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# Unitary patent system and innovation dynamics in the European Union: The role of economic resources and R&D investments

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***Abstract***

**PURPOSE:** *The EU supports competitiveness and sustainability via innovations by the patent protection of inventions. On 1st June 2023, the EU launched the Unitary Patent System (UPS) with the Unitary Patent as a universal innovation protection tool. The data regarding its first 20 months of operations offers indices about innovation and patenting trends.* **METHODOLOGY:** *The contextual exploration of the UPS was projected into four aims addressing the absolute and relative numbers of Unitary Patents (A1) and the relationship between Unitary Patents and GDP per capita (A2) and GERD (A3) and comparatively juxtaposing them (A4). This deeper contextual understanding of Unitary Patenting dynamic entails EU member states and their top four competitors (China, Japan, South Korea, USA). The data regarding the GDP, GDP per capita, GERD, number of Unitary Patents in total and per millions of inhabitants was collected and visualized via tables and charts, and submitted to a critical comparison.* **FINDINGS:** *The first 20 months of the UPS operations suggests that the Unitary Patent is a viable, but not the most popular, patenting option, and that there is a positive impact on the GDP per capita and GERD for the majority of the EU member states and that there are differences between EU member states in their efficiency to generate Unitary Patents.* **IMPLICATIONS:** *The performed study confirms the parallel co-existence of various patenting strategies and the importance of investments in patented inventions. However, the size of GDP per capita followed by GERD is a mere pre-requirement that leads to diversified efficiency (even among similar jurisdictions with at least an average GDP per capita and GERD. Arguably, the UPS magnifies the differences, and the six original European integration jurisdictions are not the best UPS players. There are indices about positive trends for Northern EU member states and negative trends for Southern EU member states.* **ORIGINALITY AND VALUE:** *This is a pioneering contribution regarding a newly launched system showing that, despite the same regime, EU member states differ dramatically in their approach to patenting and that the level of GDP per capita and GERD are just the starting points.*

***Keywords:*** *Unitary Patent System, EU member states, GDP, gross domestic expenditure on research and development (GERD), GERD per GDP (GERD Index), innovation, sustainability, economic resources, patent protection*

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## INTRODUCTION

The European history of a patent protection regime goes back to Renaissance Italy and Tudor England (MacGregor Pelikánová & Beneš, 2023) and reflects the belief about the significance and positive effect of innovations on the economy and society (Terzić, 2017), in particular for sustainable economic growth (Prędkiewicz & Prędkiewicz, 2014). A set of justifications for granting patents as temporary and territorial absolute rights (monopoly) has co-existed for centuries, and perhaps the most well-known is based on Bentham's consequentialism. An important conceptualization occurred nearly one hundred years ago when Joseph Alois Schumpeter theoretically analyzed the need to provide incentives for ideas (inventions), to protect them via a temporary monopoly (patents) and to facilitate their speedy transposition and implementation (innovations) (Schumpeter, 1934). Further, already by then, it was well established that human ideas about resolving various problems and doing better things (effective) in a better way (efficient) could be achieved by various human mind outcomes deserving different types of protection – a creative work by copyright, a solution of a technical problem by a patent, etc. (MacGregor Pelikánová, 2019). To the most prevalent and expensive are inventions as solutions to technical problems, which are protected by a national or set of national patents. To put it differently, already about 250 years ago, James Watt knew that his R&D activities desperately needed financing, and their outcome must avoid waste and be properly transposed (by innovations) and protected (by patents and trade secrets) (Crass et al., 2019).

Now, more than ever before, the human mind activities and investments are linked to innovation and sustainability (Lashitew et al., 2024) and require smart and willing minds, incentives, and investment (Koellinger, 2008). The circle is getting closed, and the question is not whether but instead how. Thus, pursuant to the prevailing tenor in the EU, innovativeness depends upon the financing of R&D (Nunes et al., 2012) and is to be measured based on the number of patents granted (Prędkiewicz & Prędkiewicz, 2014). The EU wants to boost its competitiveness and sustainability by supporting the financing of R&D and by facilitating the patenting regime (MacGregor Pelikánová & Beneš, 2023). Ultimately, this should contribute to the building of a common industrial policy in the EU encompassing jurisdictions with diverse socioeconomic interests (Plomer, 2015) and to the proper use of business property and investments (Paksiova & Kubascikova, 2015).

Consequently, on 1st June 2023, the EU launched the unified single patent protection via the Unitary Patent (UP) with the Unitary Patent System (UPS) which should be a universal tool to be employed by EU businesses. Therefore, there is a unique and basically first-time-in-the-world opportunity to file one patent application and get not just one national patent or a bundle of national patents, but a super patent protecting the invention in the majority of EU member states. The data regarding the one year of granting of Unitary Patents offers a set of highly interesting indices and helps to fill in the current vacuum about the universality and effect of Unitary patents, in particular, whether this instrument meets the high expectations of the EU, especially the European Commission.

This implies that new research interest in the contextual exploration of the newly launched UPS projected into four aims addressing the absolute and relative numbers of Unitary Patents (A1) and the relationship between Unitary Patents and GDP per capita (A2) and GERD (A3) and comparatively juxtaposing them to see emerging clusters, pairs and trends (A4). Therefore, a theoretical background, framework setting and literature review are to be presented. Then, based on them, proper data is to be collected, visualized, and discussed for all EU member states and their top four competitors (China, Japan, South Korea, USA) regarding their absolute and relative number of Unitary Patents, GDP per capita, the gross domestic expenditure on R&D (GERD) as the percentage share of GDP (GERD Index), and to be visualized by tables and charts and submitted to a critical comparative juxtaposition refreshed by glossing. This should lead to the contextual presentation and juxtaposition of results regarding the use of the Unitary Patent, emerging trends, the impact of GDP per capita, GERD and GERD Index and differences between EU member states and their four top competitors regarding their interest and perhaps even efficiency in generating Unitary Patents as precursors of innovations.

## THEORETICAL BACKGROUND, FRAMEWORK SETTING AND LITERATURE REVIEW

The concept of sustainable development has millennial continental law roots and is based on a "right and just" generation, distribution, and use of resources (MacGregor Pelikánová et al., 2021). It is marked by a systematic transformation and a multidisciplinary connection of ideas, theories and methods while demanding the engagement of both individual and collective responsibility (Fitzpatrick, 2023) within and between intersecting and mutually intra-related spheres (Dodman et al., 2020). Among the moving forces were the state establishment changes and innovation, in particular since the beginning of the First Industrial Revolution (1750-1760). In 1776, the Scottish economist and philosopher Adam Smith published

The Wealth of Nations, focused on the specialization and division of labor and the increase in productivity and the Scottish inventor James Watt improved the modern steam engine. Interestingly, as much as Adam Smith wanted to avoid the waste of labor, equally as much did James Watt want to avoid a waste of energy by repeatedly cooling and reheating the cylinder, see his design advancement by the separate condenser. It can be even suggested that the modern three pillars concept of sustainability (Purvis et al., 2019) is a demonstration of the avoidance of waste as perceived by these two Scottish thinkers. Finally, it is important to remember that James Watt struggled to obtain financing for his research and development (R&D) activities, while Adam Smith did his best to help. Once Watt managed to obtain the financing via a business partnership, he managed to come up with a set of great inventions which he ultimately managed to put to work, i.e. turn them into innovations, while protecting some of his inventions via trade secrets and others via patents yet infringements happened, law and arbitration proceedings followed and ultimately ended with law settlements. How prodigal.

