifies how a strong and diverse regional economy, coupled with significant investments in R&D, can create an environment conducive to innovation. Nestled in the middle tier of innovation are regions like Trentino-Alto Adige, Friuli-Venezia Giulia, and Piedmont. These areas display commendable levels of patenting activity, albeit not matching the heights reached by the top performers. This indicates a solid, though not exceptional, foundation in economic and research capabilities. Tuscany and Marche find themselves in this middle range as well, suggesting a balance between innovation inputs and outputs but hinting at potential areas for enhancement to propel them closer to the top tier. At the other end of the spectrum, we encounter regions such as Basilicata,

Sardinia, and Calabria. Positioned at the lower echelons of innovation propensity, these regions reflect the challenges faced by areas with economies less oriented towards R&D. The reasons behind their positioning could be multifaceted, including but not limited to, the size of the economy, the availability of R&D funding, and the presence (or absence) of universities and research institutes. This scenario underscores the critical role that economic focus, resource allocation, and educational infrastructure play in shaping a region's innovation landscape. The geographical variability in patenting propensity across Italy serves as a mirror, reflecting the broader dynamics of regional innovation systems. It brings to the fore the importance of targeted policies and strategies that consider the unique characteristics and needs of each region. By understanding and addressing the specific barriers to innovation in less innovative regions, while further strengthening the assets of more innovative ones, Italy can aspire to elevate its overall innovation capacity, ensuring a more balanced and inclusive growth across its territories. It's crucial to ponder on the pathways that might bridge the innovation divide, fostering an ecosystem where all regions can thrive. Whether through enhanced R&D funding, bolstering educational institutions, or cultivating industry-academia collaborations, the goal remains clear: to harness the full potential of Italy's regional diversity in the quest for innovation and economic prosperity (Figure 1).

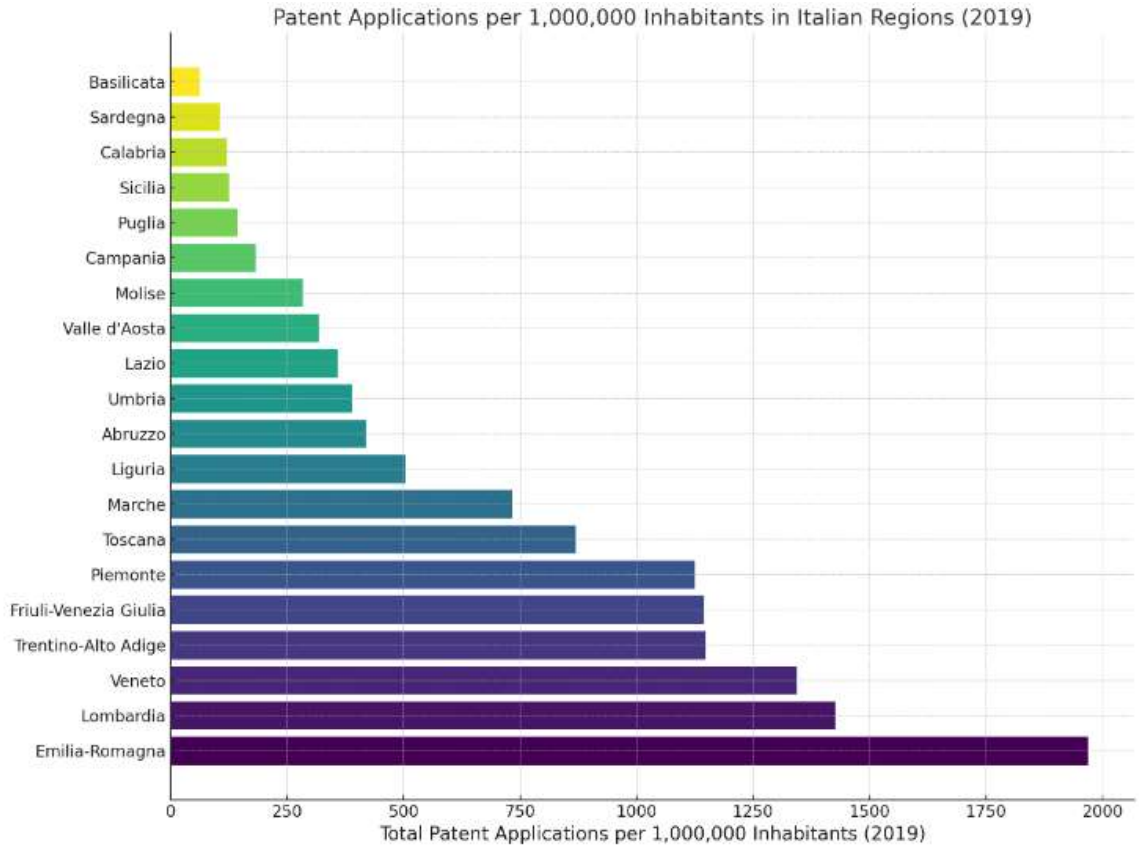

Figure 1. Total Applications per 1.000.000 inhabitants (2019)

