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ARTICLE

Patent Quality: A Critique of the State of the Discussion

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Abstract Despite decades of research and debate, the narrative that low-quality patents stifle innovation remains fraught with controversy. It is called into question because the term "patent quality" seems to be a potential misnomer, and reforms to improve patent quality are ineffective. The purpose of this study is to offer a comparative critique of the debate regarding patent quality in the European Union and the United States. It investigates five factors relating to the history of this debate, contested definitions, measurements of quality, proposals that are not implemented, and reforms that are implemented. The main contribution of this paper is to review how the debate has been constructed, indicating that certain arguments seem to talk past each other and consensus is hard to reach, that measurements are flawed, and that proposals and reforms seeking improvement seem to be treating the symptoms but not the disease. The study argues that the debate encounters a conceptual predicament characterized by substantively different conceptions of patent quality, which are influenced by differing normative expectations and assessments of patent systems. It transforms a potentially useful analytical concept into a rabbit hole. Any attempts to break the current impasse must begin with an appreciation of the different senses in which patent quality is used and an assessment of the legitimacy of their underlying normative frameworks.

Keywords Patent quality · History · Definition · Measurement · Reform

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1 Introduction

Despite having been debated for decades, the issue of patent quality is fraught with controversy. This issue garnered considerable scholarly attention in the United States (US) in the 1990s due to concerns that the increasing volume of so-called "low-quality patents" would undermine innovation.[1] Similar complaints later also gained momentum in the European Union (EU), although its examination process and litigation are considered to be relatively superior.[2] These heated debates propagated worldwide concerns regarding patent quality. Following decades of global debate, most scholars have reached a consensus that low patent quality generates devastating social costs, including stifling innovation, undermining the patent system, raising transaction costs by encouraging more infringement and litigation, and diverting resources away from true innovators.[3]

One significant controversy is that the term "patent quality" seems to be a misnomer, as many studies contend that the problem at hand is not primarily about the quality of individual patents in terms of legal validity or patent value. Instead, the focus shifts towards other factors such as the design of the patent system or the nature of patent rights. Wagner holds that the patent system constructs an incentive structure that fosters improper patenting behavior.[4] Hilty argues that patent quality is not a problem of patent law *per se* but should be understood within the framework of competition law.[5] Burk and Lemley describe this problem as a consequence of the one-size-fits-all legal framework, applying the same evaluative rules to all sectors of technology.[6] Thambisetty alleges that patents fail to represent the quality of underlying inventions due to their nature as credence goods, giving rise to information asymmetry.[7] Bessen and Meurer contend that the core of this issue is the flawed notice function of patent rights, which fails to sufficiently delineate the boundaries of the claimed property. Specifically, this notice problem primarily arises from the ambiguity inherent in the scope of patents when compared to tangible property, which possesses clear physical boundaries.[8] Despite addressing the same topic, these studies present different or even contrasting views.

Another controversy is the inefficiency of reforms aiming to improve patent quality. Among others, Hall and Harhoff offer an argument that seems to be most

[1] For example, Merges (1999), p. 578, and Jaffe and Lerner (2011).

[2] Harhoff (2006), p. 340.

[3] For example, Burk and Lemley (2009), p. 3, arguing that the patent system is plagued by "the proliferation of bad patents and the abuse of those patents in court"; Meurer (2016), p. 72, contending that low-quality patents levy an innovation tax in most industries; Kesan and Gallo (2006), p. 66, alleging that "improvidently granted patents" block innovation and impair the reliability of the patent system; Ghosh and Kesan (2004), pp. 1227–1228, contending that low-quality patents impose various social costs; Merrill, Levin and Myers (2004), p. 46, pointing out that low validity of low-quality patents encourages more infringement and litigation, and thus raises transaction costs.

[4] Wagner (2009), p. 2137.

[5] Hilty (2009), p. 31.

[6] Burk and Lemley (2009), p. 5.

[7] Thambisetty (2007), pp. 707, 726.

[8] Bessen and Meurer (2009), pp. 10, 18.

pertinent to the quality of individual patents, contending that the legal standards for evaluating patents are low and the examination procedure is lenient.[9] In response to critiques over the lax examination, patent offices have made enormous efforts to improve their efficiency over the last two decades. Unfortunately, these efforts seem to be futile as we will see below in Sect. 6. In 2018, the US Patent and Trademark Office (USPTO) continued to be criticized for its policies impeding the quality of patents.[10] In the same year, even EPO examiners openly questioned the seemingly better quality of EPO patents.[11] Furthermore, one study indicates that in the German Federal Patent Court, only 21.3% of the patents in invalidity suits were fully upheld between 2010 and 2012, arguing that "invalidated patents are likely just the tip of the iceberg," given that most patents are not litigated.[12] This suggests that the widely accepted association between patent quality and examination provides a simplified perspective on the patent quality issue, and the remedies based on this perspective alone are insufficient in effectively addressing it.

Since it remains an unresolved and fundamental controversy, the purpose of this study is to offer a detailed critique of the patent quality debate in the EU and the US. It finds that patent quality has become a perplexing rabbit hole. It argues that the current patent quality debate is trapped in a conceptual predicament characterized by substantively different conceptions of patent quality, which are influenced by differing normative expectations and assessments of patent systems. To fully explore its analytical potential, this paper calls for further research to approach this problem by elucidating the currently used definitions and assessing the legitimacy of their underlying normative frameworks.

The contribution of this paper is to review how the debate has been constructed, indicating that certain arguments seem to talk past each other and consensus is so hard to reach that measurements are flawed, and that proposals and reforms seeking improvement seem to be treating the symptoms but not the disease. Given the focus of this paper, two limitations should be stated at the outset. The first is that this research refrains from offering a preferred definition or benchmark of patent quality, leading to the second limitation – the lack of an examination of the mechanism of patent quality.

To achieve its objective, this paper investigates five factors relating to the history of this debate, contested definitions, measurements of quality, unimplemented proposals, and implemented reforms. Sect. 2 briefly surveys the history of the patent quality problem in the US. This does not by any means imply that only US history is relevant; however, the US history seems to allow for a more concise and focused investigation, bypassing some controversies in patent history. Sects. 3–6 further scrutinize the definitions, measurements, proposals, and reforms related to patent quality, and find that the definitions are kaleidoscopic, the measurements are flawed, the unimplemented proposals are problematic, and the implemented reforms are

[9] Hall and Harhoff (2004), p. 992

[10] Cotropia and Quillen (2001), criticizing the policy behind a striking increase of allowance rates for impeding the quality of patents.

[11] *See* Sect. 6, Frustrating Reforms.

[12] Henkel and Zischka (2019), p. 197.

frustrating. Collectively, these findings indicate that navigating through the conceptual labyrinth of patent quality should be the first step towards any effective resolutions or remedies.

2 A Brief History of the Patent Quality Issue

Debates regarding patent quality are nothing new and such patent debates have occurred throughout history.[13] Jaffe and Lerner investigate three historical events: the enactment of the Statute of Monopolies 1624, which granted patents to the "true and first inventor and inventors"; the establishment of a patent office in the United Kingdom (UK) via the Patent Law Amendment Act of 1852, which greatly streamlined administrative procedures and lowered application costs; and the 1869 reform abolishing Dutch patent law, which granted patents without examination.[14] Based on this investigation, the authors assert that the concept of patent quality concerns familiar issues, such as "the ability to reward inventors in a timely manner, the quality of the review provided by patent office procedures, and the risks and burdens created by litigation to enforce patents."[15]

While history provides useful lessons, the context around patent law invariably shifts over time, which imposes limits on the relevance of these three case studies. The authors claim that these historical episodes reflect "debates over the nature and quality of patent awards [which] led to dramatic and heated discussions that shed light on the complexity and durability of the issues we face today."[16] However, these events hardly concerned patent quality. First, the main objective of the Statute of Monopolies was to prevent the abuse of the royal prerogative to grant letters patents "for the granting of lands, titles, offices, and other privileges," but patents for invention were exempted.[17] These prohibited letters patent bore little relevance to patents based on inventions in the modern sense. In addition, the 1852 Act was intended to make it easier and cheaper to apply for patents,[18] whereas a common complaint concerning patent quality is that patents are easy to obtain and difficult to reject. Finally, it seems that the repeal of the Dutch patent law was associated with the free-trade movement at that time and the challenges to reform patent law to satisfy stakeholders,[19] rather than granting invalid Dutch patents with no examination and the consequent chilling effect on innovation.[20] As a result, while these historical occurrences are of great significance to understanding the controversies of patent law, they do not necessarily shed light on the particular problem of patent quality.