The development, preferably sustainable development, should be an inherent part and consideration of business strategy (Petera et al., 2021) and match up with the Porter based 3+ core paths to a competitive advantage (Moon et al., 2014). The combined effect of the, so far, four Industrial Revolutions, demonstrates the inclination of humans to transform the environment permanently and irreversibly (Barbiero, 2021), the importance of creating and sharing knowledge (Dodman et al., 2020), see Society 4.0 (Turečková et al., 2023a) and their drive to resolve problems while using technology (MacGregor Pelikánová & Beneš, 2023). Such endeavors often lead to the exhaustion of diminishing resources in a selfish manner (Barbiero, 2021) and can have permanent, irreversibly and highly negative social and environmental consequences, of which probably the worst is climate change (Jones et al., 2023: 4). Manifestly, currently, we are facing the imbalances and inequalities of the resources and their use (Dodman et al., 2020), as well as values discrepancies (MacGregor Pelikánová & Sani, 2023). It is justly suggested that the current concept of sustainability desperately needs humans to overcome their selfishness and drive for immediate and often reckless gratification (D'Adamo, et al. 2024) and employ their intellectual potential to generate intellectual property assets and solutions to boost the effective, efficient and, most importantly, responsible competitiveness (MacGregor Pelikánová, 2019). This all should lead to the satisfaction of the ongoing need for development, ideally sustainable development, taking advantage of innovations and technologies.

The desire for the development of the society leading to growth is deeply embedded in our civilization (Panta, 2019) and has led to a set of foundational and conceptual ideas projected in various theories, starting with mercantilism, physiocracy and classical theories and, so far, ending with neoclassical and endogenous theories (Saikia et al., 2023). Pursuant to the classical growth theory, the positive effect on the growth has the decline of the population and the increase of resources, i.e. in the case of limited resources the growth can be achieved by the population drop and the significance of technological advancement and innovations is underplayed, if not completely ignored. Pursuant to the Schumpeter growth theory, this is the other way around, i.e. innovations are critically important (Schumpeter, 1934) and Keynesian theories of the government intervention are needed to stabilize the economy and stimulate R&D and innovations. Pursuant to the neoclassical growth theory, the growth rests on three mutually related pillars – economic forces: labor, capital and technology, in particular there is advanced the idea that the (external) innovations increase efficiency. In contrast, pursuant to the endogenous growth theory, the pivotal role is to be played by internal factors and forces, i.e. the growth is not imported from outside sources and technologies, but rather is generated by the internal drive for R&D and resulting technological progress. Consequently, basically all growth theories for the last century, including both the neoclassical growth theory and endogenous theory, link the desired growth to innovations and are aware about the need to invest, to get inventions and to turn them into innovations (Saikia et al., 2023). However, it must be admitted that capital and labor are easily defined drivers of economic growth (Solow, 1956), while, in contrast, technical and technological progress appears ephemeral and not easily grasped (Blind et al., 2021). Further, it must be admitted that the relationship between investment, R&D, inventions, their protection by patents and implementation via innovations, and economic and other growths is neither clearly linear nor exponential and that the resulting models and curves differ across industries and jurisdictions (Das, 2020). Currently, pursuant to the growing tenor, it is about both effectiveness and efficiency regarding inventing, patenting and innovating. Without investing in R&D and conducting R&D, innovations can hardly emerge leading to growth and general wellfare improvement and even the best planned and spent investing in R&D is futile if no proper researchers are available (Blind et al., 2022). At the same time, excessive and misplaced R&D spending generates social costs and is contra-productive (Das, 2020), excessive and misplaced patenting stifles innovations and suffocates the progress and development (Jurek, 2024) and a wrong consideration or engagement of labor capital buries any growth and progress prospects (Blind et al., 2024).

The EU shares the vision that resources are needed for inventions and even more for innovations and shapes its policies and law accordingly in the hope of promoting growth (Billon et al., 2017), which should ideally lead to sustainable development (Balcerzak et al., 2023). To put it differently, the EU knows that sustainable development and competitiveness cannot be achieved in our highly competitive global society without financing for inventions and innovations (Dima et al., 2018), and without a shift from tangible to intangible resources (MacGregor Pelikánová, 2019) and without providing copyright protection for original works (Polanski, 2015) and industrial property protection via patents for inventions (Potužáková & Öhm, 2018). Both the sustainability and competitiveness need creative solutions for pre-existing problems (inventions) to be implemented (innovations) while receiving the very needed temporary monopolistic protection (patents) (MacGregor Pelikánová & Beneš, 2023). Further, the EU acknowledges that financial support for R&D is both necessary and limited (Blind et al., 2017) and that R&D has effects on profitability from various perspectives (Ciftci & Cready. 2011). Similarly, the EU recognizes that, although innovative assets are profitable (Czarnitzki & Kraft, 2010), inventions and innovations leading to them are typically the result of an unpredictable and financially demanding research and transposition process generating valuable intellectual property assets, i.e., knowledge efficiency (Polcyn, 2018) and that costs and risks are their integral and inevitable parts (MacGregor Pelikánová, 2019). Further, both EU policies and the academic tenor argue for the positive impact of patent protection for inventions and innovations and the synergy effect with respect to competitiveness and sustainability (MacGregor Pelikánová & Beneš, 2023). However, EU member states and Europeans themselves have very different views regarding the ideal regime, exact amount of financing for R&D (Hammadou et al., 2014), related super-deductions (Jancickova & Paksiova, 2023), the project management and realization (Szopik-Depczyńska et al., 2024), etc., and these differences are often cluster-linked (Prokop et al., 2024).

The EU keeps closely following the United Nations' (UN) pro-sustainability approach and shapes its policies and law accordingly (MacGregor Pelikánová et al., 2024). This well- established EU trend continues through our uncertain and turbulent times (Van Tulder & Van Mil, 2023: 1), crises such as the Covid-19 pandemic (Hála et al., 2024) or War in Ukraine (Malý et al., 2023) and generally events inducing scepticism (Szántó & Dudás, 2022) and challenging trust, the sustainability readiness and values orientation (Hála et al., 2022). Indeed, crises arguably magnify differences, accelerate pre-existing trends and even, pursuant to Einstein, should bring progress due to inventiveness because they generate unique opportunities (D'Adamo & Lupi, 2021). Therefore, rain or shine, instruments induced by the UN, such as the Brundtland Report Our Common Future from 1987 or Agenda 2030 from 2015 or the Paris Agreement from 2015, have become building blocks of EU policies and law along with the integration, competitiveness, agriculture and rural development concerns. Indeed, already in 2010, the EU formulated its decade-long strategy, Europe 2020, based on three mutually reinforced priorities (smart growth, sustainable growth and inclusive growth), centered around five objectives and seven flagship initiatives. Pursuant to Europe 2020, at least 3% of the EU's GDP was to be invested in R&D by 2020 to boost innovations along with the competitiveness and sustainability (MacGregor Pelikánová & MacGregor, 2020). Although many policy and law initiatives were taken and even completed, including in the arena of the protection of intellectual property, many objectives of the Europe 2020 were not met, including the hallmark of 3% investment (MacGregor Pelikánová, 2019). However, the European Commission of Ursula von der Leyen decided to move even further, with its Political Guidelines for 2019-2024 Keeping our promise to Europe with the famous six priorities, of which the very first is the European Green Deal (EGD), see COM(2019) 640 final. The EGD determination to transform the EU's economy and society while putting them on a more sustainable path moves the EU's meta-discourse from a negligence of environmental sustainability (2000 Lisbon Strategy) over to the idea that sustainability is linked to competitiveness and innovations and so can support a 'jobs and growth' agenda to a systemic center-stage incorporation (Schunz, 2022). Although the new European Commission of Ursula von der Leyen makes, regarding 2024-2029, some pragmatic and pro-competitiveness modifications, especially due to national inherent particularities (Jarzemskis & Jarzemskiene, 2022), the EGD is not to be abandoned, instead circularity and renewability are to be supported (Balcerzak et al., 2024) and a larger pool of subjects should be actively involved, see e.g. the new legislation to involve customers in the greening of the economy (MacGregor Pelikánová, 2024).