The analysis of italian innovation landscape from 2004 to 2019 unveils a dynamic and evolving narrative, marked by shifts in the propensity to patent across its diverse regions. This narrative is not just about numbers; it's a story of ambition, policy, and the changing tides of economic focus, painting a picture of Italy's quest for innovation and technological development. In the northern heartlands, Trentino-Alto Adige emerged as the protagonist of this period, boasting an astounding increase of over 135% in its patenting activities. This remarkable surge hints at a region reborn in the flames of

innovation, possibly driven by a deliberate shift towards fostering research and development (R&D) or perhaps the introduction of policies designed to encourage creative endeavors. The story here is one of transformation, of a region looking towards the future with a clear intent to lead in technological advancements. Moving to the southern narrative, Molise and Calabria present a tale of burgeoning potential, with significant percentage increases in patent activities from modest beginnings. These regions, initially marked by low patenting bases in 2004, have since embarked on paths of noticeable growth. This ascent could signify the early stages of an innovation awakening, perhaps spurred by newfound investments in R&D or a slowly strengthening infrastructure for support. However, not all narratives are of growth and prosperity. Piedmont and Valle d'Aosta recount a more somber story, witnessing declines in both the volume and rate of patenting activities. This downturn raises probing questions about the shifting economic landscapes or challenges in sustaining an environment conducive to high levels of patent activity. It's a reflection on the complexities and hurdles that regions can face in the race towards innovation. Amid these varied tales, Emilia-Romagna stands out, consolidating its reputation as a bastion of innovation. With increases in both the absolute numbers and percentages of patents filed, the region reinforces its pivotal role in Italy's technological landscape. Contrastingly, Lombardy, despite an overall growth in patent filings, experienced a slight percentage dip, offering a nuanced view of its innovation journey—still forward-moving but with challenges to address. Friuli-Venezia Giulia and Veneto offer side narratives of steady, if unspectacular, growth. Their stories are marked by consistency rather than dramatic shifts, illustrating a journey of persistent effort towards maintaining a positive trajectory in innovation. However, the broader canvas reveals a concerning trend of declines across many Italian regions, suggesting a multitude of underlying factors at play. These could range from shifts in economic policies, a re-evaluation of innovation priorities, or a natural settling after periods of intense patenting activities. This collective downturn underscores the intricate balance between fostering innovation and the realities of economic and policy landscapes. The fluctuations in Italy's propensity to patent from 2004 to 2019 are more than statistical data; they are indicators of regional aspirations, economic strategies, and the vibrancy of the innovation ecosystem. These changes carry profound implications for regional competitiveness, R&D employment, and economic well-being, emphasizing the critical role of innovation in shaping the future of regions and, by extension, the nation itself. As Italy navigates these evolving dynamics, the story of its innovation journey continues to unfold, shaped by the ambitions, policies, and challenges of its diverse regions (Figure 2).