[13] Jaffe and Lerner (2011), p. 95.

[14] Jaffe and Lerner (2011), pp. 78–95.

[15] Jaffe and Lerner (2011), pp. 94–95.

[16] Jaffe and Lerner (2011), p. 79.

[17] MacLeod (1998), pp. 1–2.

[18] Jaffe and Lerner (2011), pp. 82–86.

[19] Machlup and Penrose (1950), p. 5.

[20] Jaffe and Lerner (2011), pp. 86–90.

Based on the observation that a considerable portion of the literature on the patent quality issue originates in the US, it is assumed that US scholars recognized the problem of patent quality earlier than elsewhere.[21] This assumption seems to overlook the fact that a similar issue had already existed in the UK since the 18th century. MacLeod notes that the sheer number of frivolous patented articles advertised in the newspaper was astounding in the late 18th century.[22] Another study indicates that engine patents that were either technically flawed or technically unviable outnumbered those that were "probably viable" during the first half of the 19th century in the UK.[23] Furthermore, a 1929 article in *Nature* argues that a flood of patents with uncertain validity was issued by the UK Patent Office, giving rise to costly litigation and threatening manufacturers.[24] Debates about poor quality patents may therefore have commenced in the UK long ago.

Nevertheless, embarking on the analysis based on US debates remains a plausible starting point. First, the historic literature in the UK tended to be biased by antipathy towards monopolies and centered on condemning the patent system. For example, in 1944, Michael Polanvyi noticed that patents with uncertain validity or dubious technical merit could cause severe problems for industry, but he attributed these problems to the patent system being designed to grant monopolies and proposed an alternative system of public rewards.[25] Second, it seems true that patent quality as a specific concept and a research subject was initiated by US scholars, although the issue itself predated this research agenda. This appears to be confirmed by an attempt to investigate whether the challenge of patent quality is unique to the US patent system or shared by other patent systems.[26] In a study examining the European patent system, Harhoff notes that although the EPO is in a considerably superior position to the USPTO, "many of the developments mimic U.S. trends" and the increasing quantity and diminishing quality of patents are a threat to the European patent system.[27]

Dolin indicates that concerns regarding patent quality thwarting economic progress and technology development date back to the earliest days of the US patent system.[28] Although the Patent Act of 1790, the first patent law in the US, required an examination by three senior government officials, this examination was found to be too troublesome and was replaced by a registration system in the Patent Act of 1793.[29] According to this new Act, a patent could (but not must) be granted upon the completion of ministerial acts by applicants; however, the practice quickly developed into "routinely issuing patents when the ministerial acts had been

[21] Khanna (2019), p. 1.

[22] MacLeod (1998), p. 87.

[23] MacLeod et al. (2003), pp. 551, 554–555.

[24] Nature (1929), p. 715.

[25] Polanvyi (1944), pp. 62, 65, 67, 69, 72.

[26] Harhoff (2006), p. 332.

[27] Harhoff (2006), p. 340.

[28] Dolin (2015), p. 887.

[29] Walterscheid (1997), pp. 533–534.

completed" without examination.[30] Due to this practice, even patents claiming preexisting technologies could be readily granted with a fee and conformity to the ministerial requirements. With the threat of expensive and possibly devastating litigation, those holding obvious invalid patents were able to levy considerable royalties.[31]

Naturally, this arrangement attracted considerable criticism. Even Thomas Jefferson, initially an advocate of the registration system, wrote that "a previous refusal of patent would better guard our citizens against harassment by lawsuits."[32] Moreover, as early as 1809, William Thornton, Superintendent of Patents from 1802 to 1828, wrote, "many of the patents are useless."[33] However, as Thornton was uncertain whether he had the discretion to refuse a patent with improper claims, he could only resort to moral persuasion, publicly advising inventors to assess the novelty of their inventions by reviewing technical publications and reminding purchasers to be cautious of the value, novelty, and potential disputes arising from patents.[34] On some occasions, he even expressed implicit skepticism regarding the validity of granted patents in their certificates.[35] However, Thornton's efforts were a drop in the bucket. The prevalence of questionable patents and their abuse was captured in a patent dispute decision from 1826:

> [The patent system] encourages the flagitious speculations of imposters, and the arrogant pretensions of vain and fraudulent projectors. … Exactions and frauds, in all the forms which rapacity can suggest, are daily imposed and practiced under the pretence of some legal sanction. The most frivolous and useless alterations in articles in common use are denominated improvements, and made pretexts for increasing their prices, while all complaint and remonstrance are effectually resisted by an exhibition of the great seal.[36]

In this decision, the judge held that without due examination, "[t]he security and benefits to which the inventors of valuable improvements are entitled can never be adequate to their merits."[37] Fortunately, just ten years after this complaint, the new Patent Act of 1836 replaced the Patent Act of 1793, introducing a modern examination system.[38] This new Act required the patent office to perform the duty of granting patents following the legal requirements of novelty and utility.[39] The establishment of the patent office marked a watershed in patent quality. Prior to this, the patent quality problem could mainly be attributed to the defects of the patent system, the legal ambiguity in the necessity of examination, and poorly behaved

[30] Walterscheid (1997), p. 535.

[31] Walterscheid (1997), pp. 534–535.

[32] Walterscheid (1997), p. 534.

[33] Walterscheid (1997), p. 535.

[34] Walterscheid (1997), pp. 536–537.

[35] Walterscheid (1997), pp. 536–538.

[36] *Thompson v Haight*, 23 FCas 1040 (CCNY 1826) 1041.

[37] *Thompson v Haight*, 23 FCas 1040 (CCNY 1826) 1042.

[38] Walterscheid (1997), p. 549.

[39] Smith (1890), pp. 44, 47.

patentees. After the Patent Act of 1836 was passed, the focus on the patent quality problem transferred to the patent office, as screening patents according to legal criteria became one of its primary duties. Unfortunately, it was not until more than a century later, in 1961, that the earliest official patent quality initiative in the US was implemented in response to a study demonstrating that half of the appealed litigated patents were nullified.[40]

The expectation that the quality initiative would promote patent quality proved to be overly optimistic. From 1963 to 1970, two attempts to establish a quality control program failed because the process was exceedingly time-consuming.[41] Following these two failed attempts, the first continuous quality review program at the USPTO was inaugurated in 1974.[42] A Quality Review Branch was established in response to "growing public criticism of the quality of issued patents."[43] Hall suggested that the quality problem worsened in 1984 due to a "structural break" in the US between 1983 and 1984, characterized by a remarkable increase in the annual growth rate of patent applications.[44] Such a structural break also occurred in the EU and other countries.[45] Hall et al. contend that this rise in the US is partly due to the administrative, judicial, and legislative changes initiated in the 1980s that strengthened the economic value of patents and expanded patentable subject matter to include computer software and business methods.[46]

Despite continuing efforts to improve patent quality, including the establishment of the Federal Circuit Court of Appeals[47] and *ex parte* and *inter partes* reexamination,[48] complaints became commonplace in the 1990s. In 1990, the Quality Review Branch of the USPTO filed an official report regarding the underuse of the quality review program aiming to monitor and evaluate the examination quality by conducting monthly reviews of a sample of approved patents and, in 1997, another official report was filed declaring that a decrease in reviewers and sampling levels impaired the effectiveness of the program.[49] US scholars of the time warned of a "quality crisis" due to the rising number of patents with questionable quality.[50] One reason for this crisis is held to be that an increased grant rate results in a higher number of patents with questionable novelty and inventiveness in addition to overly broad claims.[51] These ill-issued patents are held responsible for various social costs.