However, this enthusiasm and drive of the EU, in particular the European Commission, is not fully shared by all EU member states and Europeans (Szántó, 2019), which are open to declare their commitment to support innovations and sustainability as an integral component of their competitiveness (Šlapáková Losová & Dvouletý, 2024), but much less open to share the unified pro-sustainability and pro-competitiveness attitude advanced by the EU (D'Adamo et al., 2022) and to recast their innovations and patenting setting (Scellato, 2007). This is entirely opposed to the European Commission and its reports, such JRC Technical Reports about green and digital inventions, which link the sustainable development, SDGs

and patenting (Bello et al., 2023). The persistent lack of readiness to spend a larger part of GDP on R&D as demonstrated, sadly, by the majority of the EU member states, along with their reluctance to accept a unified intellectual property protection system, undermines ongoing EU endeavors and ultimately are one of the many reasons why EU inventiveness and innovations are not fully explored and cannot massively boost competitiveness and sustainability. Perhaps the EU is overly enthusiastic and more future oriented, while EU member states are rather pragmatic and focused on the present, see the current saga about EGD with circular economy projects. EU member states correctly point out that many inventions have a problematic usefulness and do not support sustainability and competitiveness, as a matter of fact, they can be contra-productive, see e.g., inventions and innovations regarding electric vehicles (D'Adamo et al., 2022). Pursuant to the national tenor, it is not about any inventions and any patents at any price, but about an effective, efficient, legitimate and pro-sustainability and pro-competitive system which is lean, respects national particularities as appropriate and works. In contrast, pursuant to the supra-national regional tenor of the EU, the integration needs the unification, or at least the harmonization, in the intellectual property arena, and this can be observed in the rather smooth unification regarding EU trademarks and the harmonization of national trademarks as well as on the turbulent and extremely challenging and not yet completed Odyssean journey of patent protection unification in the EU (Kaesling, 2013).

Already before the Europe 2020, the EU engaged with the idea of a single community patent system based on typical regulations. In contrast to the EU trademark legislative package, which was initiated in 2008 and led to the harmonizing Directive (EU) 2015/2436 and unifying Regulation (EU) 2015/2424, the original plan about the same for the patent regime failed, due to massive objections to the language mechanism (English, French and German only) voiced by certain EU member states in 2010, and to the proposed Patent Court (and its incompatibility with the EU law) voiced by the CJ EU in 2011 (MacGregor Pelikánová & Beneš, 2023). Therefore, in 2015, i.e,. around the same time as when the EU trademark reform was completed, a new attempt regarding the unification of the European patent system was launched and slowly progressing. This time, there was envisaged a three-pillar structure of the European Unitary Patent System (UPS) consisting of:

- EU Regulation No 1257/2012, which creates a "European patent with unitary effect", commonly referred to as "Unitary Patent";
- EU Regulation No 1260/2012, which lays down the translation arrangements for Unitary Patents;
- The enhanced co-operation Agreement on a Unified Patent Court (UPC Agreement) from 2013 was allowed by the decision of the Council of Ministers of the EU 2011/67/EU.

One decade later, on 1st June 2023, the entire UPS was launched and a growing number of applicants which obtained a European Patent also opt for the Unitary Patent, i.e., in Summer, 2023 less than 20% opted to do so, while in Summer, 2024 more than 30% opted to do so, seethe ongoing statistical information by the EPO dashboard. A growing interest is noticeable especially by subjects from the EU.

The Unitary Patent is based on a European Patent, which is not a patent per se providing an absolute monopoly in Europe, instead the European Patent is a title generated by a centralized proceedings which allows one to obtain a bundle (set) of national patents. Namely, the European Patent is a document granted by the European Patent Organization (EPO), located in Munich, under the rules and procedures of the European Patent Convention (EPC), which was signed in 1973 in Munich, and is linked to the Council of Europe and has 39 member states (27 EU member states and 12 other countries). Similarly, the Patent Cooperation Treaty (PCT), which was signed in 1970 in Washington, is linked to the Paris Convention signed in 1883, is administrated by the World Intellectual Property Organization (WIPO) in Geneva, has 157 member states and can lead to a bundle of national patents in these jurisdictions. Plainly, the EPC and the EPO are competing systems with the PCT; they both lead to a bundle of mutually independent national patents that need to be maintained and defended independently and separately.

In this context, it is relevant to observe the evolution of the dynamics of patenting trends by the top four EU competitors. Namely, since 1960, there has been a growth in international patenting intensity, entailing both patenting effectiveness and efficiency, in China, Japan, and South Korea (O'Keeffe, 2005). As a matter of fact, the panel data indicates the positive correlation of GDP and the number of granted patents in Japan and South Korea (Sinha, 2008) and an almost unprecedented surge regarding international patenting by China since 2010 (Jiang et al., 2019). The Bank of Japan observes that the efficiency of R&D investment in Japan has recently declined and that the ultimate loss of momentum for inventing, innovating and patenting is due not only to the amount of investment and the appropriateness of its use, but as well to the population decrease and general decline in the number of researchers and intellectual property experts, along with their lack of diversity (Oh & Takashi, 2020). Perhaps this is the secret of the innovation and growth success of the

USA as well as Scandinavian countries, because they not only have a fine GDP/capita and also a more than good readiness to spend on R&D, but, in addition, they excel with respect to labor research productivity and diversity (Blind et al., 2021). Throwing money in the right direction where nobody is ready to invent is futile.

The Unitary Patent is an alternative to avoid the fragmentation, i.e., once the European Patent is granted by the EPO, the successful applicant has a choice to either conventionally continue based on the EPC and get selected national patents and keep taking care of each of them, or to take advantage of the new UPS and instead turn his European Patent into the Unitary Patent, which covers a number of jurisdictions in the EU. In such a situation, a one-stop-shop only has one renewal fee to be paid annually, only one proceeding is to be done, etc. One for all and all for one, i.e., as well an attack in one jurisdiction means a potential collapse of the entire patent protection. The UPS with the Unitary Patent is an option offered under the auspices of the EPC-EPO since 1st June 2023. The EU, in particular the European Commission, was and remains convinced that the UPS with the Unitary Patent will reduce the complexity, formalities and costs and ultimately help inventors and innovators in their pro-sustainability, pro-digitalization and pro-competitiveness endeavors (MacGregor Pelikánová & Beneš, 2023), and this despite UPS "disjointed legal mosaic" features (Plomer, 2015). In sum, the UPS and Unitary Patent should be an intersection flagship initiative boosting most, if not all, of the Six priorities.

Well, both the UPS and UPS membership have developed in a rather turbulent manner not allowing to process with an automatic assessment. The statistics calculations about the use of the UPS and granted Unitary Patents are impaired by the brief existence (less than two years), the existence of other options leading to similar results, and membership fluctuations due in particular to the enhanced co-operation leading to the UPC Agreement. Namely the UPS first and second pillars are Regulations back from 2012, while its third pillar is the UPC Agreement from 2013, which was to be signed by EU member states participating in the enhanced co-operation. Originally, there were 25 involved EU member states, including UK and partially as well Bulgaria and Italy, but except Croatia, Poland, Spain. At the moment of the launching of the UPS, there were 24 (UK left and still Croatia, Poland and Spain out) of which 17 ratified it, while the ratification by Romania in May 2024 took effect in September 2024 bringing the number of the full UPS members to 18. Consequently, in February 2025, the status quo regarding the UPS is that the UPC Agreement is not yet signed and thus cannot be ratified by three EU member states (Croatia, Poland, Spain) and six have signed it but have not (yet) ratified (Cyprus, Czechia, Greece, Hungary, Ireland, Slovakia) it. This means that any Unitary Patent is a one-stop-shop title to absolute monopoly protection in 18 jurisdictions, i.e., instead of 18 national patents is one unitary. Specifically, Unitary Patents registered from 1 September 2024 onwards cover the territory of the following 18 EU member states (second generation of Unitary Patents): Austria, Belgium, Bulgaria, Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Romania, Slovenia, Sweden. This implies the interest regarding the contextual exploration of the, so far, only 20 months operating UPS as projected into four aims addressing the absolute and relative numbers of Unitary Patents (A1) and the relationship between Unitary Patents and GDP per capita (A2) and GERD (A3) and comparatively juxtaposing them to see emerging clusters, pairs and trends (A4) regarding these 18 EU member states, the remaining 9 EU member states and the EU top four competitors (China, Japan, South Korea, USA).