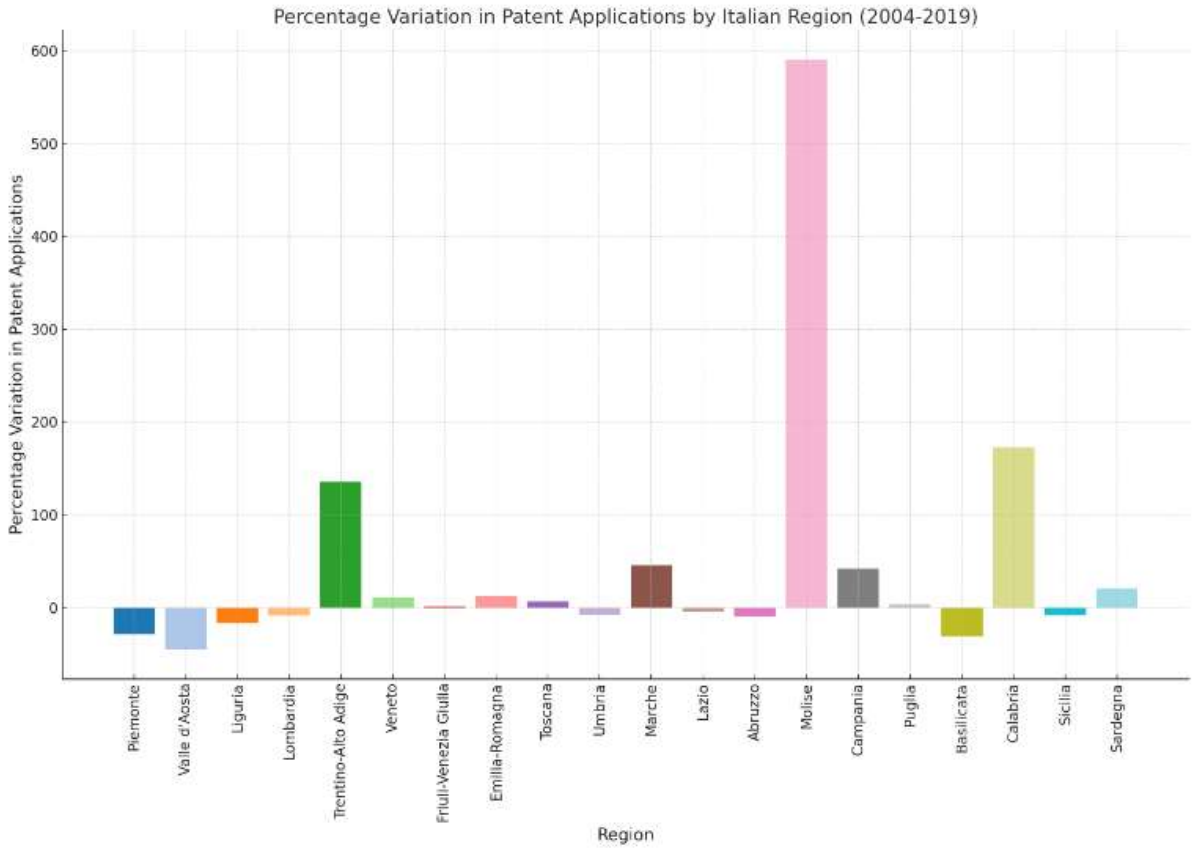

Figure 2. Percentage variations of Patent Application by italian regions.

The evolving landscape of patenting across Italy's macro-regions provides a fascinating glimpse into the dynamics of innovation, economic development, and the effectiveness of policy interventions. Each region's story unfolds within the broader narrative of Italy's pursuit of technological advancement and economic competitiveness, highlighting varied strategies and outcomes. The North-Eastern macro-region's robust increase in patenting activity signals a thriving economic environment underpinned by high levels of research and development (R&D) and a strong support system for innovation. This trend suggests that the region may have successfully capitalized on innovation-friendly policies, possibly including tax incentives, grants, or support for startups and SMEs. Additionally, the presence of specialized industrial clusters, particularly in high-tech sectors, could have played a pivotal role in fostering an ecosystem conducive to innovation. This phenomenon underscores the importance of targeted industrial policies and the potential impact of sector-specific support in driving patenting activity and, by extension, technological progress. Conversely, the Northwest's significant decline in patenting, both in absolute and percentage terms, may reflect profound structural changes within its regional economy. This downturn could be attributed to the restructuring of traditional industries, signalling a shift away from sectors that historically propelled the region's economy but may now be in decline. Additionally, this trend could indicate a decreased emphasis on innovation and R&D, possibly due to shifting economic priorities or challenges in adapting to the new technological paradigm. This situation highlights the critical need for regions to continuously adapt their economic structures and innovation strategies to remain competitive in an ever-evolving global marketplace. The observed increases in patenting activity in Southern and Central Italy are particularly noteworthy, suggesting a positive shift towards more innovative

activities. In the South, significant enhancements could stem from a variety of policy interventions, including state incentives aimed at fostering innovation, investments in higher education and research, and support for burgeoning entrepreneurial activity. These trends may reflect a concerted effort to overcome historical economic disparities and promote balanced regional development through innovation. The positive trajectory in these regions exemplifies the potential impact of targeted policy measures and investments in creating an enabling environment for innovation and economic growth. The strong percentage growth in patenting activity on the islands points to an improving position within Italy's innovation landscape. Although starting from a relatively low base, this trend suggests concerted efforts to promote innovation, potentially through specific policy measures aimed at overcoming geographical and economic challenges unique to island regions. This development emphasizes the importance of tailored approaches to innovation policy that consider the unique characteristics and needs of each region.