[40] Corcoran (1999), p. 5.

[41] Corcoran (1999), p. 5.

[42] Corcoran (1999), p. 6.

[43] Lehman and Ross (1997), p. 2.

[44] Hall (2005), p. 38.

[45] Hall (2005), p. 38.

[46] Hall et al. (2004), p. 115.

[47] Logan (2006), p. 988.

[48] Kushan (2012), p. 386

[49] Lehman and Ross (1997), pp. 2–4.

[50] Guerrini (2014), p. 3093; Cotropia and Quillen (2001), p. 13.

[51] Kesan and Gallo (2006), pp. 63–68.

In 2003, the US Federal Trade Commission (FTC) held a hearing with panelists from different fields to investigate the negative effects of and possible solutions to questionable patents.[52] The report from this hearing concludes that while a balance between competition and patent policy is necessary for them to operate together to promote innovation, poor patent quality is anti-competitive and detrimental to innovation.[53] The report recommends reforms to increase patent quality; for example, by allowing third parties to participate in patent reexamination, lowering the evidence requirement for invalidation, raising the standard of inventiveness, and limiting the scope of the patentable subject matter.[54]

The FTC report immediately received worldwide attention, which may once again indicate that patent quality has been a common issue in different jurisdictions for a long time. In response to this report, the EPO, the Japan Patent Office (JPO), and the USPTO all took action to address this issue.[55] In 2004, the JPO and USPTO adjusted their fee structures to encourage higher patent quality and/or reduce the number of claims. These adjustments included significantly increasing claims fees and lowering renewal fees. The EPO followed suit by introducing excess claims fees in 2008 and raising the standard for the scope of protected subject matter in 2010.[56] From 2012 to 2017, the EPO, the US Government Accountability Office (GAO), and the World Intellectual Property Organization (WIPO) all held conferences on patent quality trying to determine how to define it, measure it, and improve it.[57]

Although this brief historical review predominantly focuses on the US approach to engaging with the problem of patent quality, other jurisdictions have experienced the same problem. Nevertheless, this emphasis on the US offers an opportunity to focus on the evolution of the patent quality issue. Otherwise, such debates tend to intersect with justifications for a patent system or calls for patent reform which implicate several other aspects of the patent system. This does not mean that the quality problem is any less complicated in the US. On the contrary, some crucial issues can be discerned, including the abuse of patent rights, the legal criteria for granting patents, the expansion of patentable subject matter, and the role of examination. All of these concerns have normative implications; however, this historical survey offers a brief synthesis of the development of the patent quality problem. It provides a starting point for understanding the problem.

3 Kaleidoscopic Definitions

At first glance, patent quality seems to primarily be related to legal validity; however, as Higham et al. note, "[p]atent quality is a complex, multidimensional

[52] Federal Trade Commission (2003).

[53] Federal Trade Commission (2003), pp. 1–3.

[54] Federal Trade Commission (2003), pp. 7–18.

[55] Harhoff (2016), p. 193.

[56] Harhoff (2016), p. 194.

[57] EPO Economic and Scientific Advisory Board (2012); US Government Accountability Office (2016), p. 59; WIPO Standing Committee on the Law of Patents (2017).

concept, and policies looking to improve patent quality must consider this complexity."[58] This lack of a common definition is attributable to ongoing academic, bureaucratic, and stakeholder disagreements. As Mann and Underweiser correctly note, "different groups of scholars have used the term to examine distinct concepts relevant to their own interests."[59] This observation accentuates an oversimplification, alleging that legal scholars tend to define quality based on the ability of a patent to withstand invalidation in court.[60]

In the late 1990s and early 2000s, scholars began to use the terms "bad patent" or "silly patent" without a clear definition.[61] Merges provides an intuitively helpful but analytically imprecise definition, as "a patent that should have been weeded out after a reasonable investment of effort, but was not,"[62] which seems to suggest patent quality means legal validity. Burk and Lemley only offer some examples, such as so-called silly patents for seemingly frivolous inventions, patents with confusing claims, and patents claiming a disproportionate scope of protection.[63]

Other scholars disagree with the concept of bad patents. Kesan argues that compared with bad patents, "improvidently granted patents" with overly broad scopes are a real problem.[64] This is because the social costs of the former are hard to "meaningfully quantify," whereas the social costs of the latter can be better understood.[65] Similarly, Bessen and Meurer contend that most examples of silly patents are anecdotes, attributing the quality problem to the patent system's deficiency in defining clear boundaries, since problematic patents are "vaguely worded, overly abstract, of uncertain scope, or that contain strategically hidden claims."[66] In addition to the uncertainty in the scope, Hall and Harhoff regard the uncertainty of legal validity as a factor of patent quality.[67] Regarding the relationship between the patent system and individual patents, Scellato et al. also broadly assert that "the perceived quality of a patent cannot be separated from the characteristics of the overall patent system in which it operates."[68]

In an attempt at clarification, some scholars try to disentangle the different related concepts. Hall and Harhoff argue that patent quality is subject to the standard for evaluating patents established by legislation, the courts and the patent examination process in the patent office.[69] Drahos emphasizes the difference between patent quality and the quality of invention,[70] noting that patent quality

[58] Higham et al. (2021), p. 104230.

[59] Mann and Underweiser (2012), p. 2.

[60] Squicciarini et al. (2013), p. 7.

[61] Merges (1999), p. 581; Barton (2000), p. 1934; Lemley (2001); Burk and Lemley (2009), p. 3.

[62] Merges (1999), p. 581.

[63] Burk and Lemley (2009), pp. 3, 5.

[64] Kesan (2002), p. 768.

[65] Kesan (2002), pp. 766–768.

[66] Bessen and Meurer (2009), pp. 3, 19, 46–47.

[67] Hall and Harhoff (2004), p. 991.

[68] Scellato et al. (2011), p. 20.

[69] Hall and Harhoff (2004), pp. 991–992.

[70] Drahos (2010), p. 69.

relies on the extent to which a patent office applies standards of patentability, while the quality of invention should be determined by the market and practitioners in the relevant industry.[71] This suggests that the quality of invention relevant to patent value should not be confused with patent quality, an argument that is supported by a finding that reveals "one-third of patents which survived an opposition were never cited and one-fifth of the most cited applications have never been granted."[72] Citations received by later patents signify patent value as an indicator of technological importance,[73] and surviving opposition indicates sound patent quality in terms of legal validity. Wagner echoes these claims, arguing that the value of a patent should be explicitly differentiated from its quality, as patent value is not a legal concern under patent law, although the author admits that these two concepts are strongly interconnected in reality.[74] He defines patent quality as "the capacity of a granted patent to meet (or exceed) the statutory standards of patentability."[75]

Mann and Underweiser deem patent quality to be legal validity, excluding monetary value, social impact, and overly broad scope from the definition. To better identify specific indicators for empirical research, the authors posit that legal validity is a function of three independent inputs: the invention, applicant effort, and examiner effort.[76] Nevertheless, other scholars hold contrasting views concerning how to assign the responsibility of input to specific parties. Abrams and Wagner narrow down the input to "the effort (resources) dedicated to the patent by the applicant."[77] In contrast, Love et al. and Drahos assert that it is the patent office's duty to control quality; however, they further disagree regarding which specific stage of proceedings is responsible. Drahos argues that the input is "the correct application of the standards of patentability by a patent office,"[78] and thus quality control should be undertaken during pre-grant proceedings. Conversely, Love et al. consider patent quality to be "the likelihood that a patent will survive a post-grant challenge to its validity."[79]

Despite the efforts to narrow down the concept, the boundaries of patent quality have therefore been continuously expanded. It is argued that confining the understanding to statutory requirements of validity risks oversimplifying the framework of the patent system and understating the systematic effect of the quality issue.[80] Given this risk, many scholars find it reasonable to take economic factors into account. Some scholars are moderate. Allison and Tiller argue that patent quality and patent value are intertwined.[81] Logan indicates that legal validity,

[71] Drahos (2010), p. 69.