## DATA AND METHODS

Factors for obtaining patents, in particular Unitary Patents, are heterogeneous, and the information sources about them are diverse. How much is available to be spent (being rich and having the resources to be spent), how much and how is it spent (being committed to spending), on what and whom is it spent (having capable and smart carriers of innovations and patenting)? These are some of the questions raised regarding factors leading to patented inventions. Naturally, the principal source of such data on factors is the Eurostat, which is the statistical office of the EU, which has as its mission providing high-quality statistics and data on Europe. The Eurostat keeps and updates numerous datasets, indicators, etc., and makes them freely available to the public. Thus, the annual data regarding GDP, GDP per capita, population and GERD for each EU member is freely available from both Eurostat and the World Bank. The European Patent Office (EPO) keeps the Unitary Patent Dashboard with the data about the number of granted Unitary Patents (per millions of inhabitants, granted during the last 20 months as well as subsequences of this time period July 26, 2024). The time progression of the patenting process implies the appropriateness to work with GERD and GDP per capita at least from 2019 to 2022 in the context of Unitary Patents from 2023-2025.

The inherent dynamics of investment and patenting and the openness of the Eurostat, World Bank, and EPO dashboard allow for the collection of relevant data about the economic health and strength of each EU member state

as condensed into GDP and GDP per capita in a given year, their commitment and readiness to spend a part of their GDP on R&D as expressed by the Gross domestic expenditure on research and development index (GERD Index), and ultimately the number of unitary patents obtained (Potužáková & Öhm, 2018). Such data has the potential to be both statically visualized as well as critical juxtaposed. Consequently, the data creates a foundation for future (based on more than 20 months long experience with Unitary Patents) objective, measurable, and statistically robust study based on an appropriate research design (Yin, 2008). To put it differently, this study is a first (and very necessary) step towards a multispectral and encompassing content analysis (Krippendorf, 2003) with descriptive, quantitative and qualitative features (Kuckartz, 2014) and able to produce results meeting standard validity, reliability and robustness expectations (Vourvachis & Woodward, 2015). The research aims to target obtained Unitary Patents while considering GDP per capita and GERD of jurisdictions of patent holders spending years and years on inventions and their patenting.

The research design faces three challenges (types of intellectual property protection available, time of data, and the size of EU member states), which could undermine the case study's coherence and need to be considered as potential limitations (Yin, 2008).

Firstly, sustainability can be achieved without innovations, and innovations can be protected by trade secrets or other non-patent instruments (Crass et al., 2019). However, considering prior studies as well as EU and national policies and laws, along with various intellectual property academic streams, it is obvious that at least a significant percentage of innovations should be and are protected by patents, that a growing number of Europeans prefer Unitary Patents over old-fashioned European patents leading to bundles of national patents, and that sustainability needs smart, effective and efficient solutions for pre-existing problems and so is inherently dependent on inventions which should lead to patented innovations.

Secondly, not only is investing one of the many factors that are leading to innovations and patents, but in addition the patenting process can have a variable length and success rate (generally very low). Prior studies suggest a time lag between R&D spending and generating profits from patents to the extent of four to six years (Ravenscraft & Scherer, 1982), but admit an earlier start of realizing returns (Prędkiewicz & Prędkiewicz, 2014) and point to various stages of the patenting process (MacGregor Pelikánová, 2019). To offset these timing issues, the data was collected in a chronologically dynamic manner – GERD Index for 2022, GDP and the number of inhabitants in 2023 and Unitary patents in 2023-2025. The philosophy behind this reflects the interest in the freshest data and, at the same time, the fact that the commitment to spend on R&D must be well established and seldom leads to results within two years (GERD Index), while recent economic health and strength should be considered (GDP) and all Unitary Patents should be taken into account, i.e. from 1st June 2023 to 31st January 2025 (the newest data available as of the day of collecting the data for this study).

Thirdly, the EU member states have different sizes and, for comparison purposes, the GDP/capita is typically used. Similarly, this study addresses the granted Unitary Patents, i.e., the fraction based on the population. However, due to the nature of the nominal level differentiation (the population is counted in millions while Unitary Patents in units), instead of Unitary Patents per capita, there is used the proportion of Unitary Patents per one million inhabitants.

The research design addresses the interest regarding the contextual exploration of the so far only 20 months operating UPS as projected into four aims addressing the absolute and relative numbers of Unitary Patents, in particular, the share of European patent holders opting for Unitary Patents and the number of Unitary Patents per one million inhabitants from the (A1) and the relationship between Unitary Patents and GDP per capita (A2) and GERD (A3) and comparatively juxtaposing them to see emerging clusters, pairs and trends (A4). This should be done in order to achieve a deeper contextual understanding of Unitary Patenting dynamics for EU member states and their top four competitors (China, Japan, South Korea, USA).

This implies the need to proceed in a four-step consecutive manner, to use visualization by tables and charts, and to develop a critical comparative juxtaposition refreshed by glossing (Hyland, 2007) and Socratic questioning (Areeda, 1996) in order to achieve a deeper contextual understanding. Since the Unitary Patens are only available for 20 months and the impact of GDP per capita and GERD on the current number of Unitary Patents may occur with a time lag, this entire study is rather a pioneering pilot project creating the foundation for future longitudinal studies which should overcome its inherent and so far inevitable limitations and consider variables, regressions and models.

## RESULTS AND DISCUSSION

The contextual exploration of the so far only 20 months operating UPS is logically to be performed in four consecutive steps reflecting its four aims addressing the absolute and relative numbers of Unitary Patents (A1) and the relationship

between Unitary Patents and GDP per capita (A2) and GERD (A3) and comparatively juxtaposing them to see emerging clusters, pairs and trends (A4) of Unitary Patenting dynamics by EU member states and their top four competitors (China, Japan, South Korea, USA).

## Unitary Patents – 20 months around

Pursuant to general expectations as well as public speeches of EU officials, the UPS should become promptly an attractive option to holders of European Patents who should prefer to go for the Unitary Patent instead of the bundle of national patents. This (allegedly) cheaper and easier option should be more effective (having a better protection) and efficient (easier enforceable), in particular for businesses from EU member states. Following this logic, the number of requests to turn European Patents into Unitary Patents should be climbing, especially considering holders from the EU, and this trend should be visible even from the period of the first 20 months. Plainly, the so far available data from EPO dashboard about the Unitary Patents, i.e. Unitary Patents requested and received between 1st June 2023 and 31 December 2025, should offer hints in this direction. Naturally, this period is rather short, we deal with inherent patenting time delays (see above) and we work with annual data not covering the entire year (June – December 2023, January – December 2024, January 2025), but still it is highly illuminating, see Table 1.