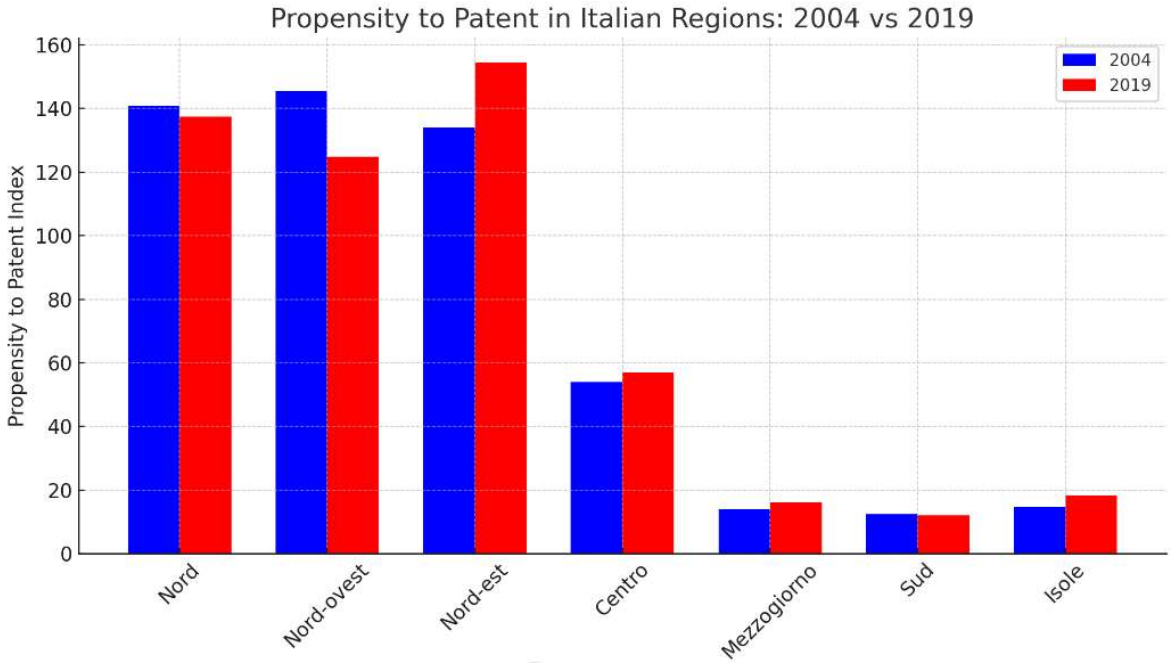

Figure 3. Propensity for patenting among italian macro-regions.

The propensity to patent across regions is intrinsically linked to investments in R&D, reflecting a broader correlation between financial commitment to research and innovation outcomes. Public policies, including innovation subsidies, the development of research infrastructure, and fostering university-industry collaborations, play a crucial role in shaping these dynamics. Moreover, regional specialization in high-tech sectors can significantly influence patenting activity, highlighting the importance of aligning regional economic strategies with global technological trends. External factors, such as economic crises, regulatory changes, or market shocks, also impact patenting trends, underscoring the complex interplay between regional innovation systems and broader economic and policy contexts.

3.1 The Territorial Inequality in Terms of Propensity to Patenting

The data on patenting propensity across Italy's macro-regions in 2019 reveal a significant disparity between the North, Central Italy, and South, highlighted by the differences in patenting indices:

- North: 137.4;
- Central Italy: 56.9;
- South: 12.