[72] van Zeebroeck (2011), p. 49.

[73] van Zeebroeck (2011), p. 39.

[74] Wagner (2009), p. 2138.

[75] Wagner (2009), p. 2138.

[76] Mann and Underweiser (2012), pp. 3–4.

[77] Abrams and Wagner (2013), p. 551.

[78] Drahos (2010), p. 70.

[79] Love et al. (2019), p. 80.

[80] Scellato et al. (2011), p. 8.

[81] Allison and Tiller (2003), pp. 997–998.

economic efficiency, and certainty in breadth should be the criteria for quality evaluation.[82] Other scholars are more radical. Guellec and van Pottelsberghe give greater significance to the economic factor, arguing that a patent providing legal certainty and technical quality could still be of low quality from the perspective of economics if it fails to promote innovation or knowledge dissemination.[83] Some scholars detach patent quality from legal criteria. According to Thambisetty, patent quality means "both the technological significance of the invention and its commercial importance."[84] Some economists equate patent quality with the private value of patents.[85] For example, Schankerman and Pakes treat patent quality as the average private value of patents in terms of monetary returns.[86] Guerrini presents the possibility of evaluating patent quality "without regard to the existing standards of patentability," asserting that the legal patentability standard must be calibrated to "reflect good patent quality in the first place."[87]

Considering these vastly different perspectives, it is difficult to define patent quality solely in terms of legal validity. Van Overwalle and Schovsbo note that a report requested by the Scientific Technology Options Assessment of the European Parliament asserts that the definition should cover both the quality of individual patents and the quality of the "patent system as such," as an institution designed for encouraging innovation.[88] Kica indicates that high quality patents should "meet patentability requirements, contribute to the state of the art, offer scientific/social benefit, and stand up to the most rigorous challenges in court."[89] Chien contends that two concepts underpin patent quality. The first is issuing patents that are strictly in conformity with legal criteria, and the second is to warrant that the granted patents are beneficial to the whole society.[90] The former notion stresses that patent quality refers to legal validity, referring to how well a patent meets the standards of patentability; more specifically, "novel, nonobvious, and clearly and sufficiently described."[91] The latter uses various indicators to evaluate different factors of patent quality, including patents' technological, economic, social, or private value.[92] Legal validity is the indispensable core of this discourse, but a wide range of considerations must also be considered. Moreover, Kica and Chien's argument suggests that patent quality has a normative power that prioritizes certain values and obligates specific behaviors.

[82] Logan (2006), pp. 980–981.

[83] Guellec and van Pottelsberghe de la Potterie (2007), p. 115.

[84] Thambisetty (2007), p. 710.

[85] Allison and Tiller (2003), p. 998.

[86] Schankerman and Pakes (1986), p. 1052.

[87] Guerrini (2014), pp. 3137–3138.

[88] Overwalle and Schovsbo (2007), pp. 835.

[89] Kica (2011), p. 208.

[90] Chien (2018), p. 76.

[91] Wagner (2009), p. 2138.

[92] Allison and Tiller (2003), p. 997; Thambisetty (2007), pp. 709–710; Squicciarini et al. (2013), p. 7; Guerrini (2014).

This divergence in definitions is well recognized by patent offices. A 2012 EPO workshop concludes that "there is no definitive definition of patent quality," and such a concept should be distinguished from "two related concepts: the quality of the patent system and the value of a patent."[93] A 2017 WIPO report reveals more perspectives from national patent offices (NPOs) worldwide.[94] The major understanding focuses on "the quality of a patent itself" and the "quality of a patent granting process within that office."[95] However, several other factors are mentioned, such as the administrative and legal procedures to challenge patents, "the extent of technological innovation," "the drafting of patent documents," "the utilisation of patents," the balance between patentees' rights and the public domain, economic benefits, and even national development policy.[96] This diversity supports the observation that "different groups approach the issue of patent quality very differently, and with different goals in mind."[97] Drahos further asserts that companies and industries leverage NPOs to push self-serving agendas in the patent quality debates.[98]

Both the EPO and WIPO reports indicate that stakeholders' perspectives must be considered.[99] A patent holder may understand patent quality as robust in terms of "enforcement, litigation, and commercialization"; applicants may favor patents with the minimum technical information fulfilling legal requirements and the widest scope; and the beneficiaries of technology transfer crave patents that reveal all technological details.[100] In addition, patent attorneys and engineers tend to evaluate patents based on the language clarity or coverage of the major invention; and economists are inclined to examine whether a patent meets the essential goals of the patent system, which is to remunerate and incentivize innovation while disseminating technological advancement.[101]

In addition to these stakeholders, the public is a crucial factor, as the goal of the patent system is to benefit the public by promoting innovation.[102] The public comprises both neutral parties with no risk of infringement and competitors endeavoring to either "practice the patented invention" or avoid infringement.[103] Such stakeholders consider patent quality as an appropriate proportionality between the contribution of the invention and patent rights,[104] which is safeguarded by a

[93] EPO Economic and Scientific Advisory Board (2012), p. 16.

[94] WIPO Standing Committee on the Law of Patents (2017), p. 2.

[95] WIPO Standing Committee on the Law of Patents (2017), pp. 1–2.

[96] WIPO Standing Committee on the Law of Patents (2017), pp. 2–7.

[97] Scientific Technology Options Assessment and European Parliament (2007), p. 27.

[98] Drahos (2010), p. 77.

[99] WIPO Standing Committee on the Law of Patents (2017), p. 6; EPO Economic and Scientific Advisory Board (2012), p. 16.

[100] WIPO Standing Committee on the Law of Patents (2017), p. 6.

[101] Squicciarini et al. (2013), p. 7.

[102] Guerrini (2014), p. 3123.

[103] Guerrini (2014), p. 3123.

[104] WIPO Standing Committee on the Law of Patents (2017), p. 2.

balanced patent system and an efficient judicial system to ensure that exclusive rights limiting access to innovations are beneficial in terms of social welfare.[105]

The only overriding consensus regarding the patent quality concept is that no consensus has yet been reached on the seemingly straightforward definition of patent quality. Exploring this concept is like peering through a kaleidoscope, as it encompasses numerous elements including the quality of the patent system *per se*, legal validity, the scope of claims, applicant efforts, examination and litigation processes, technological significance, private value, and social value. Even those who attempt to confine the definition to a particular element can have considerable disagreements regarding the specifics.

Each element implies certain normative expectations and assessments of patent systems. Different stakeholders have individual perspectives regarding these normative expectations and assessments. Inventors could be disappointed in terms of the robustness of patent protection. Scholars might be dissatisfied with the flaws of the patent system. Policymakers could intend to promote technology development and fair competition. Competitors might be frustrated by patent barriers. The public could be disquieted by the balance between exclusive rights and social welfare. Patent examiners might be exhausted by the heavy workload and embittered by the manner of document drafting. Judges could detest the fluidity of legal standards. It seems that when these diverse normative expectations and assessments are not met, widespread and compelling discontent with patent quality emerges.