**Table 1.** Unitary patents - overview

| | 1 Jun – 31 Dec 2023 | 1 Jan – 31 Dec 2024 | 1 Jan – 31 Jan 2025 | All (1 Jun 2023 – 31 Dec 2025) |
|---|---|---|---|---|
| Received requested for Unitary Patents | 17259 | 28124 | 3078 | 48461 |
| Obtained (granted/registered) Unitary Patents | 17072 | 28023 | 2732 | 47827 |
| Uptake rate EU | 26.3% | 37.3% | 37.2% | 32% |
| Uptake rate Global | 17.5% | 25.6% | 25.9% | 21.8% |

Source: Prepared by the Authors based on EPO dashboard (Unitary Patents). Retrieved from https://www.epo.org/en/about-us/statistics/statistics-centre#/unitary-patent

The message generated by Table 1 is clear, Unitary Patents represent an interesting option, but definitely this is neither the massively preferred one nor progressively getting more popular. As a matter of fact, European businesses are more inclined to go for it than businesses outside the EU. However, still the majority of European businesses prefers to turn their European patents into the old fashioned bundle of national patents in several selected EU member states rather than the Unitary Patent. In addition, there are no indices about a drastic change, instead it looks like the, so far, peak was reached in summer 2024. Consequently, it was taken advantage of EPO dashboard data from 1st June 2024, first year anniversary of the UPS, to look deeper in the national distribution, i.e. from which EU member states were businesses obtaining Unitary Patents. Considering the dramatic diffirences in the population of EU member states and the need to achieve a contextual comparison, the number of Unitary Patents per one million inhabitants was considered. This led to the preparation of the graph showing how many Unitary Patents were obtained per million inhabitants from EU member states, see Figure 1.

The message provided by Figure 1 is very clear again. Namely, businesses from Denmark, Sweden and Finland are the most inclined to go for patenting and obtaining Unitary Patents while businesses from Romania, Croatia and Bulgaria are the least interested. Naturally, this message is rather a preliminary suggestion demanding a much deeper analysis. Nevertheless, as a fast snapshot shows, where in the EU is Unitary Patenting performed, where not and where some particularities demanding further explanation occur, see e.g. extremely good results for Luxembourg and unexpectedly good results for Malta. In any case, the overwhelming dominance of Unitary Patenting per million inhabitants in Scandinavia calls for further explanation, such as the impact of the GDP per capita or GERD.

## GDP per capita and Unitary Patents – richness for patenting

As explained above, inventions and their patenting protection require both time and money. In particular, the time progression of the patenting process implies the appropriateness to work GDP per capita (in USD) during 2019-2023, if Unitary Patents are to be considered. In order to achieve an enhanced, revealing effect, the visualization of GDP per capita with the time evolution (2019 v 2023), is presented in Figure 2.

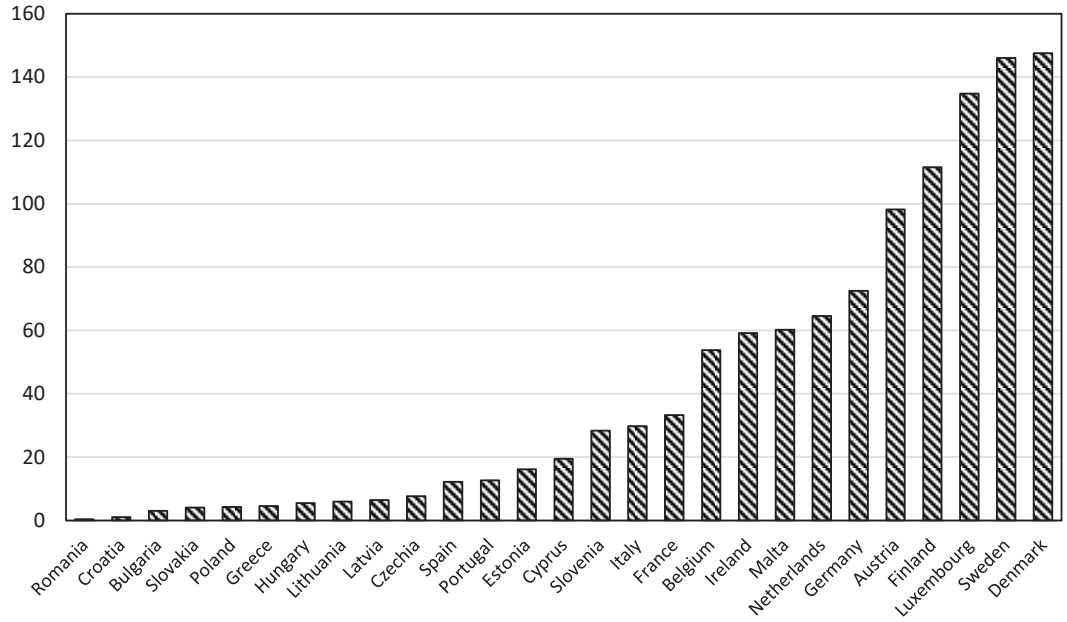


**Figure 1.** Number of Unitary Patents per millions of inhabitants in EU member states to 1st June 2024

**Source:** Statista, Eurostat (million inhabitants), EPO dashboard (Unitary Patents).

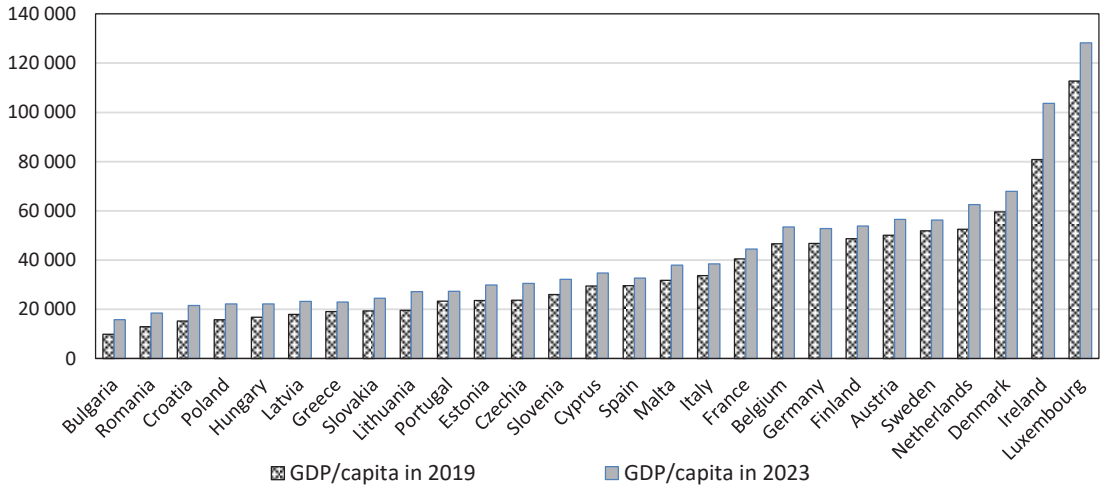


**Figure 2.** GDP per capita in USD in 2019 and 2023 (all EU member states)

**Source:** Statista, Eurostat, World Bank (GDP per capita), EPO dashboard (Unitary Patents).

Manifestly, no dramatic changes have occurred in GDP per capita in EU member states between 2019 and 2023, so there remain the same high differences in GDP per capita among EU member states. The GDP per capita of Luxembourg is 8x higher than that of the last place, Bulgaria. Generally, West and North EU member states reach a higher GDP per capita than South and East EU member states.

Considering the UPS and the full participation of 18 EU member states, it is relevant to mention that, within the half of the EU member states with a higher GDP per capita there is only one that is not fully participating in the UPS (Ireland), and that typically the 9 EU member states not fully participating in the UPS are states with the lowest GDP per capita (Croatia, Poland, Hungary, Greece and until recently Romania). This suggests that "richer" EU member states are more inclined to be in the UPS than "poorer" EU member states. A similar pattern exists regarding GERD, respectively GERD Index, in 2019 and 2022, see Figure 3.

Regarding GDP per capita and the number of Unitary Patents granted, it is highly interesting to observe four clusters – two clusters with a very high GDP per capita in 2023, see Table 2, and two clusters with a very low GDP per capita in 2023, see Table 3.

**Table 2.** Unitary Patents per millions of inhabitants by 1st June 2024 in EU member states with a high GDP per capita in 2023

| EU member state | Country Code | GDP per capita in euros in 2023 | Number of UP per millions of inhabitants by 1st June 2024 |
|---|---|---|---|
| Austria | AUT | 52 370 | 98.13 |
| Belgium | BEL | 49 720 | 53.74 |
| Denmark | DNK | 63 290 | 147.45 |
| Finland | FIN | 49 280 | 111.51 |
| France | FRA | 41 330 | 33.23 |
| Germany | DEU | 48 770 | 72.47 |
| Sweden | SWE | 51 000 | 146.02 |

Source: Statista, Eurostat, World Bank (GDP and GDP per capita in 2023), EPO dashboard (Unitary Patents by 1st June 2023).