This gap not only represents a numerical difference but also underscores a profound disparity in innovation dynamics and economic development among Italian regions. Northern Italy, with an index of 137.4, stands out as a dominant hub of innovation and patenting activity. This can be attributed to several factors, including a highly advanced industrial and technological fabric, a high concentration of high-tech companies, and solid investment in research and development (R&D). The northern regions also benefit from close collaboration between universities, research centers, and the industrial sector, facilitating technology transfer and innovation. Central Italy, with an index of 56.9, occupies an intermediate stance, reflecting a more heterogeneous reality. Although home to some centers of research excellence and innovative enterprises, the Center exhibits a less pronounced propensity for patenting compared to the North. This might result from various factors, such as a lower density of technology companies or a different sectoral composition that doesn't necessarily translate into a high volume of patents. Southern Italy, with an index of just 12, highlights the most significant challenges in terms of innovation and patenting. This scenario can be attributed to multiple obstacles, including limitations in access to research funding, a lower presence of high-tech firms, and an economic fabric struggling to integrate into global innovation circuits. Difficulties in technology transfer and a traditionally lesser emphasis on R&D further contribute to this situation. The disparity in patenting propensity between the North, Center, and South emphasizes the need for targeted policies to promote regional balance in technological development and innovation. Strategies encouraging investment in R&D, support for innovative startups, and strengthening synergies between academic research and the industrial sector could be crucial for reducing these disparities. At the same time, it's essential to consider the specificities of each macro-region, designing interventions that reflect their unique economic and cultural identities, to stimulate inclusive and widespread innovation across the entire national territory.

4) The Econometric Model for the Estimation of Propensity to Patenting

Below we present a model for estimating the propensity to patent in Italian regions. The data is analyzed with the following models: Panel Data with Fixed Effects, Panel Data with Random Effects. Specifically, we estimated the following equation:

$$\boldsymbol{PTP_{it} = \alpha + \beta_1 (RI)_{it} + \beta_2 (IPS)_{it} + \beta_3 (CCE)_{it} + \beta_4 (MIG)_{it} + \beta_5 (RIU)_{it} + \beta_6 (MEOSF)_{it}}$$

List of Variables			
	Variable	**Acronym**	**Label**
y	Propensity towards patenting	PTP	A98
x	Research intensity	RI	A97
	Innovation of the production system	IPS	A99
	Cultural and creative employment	CCE	A101
	Mobility of Italian graduates (25-39 years)	MIG	A102
	Regular internet users	RIU	A103
	Municipalities with entirely online services for families	MEOSF	A105

With i=20 and t=2004-2022.

There is a positive relationship between the PTP value and the following variables:

- RI: The positive relationship between PTP and RI in a business or economic context refers to the phenomenon whereby an increase in research and development (R&D) efforts and investments tends to correspond to an increase in the number of patents generated. Companies that invest significantly in R&D are often looking for technological or process innovations that can be protected through patents. Investment in R&D is a prerequisite for generating new technical knowledge that can lead to patentable inventions. Patents are a form of intellectual property that gives the inventor the exclusive right to exploit an invention for a limited period. Obtaining patents is therefore a crucial means for companies to protect and capitalize on investments in innovation. The more innovative a company is (often measured by the intensity of its R&D activity), the greater its propensity to patent to safeguard its inventions. Patents can also serve as a strong signal to the market and investors regarding a company's technological value and competitive potential. Companies with a high number of patents can be perceived as more innovative and technologically advanced, attract investment and establish barriers to entry for competitors. There is a positive feedback effect: obtaining patents can generate revenue through licensing or can secure exclusive markets, making additional resources available for R&D. This, in turn, can lead to more innovation and more patents. The strength of the relationship between patenting propensity and research intensity can vary significantly across different industries. High-tech industries such as pharmaceuticals, biotech, and information technology tend to show a much stronger correlation than less R&D-intensive industries. However, it must also be considered that not all patents are the same in terms of commercial value or innovation and in this case R&D intensity does not always translate into high-quality patents. Additionally in some cases, companies may choose to protect their innovations through trade secrets or other forms of intellectual property protection. Overall, the positive relationship between propensity to patent and research intensity highlights the importance of investments in R&D for the generation of innovations protected by patents, essential for the competitive success and long-term growth of companies.
- MEOSFF: The relationship between PTP and MEOSFF represents an interesting intersection of technological innovation and public service, which may not be immediately apparent but is revealed when considering how digital innovation impacts society and the economy at large. Municipalities that offer family services entirely online demonstrate a high degree of digitalisation and innovation in the public sector. This digital transformation can reflect or stimulate a broader environment conducive to innovation in several ways. The presence of fully digitalized services implies a solid technological infrastructure. This technologically advanced environment can facilitate the development and adoption of new technologies, including the creation of patentable inventions. The digitalisation of public services can be indicative of a broader local culture that values and promotes innovation. This culture can encourage companies and individuals to invest in R&D, leading to an increase in the propensity to patent. Online services improve efficiency and accessibility, saving time and resources for both users and service providers. This can free up resources that can be reinvested in innovative activities, including research and development of new patentable technologies. Municipalities implementing online services could collaborate more closely with the private sector, including startups and technology companies, to develop and implement these solutions. These partnerships can accelerate technology transfer and commercialization of inventions, thus increasing the propensity for patenting. Areas with a strong commitment to digitalisation and innovative public services can attract businesses and

talent, including those oriented towards research and innovation. This can create a virtuous cycle that further stimulates innovation and patenting.