4 Flawed Measurements

Given the complexity and ambiguity of the definition of patent quality, an empirical approach to evaluating patent quality offering more clarity seems appealing. In addition, scholars criticized the arguments regarding decreasing patent quality for lack of empirical evidence as early as 2004.[106] It is also claimed that measuring the quality of patents offers a factual basis for understanding the current status of patent quality and assessing the necessity of improvement.[107] However, measuring patent quality encounters the fundamental difficulty of validity, meaning the extent to which a measurement can "adequately reflect the concept the researcher seeks to measure."[108] This problem is both conceptual and practical.

Conceptual validity is closely related to how patent quality is defined. As indicated previously, the definition of patent quality lacks clarity and consistency, involving numerous different and even contradictory elements. The GAO correctly asserts that this ambiguity leads to the absence of "fully developed measurable goals and performance indicators" and lacks the capability to "fully measure and capture key performance data on whether the agency is meeting its strategic goal to

[105] Guerrini (2014), pp. 3123–3126.

[106] Merrill et al. (2004), p. 48.

[107] Squicciarini et al. (2013), p. 7.

[108] Adcock and Collier (2001), p. 529.

optimize patent quality."[109] The absence of common measures results in disregarding potentially relevant factors, such as time allocation and monetary incentives for examiners, data on Patent Trial and Appeal Board decisions, and the influence of other policies and procedures.[110] Therefore, without a coherent and clear definition, measuring patent quality is akin to the parable of the blind men and the elephant, where consensus cannot be reached and accumulated information based on different perspectives misses the point.

For example, in a 2013 study, although the authors are fully aware that patent quality has "a wide array of meanings," and some indicators actually refer to private or social value, they still propose and test 13 quality indicators without investigating the consistency between these indicators.[111] Another instance is found in a systematic review of the empirical research on patent quality,[112] noting that multiple previous studies do not evaluate patent quality based on legal validity but on two other factors of patents' economic value and the efficacy of the patent system in promoting economic development and technology diffusion.[113] Neither of these two approaches considers other elements, such as legal validity. Legal validity might not be the only measure of patent quality but approaches that do not include it are contentious. Although such approaches might provide valuable insights, their conceptual validity is dubious.

Practical validity refers to how effectively the indicators employed in empirical research represent patent quality. There are three concerns. First, many indicators for quality evaluation are initially used for value or technology evaluation. For example, among the 13 indicators of patent quality mentioned above, seven are identified based on patent value, and four on technological importance.[114] In particular, forward citations, patent family size, and patent renewal are common indicators of patent value.[115] Mann and Underweiser stipulate that these value indicators only offer limited insight into patent quality due to their tenuous association with legal validity.[116]

The second concern refers to the heterogeneity between different indicators and approaches. Higham et al. conduct an interesting study to examine "the empirical relationships among and between *ex-post* metrics and *ex-ante* characteristics" to determine the consistency of different interpretations of patent quality.[117] The results for the *ex-post* metrics examined generally contradict one another. Similarly, a striking inconsistency is also observed in the *ex-ante* characteristics of patents. Furthermore, heterogeneity not only exists between the information offered by

[109] US Government Accountability Office (2016), p. 37.

[110] US Government Accountability Office (2016), p. 37.

[111] Squicciarini et al. (2013), p. 7.

[112] Mann and Underweiser (2012), p. 3.

[113] Mann and Underweiser (2012), p. 3.

[114] Squicciarini et al. (2013), p. 7.

[115] Svensson (2021), pp. 1718–1719.

[116] Mann and Underweiser (2012), pp. 3–4.

[117] Higham et al. (2021), p. 104216.

different indicators but also between different technology groupings.[118] Therefore, this heterogeneity makes producing valid empirical results regarding patent quality much more complicated.

The final concern is that the selection effect impairs the validity of indicators. The selection effect suggests that patents that are litigated or opposed are not selected randomly, but share certain features; thus, the data collected from them could contain systemic errors. Furthermore, pre-litigation settlements may introduce selection bias by interrupting the initiation of litigation, thereby obstructing causal inferences about the screening effect of litigation.[119] This concern finds support in four studies. First, Merrill et al. reveal that three indicators directly measuring US patent quality illustrate hybrid outcomes,[120] which include the ratio of invalidation in infringement lawsuits, the error rate of USPTO quality assurance reviews, and claim amendment or patent revocation rates in reexamination proceedings. The authors attribute this inconsistency to the selection effect.[121] Moreover, Scellato et al. contend that the selection effect could be a caveat when analyzing EPO data. As litigated or opposed patents constitute a small portion of all patents, the analysis results are not generalizable to the average patent. They also indicate that litigated or opposed patents might not be examined in the same pattern of examination proceedings.[122]

In addition, a 2019 study investigates patent quality using twin patent applications filed to different NPOs but which received different examination results.[123] This study collects and compares the examination data of 1,064,513 patent applications associated with 408,133 inventions filed in at least two of the IP5 Offices between 2000 and 2006.[124] The result of this research based on examination data significantly differs from studies based on litigation or opposition data. One of the possible reasons for this variance is the selection effect, with the remaining potential causes being the difference in patentability standards between examination and litigation, and the difference between adversarial litigation and non-adversarial examination proceedings.[125]

The final study directly examines the selection effect in patent validity and infringement litigation.[126] In this research, Marco draws on the earlier research of Priest and Klein, arguing that the selection effect should be considered when extrapolating statistical data gathered from litigated disputes to the entire population of disputes or potential disputes.[127] The author establishes a Priest–Klein model to

[118] Higham et al. (2021), p. 104226.

[119] Frakes and Wasserman (2019a), p. 10.

[120] Merrill et al. (2004), p. 48.

[121] Merrill et al. (2004), p. 49.

[122] Scellato et al. (2011), p. 62.

[123] de Rassenfosse et al. (2019), p. 1.

[124] de Rassenfosse et al. (2019), p. 1 (the IP5 offices include the USPTO, the EPO, the JPO, the KIPO, and the CNIPA).

[125] de Rassenfosse et al. (2019), p. 18.

[126] Marco (2004), p. 547.

[127] Marco (2004), p. 548.

test the impact of the selection effect on win rates based on a data set of more than 400,000 patents issued between 1965 and 1995, wherein 361 patents were adjudicated for validity or infringement.[128] The test result reveals a substantial selection bias for validity decisions.[129] This research verifies concerns that selection bias can jeopardize the soundness of validity indicators. These three concerns undercut the credibility of the outcomes of patent quality measurements.

The investigation of patent quality measurements highlights the problem of validity between the analytical target (patent quality) and the evidence to support an assessment of it, both conceptually and practically. A lack of conceptual validity due to the lack of a proper definition results in the absence of sophisticated measurable goals and indicators to comprehensively assess patent quality. Practical validity is constrained by a lack of validated indicators, heterogeneity between different indicators and approaches, and the selection effect. Given these difficulties, the current state of measurement is unlikely to meaningfully characterize patent quality.

5 Problematic Proposals

Despite the difficulties in defining and measuring patent quality, the normative nature of this concept drives an agenda for improvement. As a result, in contrast to the diverse definitions and measurements, various proposals are presented to both the EPO and USPTO, most of which are more pragmatic and narrowly focused on legal validity and relevant proceedings. This is understandable because patent issuance and revocation rely on administrative and legal proceedings implementing statutory requirements for legal validity. Ostensibly, the regulation of these proceedings and legal validity seems to be the most accessible and practical approach to improving patent quality. This part delves into unimplemented proposals aimed at regulating examination proceedings, while the subsequent part investigates implemented reforms regarding pre-grant and post-grant proceedings. These two parts together suggest that the concept of patent quality should not be simply reduced to legal validity.