Table 2 includes the EU member states with the highest GDP per capita while omitting Luxembourg and Ireland due to a strong external impact on their GDP and their copyright inclination. The Scandinavia trio (Denmark, Finland, Sweden) has a similar GDP per capita as the foundation EU trio (Belgium, France, Germany) but is roughly two times more efficient in getting Unitary Patents. The biggest, most obvious difference occurs between Belgium and Finland. These two member states have basically the same GDP per capita. Still, Finland is twice as efficient in getting UPs. However, the GDP of Belgium is more than two times larger than that of Finland; both states have basically the same absolute number of Unitary Patents (632 and 622). Even more worrisome is the situation of France, which has a comparable GDP per capita to Finland and Germany and is not only almost one-fourth as efficient as Finland, but even Germany is twice as efficient as France. To complete this overview, it is good to mention that Austria is the closest one to reach the level of the Scandinavian trio. This points to the recognition that although clichés and national and other stereotypes are typically misleading generalizing tools, they might still have elements of merit (Hřebíčková *et al.,* 2018), particularly in the arena of sustainability and innovations in the EU (Szántó, 2019). Well, it appears that free creativity, personal and organizational discipline, individual responsibility, and openness to co-operate are definitely important for patenting, and the EU member states with high GDP per capita (Turečková *et al.,* 2023b) differ in them significantly (Prokop *et al.,* 2024). Well, the situation for lower GDP per capita states reflects the same pattern, see Table 3.

**Table 3.** Unitary Patents per millions of inhabitants by 1st June 2024 in EU member states with a lower GDP per capita in2023

| EU member state | Country Code | GDP per capita in euros in 2023 | Number of UP per millions of inhabitants by 1st June 2024 |
|---|---|---|---|
| Czechia | CZE | 29 180 | 7.63 |
| Estonia | EST | 27 590 | 16.11 |
| Greece | GRC | 20 920 | 4.46 |
| Hungary | HUN | 20 480 | 5.42 |
| Latvia | LVA | 21 440 | 6.38 |
| Lithuania | LTU | 25 070 | 5.92 |
| Poland | POL | 19 920 | 4.17 |
| Portugal | PRT | 25 740 | 12.60 |
| Slovakia | SVK | 22 210 | 3.98 |

Source: Statista, Eurostat, World Bank (GDP and GDP per capita in 2023), EPO dashboard (Unitary Patents by 1st June 2024).

Table 3 includes EU member states with a lower (but not the lowest) GDP per capita, i.e., between EUR 19 920 EUR and EUR 29 180. Interestingly, Slovakia, Greece, and Poland have a similar GDP per capita and very low Unitary Patent performance. In contrast, the highest patenting performance is achieved by Estonia, Portugal, Czechia and Latvia, while Czechia has a significantly higher GDP per capita than Latvia. It might be speculated that the obvious handicap of a smaller GDP and GDP per capita is addressed very well by Estonia and Latvia and very poorly by Slovakia and, to a certain extent as well, Poland and Greece. This might point to historical, cultural and production orientation backgrounds, such as that EU member states excelling in conditions for agricultural production are generally less efficient in getting Unitary Patents than other EU member states with similar GDP per capita, in particular, if these other states are close to the hub of the above-mentioned Scandinavian trio. However, it might be argued that having resources is futile without the determination and capacity to go for R&D, and so not only GDP per capita should be considered, but as well GERD and GERD Index.

## GERD and Unitary Patents – commitment to patenting

As explained above, inventions and their patenting protection need both time and money. In particular, the time progression of the patenting process implies the appropriateness to work with GERD and GERD Index (percentage of R&D spending compared to GDP in 2019-2022) and the number of Unitary Patents as of 2024. In order to achieve an enhanced, revealing effect, the visualization of GDP per capita with the time evolution, is presented in Figure 3.

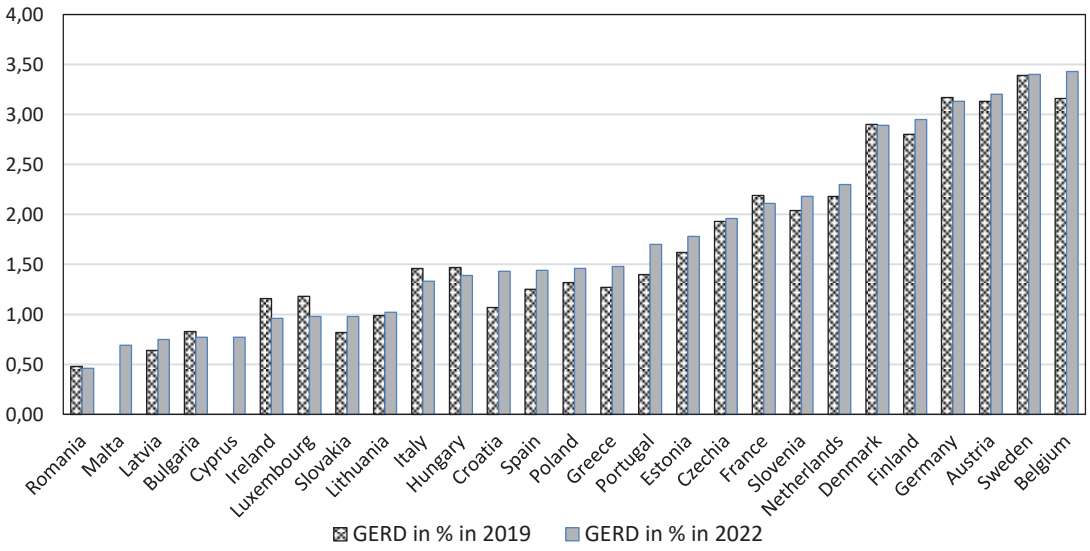


**Figure 3.** GERD in percentage of GDP aka GERD Index in 2019 and 2020 (all EU member states)
**Source:** Statista, Eurostat.

Similar to GPD per capita, no major changes occurred in GERD in EU member states between 2019 and 2022. Due to the lack of data about the GERD of Cyprus and Malta in 2019, the preceding statement should be taken with caution regarding these two jurisdictions. Despite this reserve, it is obvious that there are massive differences in GERD among EU member states, while the value for the first place, Belgium, is 7x higher than for the last place Romania. Again, generally, the West and North EU member states reach higher GDP per capita than the South and East EU member states. Considering the UPS and the full participation of 18 EU member states, it is relevant to mention that, as of 2022, only four EU member states had met the target of Europe 2020, i.e., only Belgium, Sweden, Austria and Germany reached the threshold of 3% of GERD Index, and that in the half of the EU member states with a higher GERD Index there are only (towards its end) two states not fully participating in the UPS (Czechia and Greece). This suggests that jurisdictions where the investment in R&D takes a larger part of GDP are, at the same time jurisdictions with a higher GDP per capita. Namely, it appears, prima facia, that West and North EU member states are richer, more committed to invest in R&D, and more pro-UPS. Rather unsurprisingly, the Figure below indicates that these GDP per capita and GERD Index winners are as well Unitary Patents winners (Table 4).

**Table 4.** Unitary Patents per millions of inhabitants b 1st June 2024 in EU member states with a high GERD Index in 2022

| EU member state | Country Code | GERD Index in 2022 | Number of UP per millions of inhabitants by 1st June 2024 |
|---|---|---|---|
| Austria | AUT | 3.20 | 98.13 |
| Belgium | BEL | 3.43 | 53.74 |
| Denmark | DNK | 2.89 | 147.45 |
| Finland | FIN | 2.95 | 111.51 |
| France | FRA | 2.11 | 33.23 |
| Germany | DEU | 3.13 | 72.47 |
| Sweden | SWE | 3.40 | 146.02 |

Source: Statista, Eurostat (GERD in 2022), EPO dashboard (Unitary Patents by 1st June 2024).