There is a negative relationship between the PTP value and the following variables:

- IPS: A negative relationship between PTP and IPS may seem counterintuitive, given that a higher number of patents is often assumed to reflect a high level of innovation. However, there are specific contexts and dynamics in which an increase in patenting does not necessarily translate into a real advancement of innovation in the production system. The propensity to patent might be high in contexts where incremental innovation prevails, i.e. minor improvements or adaptations of existing products or processes that are relatively easy to patent. In contrast, radical or revolutionary innovation, which could have a more significant impact on the production system, may not be immediately patentable or may take longer to be legally recognized and protected. The propensity to patent can create barriers to entry for new entrants, thus limiting competition. In some industries, this can lead to stagnation of innovation because dominant companies may not have sufficient incentives to radically innovate, instead focusing efforts on maintaining the status quo. A large concentration of patents in the hands of a few can hinder the overall innovation of the production system. This is because access to patented technologies becomes more expensive and complicated for startups and SMEs, which are often significant sources of disruptive innovation. The quantity of patents does not necessarily reflect the quality or impact of the innovation. A high propensity to patent could result in many low-value patents, which do not contribute significantly to technological advancement or the efficiency of the production system. In some innovation ecosystems, open knowledge sharing (e.g. open source software, shared research between universities and industry) can accelerate innovation more effectively than rigorous protection through patents. In these contexts, an excessive propensity for patenting could actually slow down innovation. There can be a misalignment between what is patentable and what actually drives innovation in the production system. Some of the most important innovations might be production methodologies, business models or forms of organization that are not easily patentable. A negative relationship between propensity to patent and innovation in the production system suggests that, in certain contexts, an excessive emphasis on patenting can actually hinder substantial innovation and economic dynamism. This requires a careful balance in intellectual property policy, incentives for innovation that go beyond simple patenting, and support for a broad range of innovation pathways.
- CCE: The negative relationship between PTP and CCE can be interpreted in various ways, considering the different contexts and mechanisms that influence both innovation and the cultural and creative sectors. The propensity for patenting is often linked to highly technologically intensive sectors where innovations are clearly definable and quantifiable, such as in pharmaceuticals or electronics. In contrast, in cultural and creative sectors (such as art, fashion, design, music), innovation can be more subjective and based on creative expressions that are not always effectively protected by patents. In the cultural and creative sector, other intellectual property protection mechanisms, such as copyright, are often more relevant than patents. This can lead to a lower propensity to patent while still promoting innovation and creativity. Cultural and creative sectors tend to value collaboration, networks and the open flow of ideas, while patent-prone sectors may be more competitive and focused on tightly protecting innovations to maintain a competitive advantage. Cultural and creative products often follow rapidly changing trends and tastes, making patenting, which is a long and expensive process, less attractive. In contrast, in technology sectors, a patent can protect

an invention that has a longer life cycle. Investments in R&D (research and development) in sectors with a high propensity for patenting may be incentivized by government policies, while cultural and creative sectors may depend more on public funding, patronage or self-generated revenue, thus influencing the ability and propensity to patent. Cultural and creative employment may be more oriented towards generating social, cultural and educational value, rather than pure market value. This orientation can reduce the incentive to patent, which is often seen as a means to maximize financial returns. The negative relationship between patenting propensity and cultural and creative employment reflects fundamental differences in innovation mechanisms, intellectual property protection strategies, business models and socioeconomic objectives of these sectors.