Various proposals have been addressed to both the EPO and USPTO, such as raising the bar for what constitutes nonobviousness, abolishing the examination of the inventive step, introducing third-party review and search, motivating examiners, and penalizing poor-quality patents.[130] Although these proposals are to some extent reasonable, they all have certain weaknesses. For instance, raising the inventive step criterion sounds intuitively plausible, but Sir Robin Jacob argues that this risks sabotaging the incentive for research by excluding improvements that are novel and nonobvious but incremental.[131] On the other hand, the abolition of the inventive step would exacerbate rather than solve the problem, given that utility models with a

[128] Marco (2004), pp. 548, 560–561.

[129] Marco (2004), p. 589.

[130] Hilty (2009), pp. 8–30; Wagner (2009), pp. 2158–2161.

[131] Jacob (2005), p. 304.

low inventiveness requirement and design patents with no inventiveness requirement in China are alleged to generally be of low quality.[132] Furthermore, outsourcing a portion of the burden of substantive examination could introduce more uncertainty into the process, as the quality of third-party services is even more difficult to monitor and control. Encouraging examiners to invest more effort in examination faces the double challenges of resource constraints and patent explosion, and imposing penalties on applicants for filing questionable patents could deter inventors by making the prospect of patenting uncertain.

Amongst the range of suggestions, two types of proposals seem to be the most relevant. The first is optimizing resource allocation, and the second is imitating the post-grant opposition system of the EPO. Both touch on the most practical issues. Resource constraints might be a problem that any proposal has to face in pre-grant proceedings. The opposition system is widely regarded as a panacea. Since post-grant opposition was introduced in the US by the Leahy–Smith America Invents Act of 2011,[133] this part focuses on proposals for optimizing resource allocation. The post-grant opposition proceedings will be discussed in the next part.

Merges first introduced the idea of optimizing resource allocation in 1999, questioning the presumption that low-quality patents in terms of legal validity should be completely weeded out.[134] The author argues that although the social costs of having a large volume of invalid patents are undesirable, it is neither realistic nor consistent with patent law to completely eliminate all invalid patents. The incongruity lies in the steep diminishing-return curve, which causes the examination effort to consume more but contribute little beyond a certain point.[135] The legal inconsistency stems from the legal design of the independent court for reviewing validity with a "presumption of validity" rather than a "conclusive presumption."[136] The presumption of validity means that courts bear the obligation to respect the patent office's decisions regarding the patent validity, unless there is "clear and convincing" evidence to the contrary,[137] while a conclusive presumption indicates that the patent office's decision is final.[138] Since courts can revisit validity, i.e. question the conclusion of the examiner, it does not make rational sense to aim for infallible examination in the first place.

Given the unreality and legal inconsistency of perfect examination, Merges advocates a rational estimation of the examination budget.[139] This suggests introducing the EPO's post-grant opposition system and optimizing resource allocation. In the same vein, Lemley provides two controversial proposals of rational ignorance and gold-plated patents,[140] both of which are discussed below.

[132] Prud'homme (2012), pp. 20–21.

[133] Dolin (2015), pp. 886–887.

[134] Merges (1999), p. 593.

[135] Merges (1999), p. 605.

[136] Merges (1999), p. 593.

[137] Lichtman and Lemley (2007), p. 47.

[138] Lemley (2001), p. 593.

[139] Merges (1999), p. 598.

[140] Lemley (2001); Lichtman and Lemley (2007).

5.1 Rational Ignorance

Rational ignorance indicates that allowing the patent office to issue invalid patents is reasonable and desirable because doing so is cost-effective.[141] This cost–benefit analysis has three foundations. The first is the fact that only about 1.5% of patents are litigated.[142] The second is an assertion that the social costs of unchallenged invalid patents are exaggerated, while the private benefits of eliminating them are trivial.[143] The third is a rough calculation of the diminishing returns indicating that the cost of doubling the time of domestic patent examination is about three times more than the related benefits.[144] Consequently, it is cost-effective to be rationally ignorant during the examination and leave the stringent validity determination of a few invalid patents to the courts.[145] In other words, Lemley seems to argue that even if most un-litigated patents are invalid, it costs the whole society little to allow them but a lot to weed them out.

This proposal has many theoretical and empirical challenges; however, the theoretical criticisms themselves are also problematic. Heald's objection is correct in that rational ignorance would reduce the patent validity rate, but it is also misguiding in suggesting that the patenting rate would consequently be reduced.[146] His argument is based on a correlation between the increased propensity for patents in the US semiconductor industry and a higher patent validity rate in courts during the 1980s.[147] However, this correlation only addresses part of the picture. Patent propensity persistently grows over a longer period, regardless of transitions between strong and weak patent regimes.[148]

Another criticism is that rational ignorance violates the legal duty of validity examination.[149] Instead, Duffy advocates "rational sloth," delaying examination to make the validity results of some patents inessential because their economic worthlessness will be revealed over time.[150] However, Duffy ignores the fact that prolonged pendency impedes patent quality by compelling examiners to rush into hasty decisions, and impedes innovation by creating legal uncertainty regarding the scope of claims and financial uncertainty regarding the investment in innovation.[151] In addition, applicants have been found to deliberately extend the pendency by filing poorly drafted patents with unclear and overly broad claims.[152] Therefore, rational

[141] Lemley (2001), pp. 1497, 1531–1532.

[142] Lemley (2001), p. 1507.

[143] Lemley (2001), pp. 1514–1523.

[144] Lemley (2001), pp. 1499, 1509.

[145] Lemley (2001), pp. 1531–1532.

[146] Heald (2006), p. 459.

[147] Hall and Ziedonis (2000), pp. 102, 125.

[148] Lemley (2016), pp. 14–18.

[149] Duffy (2019), pp. 2354–2355.

[150] Duffy (2019), p. 2365.

[151] Mabey (2010), pp. 242–244.

[152] de Rassenfosse and Zaby (2016), p. 4.

sloth ostensibly complies with the legal duty but completely discounts the purpose of patent law and applicants' motives.

A further criticism is from Ghosh and Kesan, correctly noting that Lemley overlooks the social benefits of valid patents and the social costs of invalid patents, which are multipronged[153] and not as easy to ignore as Lemley claims. As an alternative, the authors propose "optimal ignorance," which means "a patent agent acquires as much information as is necessary to ensure that socially desirable patents are granted."[154] However, this alternative is self-contradictory and possibly even more controversial than rational ignorance. On the one hand, it admits that the USPTO faces physical constraints in time and costs as well as mental constraints such as bounded rationality.[155] On the other hand, it establishes the almost insurmountable task of ensuring that issued patents have a net positive social benefit,[156] without providing a clear test for evaluating the benefit of an individual patent to the whole society. Neither analyses nor data are provided to suggest that the intensive examination required by optimal ignorance can be achieved with limited resources. It seems that the acknowledgement of resource constraints does not preclude the authors from proposing a more resource-consuming solution.

In addition to these theoretical criticisms, some empirical studies appear to challenge Lemley. One study directly tests rational ignorance by comparing the search intensity for US patents and the examination results of counterpart applications in the EPO.[157] The study reveals that US examiners actually devote more effort to searching the prior art of weak patents when counterpart applications are more likely to be rejected by the EPO.[158] Although it remains unclear why some weak patents that received more search effort were still granted by the USPTO, this study suggests that the US examiners are not as ignorant as asserted by Lemley.