The same pattern and segregation occur for the number of Unitary Patents per million inhabitants, as in the case of GDP per capita, GERD, GERD Index, and even UPS full participation. The leadership of Northern EU member states regarding the density of Unitary Patents is obvious, and there is sparsity in the case of East and South EU member states without UPS full participation (Croatia, Slovakia, Poland, Greece, Hungary) and at the same time a lower GERD Index, i.e. under 2% (Table 5).

**Table 5.** Unitary Patents per millions of inhabitants by 1st June 2024 in EU member states with a lower GERD Index in 2022

| EU member state | Country Code | GERD GERD Index in 2022 | Number of UP per millions of inhabitants by 1st June 2024 |
|---|---|---|---|
| Czechia | CZE | 1.96 | 7.63 |
| Estonia | EST | 1.78 | 16.11 |
| Greece | GRC | 1.48 | 4.46 |
| Hungary | HUN | 1.39 | 5.42 |
| Latvia | LVA | 0.75 | 6.38 |
| Lithuania | LTU | 1.02 | 5.92 |
| Poland | POL | 1.46 | 4.17 |
| Portugal | PRT | 1.70 | 12.60 |
| Slovakia | SVK | 0.98 | 3.98 |

Source: Statista, Eurostat (GERD in 2022), EPO dashboard (Unitary Patents by 1st June 2024).

Therefore, a mere collection, the positioning of the data and the visualization support the intuitive suggestion that the higher economic wealth of the country and being committed to investing in R&D might have a positive effect on participation in the UPS and/or on the number of Unitary Patents. This immediately suggests considering other factors as well as, non-EU member states, i.e., to see whether the same applies to the biggest competitors of the EU and EU member states.

## Comparative juxtaposition pointing to emerging clusters, pairs and trends

The above presented data suggest that there are massive differences in Unitary patenting per million of inhabitants, GDP per capita and GERD in EU member states and that at the same time there are no dramatic trend differences, i.e. in particular GDP per capita and GDP per capita, GERD and GERD Index have not has not changed dramatically in recent years in these jurisdictions. Further, data regarding the first 20 months of UPS operation suggests that the entire system magnifies differences, i.e. EU members states with a higher GDP per capita have as well a higher GERD Index (around 3%) and are more likely to be full members of UPS and getting more Unitary patents per million of inhabitants. This avalanche effect works as well in the opposite direction, i.e. a lower GPD per capita typically parallels with a lower GERD Index (under 2%) and with the absence of the full participation in the UPS and with a lower number of Unitary Patents per million of inhabitants. To put it differently, it appears GERD has a positive impact on the number of Unitary Patents, but its significance is not as strong as GDP per capita levels. Since the Scandinavian trio manages to achieve the desired threshold of 3%, it benefits from the double positive effect of a high GDP per capita and a high GERD Index. There are only three other EU member states getting close to or passing the 3% GERD Index threshold - Austria, Belgium and Germany, i.e., these three countries have as well a high GDP per capita, but their efficiency in getting Unitary Patents is lower; see below. This leads to questions – which EU member states have a high GDP per capita and a lower GERD Index, and how are they doing regarding efficiency in getting Unitary Patents? Such data is placed in the Table below by skipping small EU member states with few Unitary Patents in order to avoid random results, see Table 6.

**Table 6.** GDP, GERD, and Unitary Patents in EU member states with a higher GDP and a lower GERD Index

| EU member state | Country Code | GDP per capita in euros in 2023 | GERD in % of GDP aka GERD Index in 2022 | Number of UP per millions of inhabitants |
|---|---|---|---|---|
| Czechia | CZE | 29 180 | 1.96 | 7.63 |
| France | FRA | 41 330 | 2.11 | 33.23 |
| Italy | ITA | 35 350 | 1.33 | 29.75 |
| Netherlands | NLD | 59 710 | 2.30 | 64.54 |
| Slovenia | SVN | 29 750 | 2.18 | 28.29 |
| Spain | ESP | 30 320 | 1.44 | 12.17 |

Source: Statista, Eurostat, World Bank (GDP and GDP per capita in 2023), Eurostat (GERD in 2022), EPO dashboard (Unitary Patents).

This pool of six EU member states can be split into two sub-groups. The first one includes EU member states with a GERD Index in 2022 over 2%, and, interestingly enough, these three EU member states have as well a higher GDP per capita than the other EU member states with a GERD Index between 1.33% and 1.99%. The first sub-group is clearly more efficient in patenting than the second sub-group. However, it is worth observing that, within the first sub-group, two EU member states have a similar GERD Index and similar patenting efficiency, i.e., the number of Unitary Patents per million inhabitants, but dramatically different GDP per capita – EUR 41 330 (France) v EUR 29 750 (Slovenia). Hence, Slovenia is more efficient in turning the invested funds into patents than France. Further, it is worth observing that, within the second sub-group, two EU member states have similar GERD Index and even a rather similar GDP per capita and size (geographical + population), but their patenting efficiency is dramatically different – 29.75 (Italy) v 12.17 (Spain).

In sum, EU member states with at least an average GDP per capita and with at least an average GERD Index have more Unitary Patents per million inhabitants and arguably might be more efficient in getting them. However, this statement about the synergy effect of GDP per capita and GERD, which ultimately magnifies the differences between EU member states, can be expanded by a deeper and more individual look at these potential innovation and sustainability leaders and by addressing questions such as: Why are Scandinavian states doing so much better than the rest? Why are Austria, Germany and the Netherlands doing so much better than Belgium, France and Spain? Naturally, it is unrealistic to expect massive innovation, sustainability, and patenting effectiveness and efficiency from EU member states with low GPD, GDP per capita, and GERD. However, it is realistic to expect that more fortunate EU member states with a high GPD, GDP per capita, and GERD should excel and, potentially, they, along with the entire UPS, should help the, so far, less fortunate EU member states, see the principle of solidarity. Arguably, this is not the case and, as a matter of fact, certain alleged innovation, sustainability and patenting leaders appear to have lost their momentum and to be lagging even behind allegedly economically and otherwise weaker states – see the decline of France which, pursuant to the ongoing trend, should soon have even fewer Unitary Patents than Italy (France acquired 1238 Unitary Patents during 7 months in 2023 and only 1059 during the first 7 months in 2024, while Italy got 904 and 903) and this despite the much higher GDP, GDP per capita and GERD of France compared to Italy. Since even Germany is not excelling, it is not irrelevant to ask for the legitimacy and appropriateness of the German-French tandem to shape, if not dictate, the EU policies for innovations, sustainability and patenting … perhaps other nations should be given much more input about how to transform the money invested in R&D into innovations, and ideally into pro-sustainability and pro-competitiveness solutions protected by the European intellectual protection, in particular the industrial property protection *par excellence* – the Unitary Patents.

However, it cannot be overemphasized that these ideas are rather indicative suggestions and definitely are not solid and statistically robust conclusions. The UPS needs more years of operation and stable membership. In additon the inherent and overwhelming differences in GDP per capita and GERD between EU member states make conventional statistic comparision highly problematic, and this even if jurisdictions with GDP particularities and missing GERD data are omitted, i.e. financial sector oriented Luxembourg, modern tehnologies headquartering Ireland, and Malta. The below Table 7 demonstrates the disparities between the remaining 24 EU member states.

**Table 7.** Summary statistics for 24 EU member states

| Variable | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|
| **Unitary Patents per mil. Inhabitants as of 1st June 2024** | 37.75 | 45.99 | 0.37 | 147.4519 |
| **GDP per capita in euros in 2023** | 32,967.94 | 15,868.79 | 9,874.34 | 69,268.65 |
| **GERD in 2022** | 1.88 | 0.89 | 0.46 | 3.49 |

Source: Statista, Eurostat, World Bank (GDP per capita), EPO dashboard (Unitary Patents).