- MIG: the negative relationship between PTP and MIG can be explored from various aspects, considering how these two factors interact within the economic and social fabric. In contexts with a high propensity for patenting, companies and institutions may seek to limit the mobility of skilled workers (including graduates) to protect trade secrets and technical knowledge. This may reduce the incentive or ability for graduates to move. regions with strong patenting policies and incentives could be effective in attracting talent and innovation, but could also create a less dynamic environment in terms of worker mobility, as individuals may perceive fewer career or personal development opportunities outside that context specific. A strong propensity towards patenting can favor a closed innovation model, where knowledge is protected and shared less freely. This can limit learning and growth opportunities for graduates, who may seek more open and dynamic environments. Restricting graduate mobility can reduce the exchange of ideas and diversity in institutions and companies, potentially curbing innovation and creativity. The relationship between these two phenomena can vary significantly depending on the specific context, such as the industrial sector, government policies, labor market conditions, and corporate culture.
- RIU: the negative relationship between PTP and RIU suggests that, as the percentage of regular internet users in a given population or context increases, the propensity to patent ideas, inventions or processes tends to decrease, and vice versa. Regular internet users have access to a wide range of information and knowledge, which can reduce the need for patenting, as ideas may turn out to be already explored or less original than previously thought. Furthermore, exposure to such a variety of information could lead to greater collaboration and sharing of ideas rather than their protection through patents. The prevalence of the internet has also promoted cultures of open source and sharing, where the emphasis is on the free distribution and sharing of software, ideas and knowledge, rather than on their protection through intellectual property rights. This may lead to a lower propensity to patent, as the prevailing culture encourages open sharing rather than exclusive protection. The digital environment evolves at a very fast pace, sometimes making the patenting process too slow to be effective. When a product or technology may become obsolete in a short time, patent protection may not be considered useful or economically advantageous. Patenting can be an expensive and complex process, requiring significant time and resources. For regular internet users, who may have access to more agile and less burdensome ways of protecting or sharing their creations, patenting may not be the preferred option. For startups and businesses operating in high-tech sectors, a lower propensity to patent could have mixed implications. On the one hand, it could foster a more open and collaborative environment, accelerating innovation. On the other hand, it could limit the ability of companies to protect their innovations and gain a competitive advantage.

5) Policy Implications

Analyzing the political implications linked to the development of patent propensity in Italian regions requires an understanding of the intricate balance between territorial, economic, and political dynamics that influence innovation and its protection through patents. This propensity is multifaceted, encompassing technological innovation, investments in research and development (R&D), supportive policies for innovation from both local and national institutions, and collaborations between universities, research centers, and industries.

Policies promoting innovation and patenting can significantly differ across Italian regions, reflecting the varying priorities and economic strategies. Wealthier regions might have more resources to invest in R&D and support patent applications, leading to a geographical innovation divide. This disparity calls for nuanced political strategies that ensure balanced national growth, promoting R&D investment across all regions, including those less economically developed. Regions with a higher propensity for patenting often experience more dynamic economic growth due to the direct correlation between innovation, competitiveness, and economic development. This situation posits a political challenge to create equitable economic opportunities across regions, necessitating policies that foster innovation ecosystems everywhere, from north to south. A skilled workforce is crucial for innovation and patenting activities. Regional disparities in education and professional training can impact the local population's ability to contribute to and benefit from innovation. Politically, this underscores the importance of investing in education and training programs tailored to the needs of each region's industries and innovation sectors. The propensity to patent is also influenced by the ability of businesses, especially SMEs, to collaborate with research institutions. Political efforts to encourage such collaborations through funding, tax incentives, and networking opportunities can stimulate innovation across diverse regions, reducing the innovation gap between them. Effective protection of IP rights is foundational for encouraging patent applications. Politically, this involves not only the enforcement of existing laws but also the potential introduction of new legislation to keep pace with technological advancements, ensuring that inventors feel secure in their investments into R&D. On a broader scale, a region's propensity to patent influences its competitiveness on the international stage. Politically, this necessitates strategies that not only support domestic innovation but also promote Italian innovations abroad, positioning Italy as a leader in certain technological sectors. Increasingly, political implications of patent propensity intersect with sustainability and social equity goals. Policies encouraging patents in green technologies, for instance, can drive sustainable innovation, aligning economic growth with environmental objectives. Similarly, considering social challenges in patent policies can ensure that innovation contributes to broader societal benefits. The development of patent propensity in Italian regions is deeply intertwined with a range of political, economic, and social considerations. Addressing these implications requires a holistic approach that combines supportive policies for innovation, education, IP protection, and international competitiveness with a commitment to sustainability and social equity. Through such comprehensive strategies, Italy can harness the full potential of its diverse regions, promoting balanced and inclusive economic growth driven by innovation.