Two other studies challenge Lemley's cost–benefit analysis. The first investigates the phenomenon that most patent litigations do not offer conclusive validity but end up in settlement, and "far more patents are licensed without litigation."[159] The study finds that weak patents can charge surprisingly high royalties if they cover the necessary technology for downstream rivals.[160] This research illustrates that patents with questionable validity are not less harmful and useful, as Lemley suggests, but instead have high and undesirable social costs.[161]

The second study by Frakes and Wasserman draws on data that were not available to Lemley, arguing that Lemley over-emphasizes the costs related to increased patent examination time and downplays the savings from the increase in

[153] Ghosh and Kesan (2004), p. 1227.

[154] Ghosh and Kesan (2004), p. 1243.

[155] Ghosh and Kesan (2004), pp. 1248–1249.

[156] Ghosh and Kesan (2004), p. 1249.

[157] Lei and Wright (2017), p. 44.

[158] Lei and Wright (2017), p. 44.

[159] Farrell and Shapiro (2008), pp. 1347–1348.

[160] Farrell and Shapiro (2008), p. 1361.

[161] Farrell and Shapiro (2008), p. 1362.

patent review time.[162] Contrary to Lemley's calculation, the results indicate that the benefits of increasing examination time outweigh its costs. However, this study has several notable caveats. As will be demonstrated in the following section regarding reforms, the outcomes of additional examination efforts are frustrating,[163] and it seems that more examination efforts do not necessarily produce a proportionally beneficial outcome. In other words, Frakes and Wasserman's estimation of the benefits and costs based on extending examination time must be considered with caution. In addition, as Wagner notes, the approach of investing more effort in examination has two weaknesses. First, increasing examination time might render the system unable to catch up with the rising volume of patent applications. Second, it is unlikely to encourage applicants to adopt a lower-volume, higher-quality patenting strategy.[164] Subsequently, it seems that intensive examination could significantly increase examiners' workload while producing a disproportionate effect on the quality of the applications drafted and filed by applicants.

The proposals discussed here attempt to address the restrictions on resources available for patent examination. Regardless of whether the solutions are to defer to, circumvent, or ignore this restriction, they are all problematic. It seems that this approach leads to a dead end. As a corollary, the gold-plated patent proposal to mitigate this constraint by transferring examination costs to applicants is tabled.

5.2 Gold-Plated Patents

Gold-plated patents, also called the two-tier system, seem to be the polar opposite of rational ignorance. The latter suggests maintaining lenient examination in the patent office and leaving the validity inquiry to the courts.[165] In contrast, the two-tier system advocates a more costly and thorough examination and higher credit for this examination in courts for certain patents.[166] Application for gold-plated patents is elected by applicants.[167] Once such patents are issued, they have a stronger presumption of validity and courts should defer to the examiners' decisions and consider new evidence "only if it could first be shown not to be redundant to materials already reviewed."[168]

From the perspective of reducing transaction costs, Heald praises gold-plated patents for allowing applicants to signal more promising applications and the patent office to cost-effectively strengthen the validity of these patents.[169] In contrast, Kieff is opposed to the proposal of gold-plated patents for two reasons. First, it concentrates solely on patent quality, ignoring many other important issues, such as information costs, error costs, and increased uncertainty due to the flexibility and

[162] Frakes and Wasserman (2019b), p. 1022.

[163] *See* the discussion in Sect. 6.1 regarding pre-grant reforms.

[164] Wagner (2009), pp. 2163–2164.

[165] Lemley (2001), pp. 1351–1352.

[166] Lemley et al. (2005), pp. 12–13.

[167] Lemley et al. (2005), pp. 12–13.

[168] Lichtman and Lemley (2007), pp. 61–62.

[169] Heald (2006), p. 459.

discretion of the administrative process. Second, it overlooks the necessity of balancing speed, cost, accuracy, and finality in civil litigation.[170] These arguments focus on the cost–benefit analysis but miss a key point of this proposal, that is, signaling.

It is doubtful that applicants would send such a signal for a considerable fee. As it takes time for patentees to learn the value of their patents, they may not even be able to determine which patents to gold-plate at the outset.[171] More importantly, it seems that applicants would only be motivated to do so in exchange for a more robust validity. They are unlikely to do so if it either endangers applications or does not offer stronger protection. Such negative outcomes appear to be most probable.

First, the gold-plating examination is more likely to reject applications. In the patent office, selected patents must undergo an extremely rigorous examination, for which examiners are not only allowed abundant time but also assistance from external experts. Furthermore, applicants are required to submit all prior art references discovered in a thorough search and to demonstrate that none of these references precludes the patentability of their applications.[172] As rightly indicated by Devlin, such an enhanced examination would result in a considerably higher risk of rejection.[173]

Second, even if patents survive the gold-plating examination, it does not necessarily guarantee stronger protection in the courts. As valuable patents are more likely to be litigated[174] and information asymmetry exists between patentees and competitors regarding patent value,[175] gold-plating exposes valuable patents to potential challengers. Most notably, Lichtman and Lemley themselves indicate a lack of surety regarding whether gold-plating would offer a more solid defense against challenges. The authors draw on data showing that a strengthened presumption of validity increased the validity rate from 35% to 54% in the early 1980s;[176] however, a fifty-fifty chance cannot be considered a reliable assurance. Without consolidated legal validity, gold-plated valuable patents still face fatal scrutiny in court.

Ironically, if gold-plated patents are invalidated by either the patent office or courts, it is the applicants who spend exorbitant fees to invite their own loss. This grim prospect makes gold-plating an unattractive option for applicants. Therefore, this approach is unlikely to achieve the objectives of signaling and improving patent quality. Prohibitive private cost is the soundest reason to reject this two-tier system.

The debates regarding rational ignorance and gold-plated patents highlight a predicament. The hazard of the patent quality problem cannot be ignored and remedial action is required, whereas proposals that aim to improve the legal validity of granted patents encounter many unavoidable practical challenges, especially

[170] Kieff (2009), pp. 1937–1940.

[171] Chien (2018), p. 99.

[172] Lichtman and Lemley (2007), p. 62.

[173] Devlin (2008), p. 342.

[174] Allison et al. (2009), p. 3.

[175] Thambisetty (2007), p. 732.

[176] Lichtman and Lemley (2007), pp. 69–70.

private costs and resource constraints, casting doubt on the soundness of such validity-oriented proposals. Indeed, as will be demonstrated next, the efficacy of the validity-oriented reforms that have been implemented is likewise problematic.

6 Frustrating Reforms

As argued in Sect. 2, the patent office has risen to the forefront of the patent quality problem since the establishment of the examination system. This perspective results in the hypothesis that an ideal patent office would never issue a patent that turned out to be invalid.[177] It is subsequently not surprising that patent offices are widely held responsible for granting low-quality patents. Various policies and reforms have been adopted to strengthen the examination process in patent offices for screening out low-quality patents, most of which address both pre-grant and post-grant proceedings. In the pre-grant proceeding, the patent office determines whether to grant patent rights, whereas this decision can be challenged in the post-grant proceeding. This part investigates the effectiveness of these reforms and finds that these reforms are frustrating, thus suggesting that narrowly focusing on legal validity and relevant proceedings is inadequate.

6.1 Pre-Grant Proceeding Reform

Both the USPTO and the EPO put tremendous effort into improving patent quality in the pre-grant proceeding. The USPTO has instituted an Office of Patent Quality Assurance,[178] implementing a "Second Pair of Eyes" review,[179] a quality assurance program,[180] and the Enhanced Patent Quality Initiative.[181] Similarly, the EPO has been dedicated to improving patent quality since 1977.[182] Numerous projects have been implemented, including the European Quality System, consisting of the European Quality Management System and the Product Quality Standard (PQS); a "Raising the Bar" initiative; collaborations with other NPOs;[183] and adopting the ISO 9001 system for the entire patent granting procedure.[184]

Nevertheless, these measures fall short of the target of weeding out low-quality patents. Concerns about patent quality continue to grow as patent filings and grants continue increasing. The trends of both patent applications and patent grants in the USPTO and EPO continued to rise in 2019.[185] The upward trend in patent applications in the US and EU was momentarily disrupted by the Covid-19

[177] Cohen and Merrill (2003), p. 55.