This suggests to depart from national particularies and consider the EU in its entirety and compare the nominal GDP in millions of USD, such GDP per capita, GERD, GERD Index and number fo Unitary Patents and Unitary Patents per million of inhabitants for the EU and its top four competitors, see the Table 8.

**Table 8.** GDP, GERD, and Unitary Patents in EU and selected non-EU states

| State | Code | GDP (nominal) in millions of dollars in 2023 | GDP per capita in dollars in 2023 | GERD in % of GDP aka GERD Index in 2022 | Number of UP per millions of inhabitants | Number of UP granted to July 26, 2024 |
|---|---|---|---|---|---|---|
| EU | EU | 18 349 388 | 40 697 | 2.24 | 38.96 | 17551 |
| China | CHN | 17 794 782 | 12 514 | 2.41 | 1.20 | 1 706 |
| Japan | JPN | 4 212 945 | 33 806 | 3.34 | 9.03 | 1 125 |
| South Korea | KOR | 1 712 793 | 35 569 | 4.93 | 21.58 | 1 039 |
| USA | USA | 27 360 935 | 81 632 | 3.46 | 13.73 | 4 601 |

Source: Statista, Eurostat, World Bank (GDP and GDP per capita in 2023), Eurostat (GERD in 2022), EPO dashboard. (Unitary Patents)

There are dramatic differences in GDP per capita (the GDP per capita in the US is 6x higher than in China), in GERD Index (the GERD Index of South Korea is 2x higher than that of the EU and GERD of the EU and China is similar!) and even in the number of United Patents per million inhabitants (32x higher in the EU than in China). However, it needs to be observed that these jurisdictions have different political and legal regimes and that, for various reasons, it might be better to use PCT patenting instead of EPO patenting with the European Patent or Unitary Patents. Consequently, the data placed in Table 8 should be considered with caution, and it needs to be kept in mind that they may easily lead to speculations and not academically robust conclusions. Thus, Table 8 should be rather appreciated as an illustration, perhaps an indication that GDP per capita and GERD might have a genuinely positive impact even if other than EU member states are considered; see the USA and South Korea and how they are overshadowing China and Japan.

Firstly, it should be emphasized the massive dominance of the GDP per capita of the USA, which is definitely not matched by the GERD Index dominance. Secondly, it is noteworthy the rather peculiar GERD Index position of the EU, which keeps very remote from the expected (and by its competitors predominantly achieved) milestone of 3%. To put it differently, the EU is not behind its competitors in terms of GDP per capita, but it is definitely behind in terms of GERD. The picture gets slightly more positive when the relative number of Unitary Patents is considered. This can be presented as supporting the relevance of the stated aims, especially of the GDP per capita on innovation protection (A1 and A2), in particular, if one patenting system for a set of states with the same regime is considered, i.e., the UPS. However, their empirical validity is a springboard for future longitudinal analyses and studies that could engage in multivariate regression analysis.

## CONCLUSION

A theoretical background, framework setting and literature review demonstrate that inventions are typical intellectual property assets employed to resolve technical problems, and so are pivotal for improvements via innovations, which can boost competitiveness and support sustainability, in particular by finding new measures and avoiding waste. Inventions and innovations are critical for development, particularly sustainable development, and, at the same time, they are not easy to achieve, transposed in operation, and protected. They require creativity, determination, time, and resources.

The research utilized data collected from all EU member states regarding their GDP, GDP per capita, GERD, GERD Index, and number of Unitary Patents in total and per million inhabitants and explored the role of economic resources on the Unitary Patent levels. The so far available data about UPS suggests that EU jurisdictions keep their levels of GDP per capita and GERD, and generally, those with a higher GDP per capita are likely to have GERD Index, over 2% (preferably closer to 3% or over), are more likely to be full members of the UPS and their subjects are more likely to get Unitary Patents. Similarly, EU jurisdictions with a lower GDP per capita are likely to have a lower GERD Index (under 2%), not to be full members of the UPS and their subjects are less likely to get Unitary Patents. Nevertheless, the freshness of the entire UPS, the motions in its membership, the inherent patenting time delay, alternative options such as European patents and PCT, and massive cultural, social, and other differences between EU member states make conventional statistical, regression and modeling processing not robust at this point of time.

Nevertheless, despite these massive limitations, inevitable data shortage and a speculative time delay, the provided analysis has merits. In particular, the first step allows for moving on to a deeper appreciation of the interaction, mutual influence and impact of variables such as GPD/capita, GERD, GERD Index, and Unitary Patents per millions of

inhabitants. Further, it has the potential to induce thoughts about relevant economic and institutional factors and national particularities shaping the overall innovation ecosystem. The future studies should definitely focus on the Scandinavian trio, which appears to lead the way, while Austria and Germany do their best to follow and France and Belgium might have lost their momentum and might be passed by Italy, while for the Czechia and Poland, the situation looks even less promising. Further studies need to keep an eye on the top four competitors, while their conclusions in particular regarding GERD Index (China having more than EU!) and patenting, should promptly get out of the academia into the business universe and to policy and law makers.

In sum, UPS is operational and despite the joint institutional regime and setting, EU member states are heterogeneous in their resources, efficiency and UPS performance, while the top competitors use it along with other options. The pro-integration EU tandem – France and Germany – does not hold firmly the effectiveness and efficiency laurel wreath in this arena, and perhaps ideas about the setting and operating of the regime for inventions, innovations, and their patenting protection should come from places other than Berlin, Brussels and Paris, yet this would require more work in addressing the hot-spots, i.e., cities and regions with the most Unitary Patents, which could be subject of regional and spatial analysis. It might be enlightening to engage in more depth in the ephemeral relationship between inventions turned into innovations which enhance sustainability and competitiveness. Indeed, the search for roots and substrata causes that are promoting or inhibiting the drive for sustainability and innovation in the EU is critical, especially since the new European Commission of Ursula von der Leyen has as one of its three priorities "A prosperous and competitive Europe" The motto of the EU is "united in diversity" and this unification needs definitely to materialize in this arena in a smart, sustainable and respectful manner.

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## Biographical notes

**Radka MacGregor Pelikánová** is a senior lecturer at Metropolitan University Prague (MUP) with a strong academic background and practical expertise in law, economics, management, business and Intellectual Property (IP). For over two decades, she has been a member of the Czech Bar Association and the Michigan Bar Association and has provided clients with advice regarding IP, in particular patents, trademarks and domain names. During the last fifteen years she has been focusing on academic activities and became a prolific writer of highly influential and referred articles about IP, EU law, Competition law, sustainability, and Common law vs. Continental law comparisons, in particular about the approach to creativity, inventiveness, innovations, and sustainability in various jurisdictions sharing different traditions.

**Martin Hála** is a senior lecturer at Metropolitan University Prague (MUP). He teaches statistics, mathematics, econometrics, and economic courses. He develops various methodology strategies and works on the transposition of statistics and mathematics approaches into other arenas, such as sustainability, innovations, and IP. He has a solid record of publications and has participated in many research projects.

**Marek Beneš** is an experienced copyright lawyer and committed academic with an outstanding record of performing managerial tasks at Metropolitan University Prague (MUP). His research concerns are well embedded in the IP arena, in particular regarding copyright issues linked to creativity and its protection regime in the EU. His publications reflect it.

## Authorship contribution statement

**Radka MacGregor Pelikánová**: Concept, Search and Collecting Data, Methodology and Data Processing, Framework and Background Development, Writing Original Draft, Writing. **Martin Hála**: Search and Collecting Data, Methodology, Drafting. **Marek Beneš**: Framework and Background Development, Drafting.

## Conflicts of interest

The authors declare no conflicts of interest.

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