6) Conclusions

The propensity to patent has grown in Italian regions between 2004 and 2019. Policies to increase the propensity to patent can have a significant impact on the economic development and innovation of a region or country. Increasing public funding for R&D can stimulate basic and applied research, leading to more patentable inventions. R&D tax credits can encourage companies to invest in new research projects. Support policies for small and medium-sized enterprises and innovative start-ups can encourage the creation of new patents. Collaboration between universities, research centers and industries can accelerate technology transfer and the commercialization of inventions. Promote

science, technology, engineering and mathematics (STEM) education to develop the skills needed for innovation. A well-defined and functioning intellectual property system is essential to protect patents and incentivize innovation. Simplifying the patenting process and reducing associated costs can encourage more individuals and companies to patent their inventions. Creating industrial clusters where companies, research institutions and universities collaborate can promote innovation. Support networks between companies to share knowledge, resources and create synergies that can lead to innovation. Provide access to venture capital to finance innovation and commercialization of inventions. Regulations that keep markets open and competitive can encourage companies to innovate to maintain or increase their market share. Policies specific to regional needs, recognizing that the driving forces of innovation can vary greatly from one region to another. Continue to monitor and evaluate the effectiveness of policies to allow for timely adjustments and improvements. Actively listen to feedback from innovators to understand the practical barriers to innovation and patenting. Collaborate with other nations to promote the exchange of knowledge and technologies. Policies to develop the propensity for patenting in Italian regions should be integrated into a broader economic development strategy that considers local specificities and is sustainable in the long term.

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Declarations

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Appendix

Fixed-effects, using 375 observations
Included 20 cross-sectional units
Time-series length: minimum 17, maximum 19

Dependent variable: A98

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
const	46.5080	5.28921	8.793	<0.0001	***
A97	31.5393	3.86326	8.164	<0.0001	***
A99	−0.174213	0.0601014	−2.899	0.0040	***
A101	−9.67995	1.26902	−7.628	<0.0001	***
A102	−0.740930	0.182690	−4.056	<0.0001	***
A103	−0.277999	0.0913644	−3.043	0.0025	***
A105	1.12366	0.211900	5.303	<0.0001	***

Mean dependent var	55.30827	S.D. dependent var	56.45687
Sum squared resid	212013.6	S.E. of regression	24.64729
LSDV R-squared	0.822148	Within R-squared	0.496327
LSDV F(25, 349)	64.53227	P-value(F)	9.6e-115
Log-likelihood	−1720.379	Akaike criterion	3492.759
Schwarz criterion	3594.859	Hannan-Quinn	3533.293
rho	0.304440	Durbin-Watson	1.297997

Joint test on named regressors -

Test statistic: F(6, 349) = 57.3183

with p-value = P(F(6, 349) > 57.3183) = 4.0877e-49

Test for differing group intercepts -

Null hypothesis: The groups have a common intercept

Test statistic: F(19, 349) = 43.4951

with p-value = P(F(19, 349) > 43.4951) = 5.76937e-80

Random-effects (GLS), using 375 observations

Using Nerlove's transformation

Included 20 cross-sectional units

Time-series length: minimum 17, maximum 19

Dependent variable: A98

	Coefficient	*Std. Error*	*z*	*p-value*	
const	44.7160	11.1681	4.004	<0.0001	***
A97	32.6285	3.81796	8.546	<0.0001	***
A99	−0.176330	0.0599298	−2.942	0.0033	***
A101	−9.57356	1.26409	−7.573	<0.0001	***
A102	−0.702699	0.181885	−3.863	0.0001	***
A103	−0.269195	0.0911003	−2.955	0.0031	***
A105	1.11507	0.211249	5.278	<0.0001	***

Mean dependent var	55.30827	S.D. dependent var	56.45687
Sum squared resid	853960.8	S.E. of regression	48.10672

Log-likelihood	−1981.611	Akaike criterion	3977.222
Schwarz criterion	4004.710	Hannan-Quinn	3988.135
rho	0.304440	Durbin-Watson	1.297997

'Between' variance = 1819.36

'Within' variance = 565.37

mean theta = 0.872262

Joint test on named regressors -

Asymptotic test statistic: Chi-square(6) = 348.915

with p-value = 2.63859e-72

Breusch-Pagan test -

Null hypothesis: Variance of the unit-specific error = 0

Asymptotic test statistic: Chi-square(1) = 1100.96

with p-value = 2.03784e-241

Hausman test -

Null hypothesis: GLS estimates are consistent

Asymptotic test statistic: Chi-square(6) = 15.9175

with p-value = 0.0142035