[178] Chen (2008), p. 37.

[179] Chen (2008), p. 39.

[180] Zinser (2010), p. 1.

[181] Camarota (2016), pp. 76–77.

[182] Scellato et al. (2011), p. 119.

[183] Scellato et al. (2011), pp. 115, 121–122.

[184] Nieto et al. (2015), p. 194.

[185] World Intellectual Property Organization (2020a, b), pp. 27, 30.

pandemic. However, it is noteworthy that the total number of patent applications worldwide in 2021 still managed to slightly surpass the historical record set in 2018.[186] In a 2016 report, almost 75% of the US patent challenges with a final decision from 2012 to early 2016 resulted in all of the opposed claims being ruled unpatentable.[187] To address this troubling issue, Chien advocates that the USPTO should learn from the EPO.[188] However, the EPO also suffers from quality critiques.

EPO patents are increasingly questioned as the "gold standard" of quality.[189] A petition from 924 EPO examiners declares that the "quality of the EPO patents is endangered."[190] This petition references a blog by Thorsten Bausch, a senior patent attorney, questioning this gold-standard label, as approximately 70%–75% of the patents granted by the EPO but challenged in Germany are completely or partially invalidated by the German Federal Court each year. Bausch contends that the EPO's positive rating is whitewashed using unreliable indicators and further claims that "the trend of quality is downwards."[191] This assertion is warranted by a 2018 study illustrating that a remarkably high percentage of patents are potentially invalid in Germany.[192] Considering the tremendous efforts engaged to improve patent quality, these critiques are frustrating.

Reforms to intensify examination efforts are ineffective in at least two ways. First, a more intensive examination should not be equated with higher quality. In recent cross-country research, de Rassenfosse et al. find that stricter examination standards do not mean higher quality.[193] The authors compare the examination data of "twin" applications filed in the five biggest patent offices, which are the USPTO, EPO, JPO, the Korean Intellectual Property Office (KIPO), and the China National Intellectual Property Administration (CNIPA).[194] The results indicate that although the JPO and EPO have the most stringent examination standards, they also have the lowest accuracy rates. In contrast, in the CNIPA, USPTO, and KIPO, which are deemed to have lower examination standards, the number of incorrectly granted patents is much lower than incorrectly refused patents. In contrast, both the JPO and EPO have higher rates of incorrectly granted patents.[195] This finding contradicts the common assumption that a strong positive correlation exists between lenient examination and low patent quality. The authors further conclude, "raising the U.S. standard to the level of the highest country would eliminate some low-quality patents, but perhaps not as many as some commentators believe."[196]

[186] World Intellectual Property Organization (2022), pp. 27, 30.

[187] US Government Accountability Office (2016), p. 12.

[188] Chien (2018), p. 74.

[189] Chien (2018), p. 74.

[190] EPO Central Staff Committee (2018).

[191] Thorsten Bausch (2018).

[192] Henkel and Zischka (2019), p. 197.

[193] de Rassenfosse et al. (2019), p. 5.

[194] de Rassenfosse et al. (2019), pp. 14–16.

[195] de Rassenfosse et al. (2019), p. 14.

[196] de Rassenfosse et al. (2019), p. 19.

Second, intensive examination is caught in a Mobius trap, highlighting the tension between the increased workload due to intensive examination and human resource constraints. Chen argues that the USPTO's enhanced quality review initiative and productivity-promoting count system generated an unexpected rise in the number of continuing applications and *ex parte* appeals.[197] In addition, this combination led to increased examiner attrition due to unpaid overtime.[198] Such trends are held responsible for raising examiners' workload and backlog.[199]

Similar circumstances are also evident in the EPO, although one study finds that the EPO offers a better fee structure in comparison to the USPTO, and is therefore more likely to maintain a rigorous examination and high quality standard.[200] It is argued that the extensive "production pressure" imposed by the EPO's policy prevents at least some examiners from thoroughly examining applications.[201] This is hardly surprising, as patent examination is a labor-intensive endeavor.[202]

The conflict between productivity policy and quality control highlights an inherent Mobius trap for reforms intensifying examination. Strengthened examination requires more effort and time, exacerbating the workload and backlog. This backlog must be managed by the patent office, as it increases economic and legal uncertainty, suppresses innovation, and impedes investment in creative ideas.[203] This need has driven the USPTO and EPO to adopt productivity policies, which are alleged to diminish examination criteria.[204] As a result, patent offices seem to fall into a Mobius trap. In this trap, intensive examination consumes more time and effort, subsequently increasing the workload and backlog. The rise in workload and backlog leads to productivity policies that reduce the time and effort devoted to patent examination. Time constraints are found to result in a higher grant rate and the issuance of lower quality patents.[205] Consequently, the examination reforms are futile. This Mobius trap argument differs from the vicious circle hypothesis mentioned previously. This hypothesis posits a causal relationship between the decline in examination quality or the rise in patent quantity and the decline in patent quality, while the Mobius trap stresses the limitation of the policy for strengthening patent examination.

This trap can be further aggravated by applicants' strategic behavior. In both the US and EU, applicants strategically file massive continuing applications or divisional applications as a countermeasure against more stringent examination.[206] Also, since prolonging pendency duration has several advantages, such as evading a

[197] Chen (2008), pp. 42–43.

[198] Chen (2008), p. 41.

[199] Chen (2008), p. 44.

[200] Picard and van Pottelsberghe de la Potterie (2013), p. 24.

[201] Bausch (2018).

[202] Chen (2008), p. 28.

[203] Mabey (2010), p. 214.

[204] Harhoff (2006), p. 341; US Government Accountability Office (2016), p. 25.

[205] Frakes and Wasserman (2019a), p. 11.

[206] Chen (2008), pp. 42–43; Harhoff (2016), p. 196.

final decision on patentability and increasing the allowance rate,[207] avoiding the restriction of claim breadth at an early stage, and allowing better evaluations of applications' value,[208] applicants are highly motivated to expand examination time by drafting applications in a way that increases examiners' workload.[209] These high-workload applications are more likely to be of low quality due to their broad scope and vague language.[210] These intentionally filed continuing applications, divisional applications, or high-workload applications exacerbate the workload and backlog problem.

It is frustrating to find that the attempts to intensify examination are trapped in a full circle and greater effort in the pre-grant examination only seems to produce limited improvement in patent quality. Naturally, introducing an additional procedure to remedy the flaws in pre-grant proceedings seems reasonable. For the USPTO, this remedy is the post-grant review.

6.2 Post-Grant Proceeding Reform

Prior to the implementation of the USPTO post-grant review mechanism, EPO post-grant opposition was widely held to be the crucial mechanism guaranteeing high patent quality. However, Graham et al. urge caution due to the absence of empirical data.[211] Despite this prudent appeal, three seminal studies conducted by the USPTO, the FTC, and the US National Academy of Sciences in 2003 and 2004 all recommend introducing a third-party opposition similar to the EPO opposition to improve the US patent system.[212] In 2011, the American Invents Act established three new post-grant proceedings, including an *inter partes* review (IPR), a post-grant review, and a covered business method review, aiming to "improve patent quality and limit unnecessary and counter-productive litigation costs."[213]

To evaluate the effects of the adoption of post-grant proceedings, Graham and Harhoff investigate the opposition rates of the EPO equivalents of US patents, comparing EPO equivalents of both litigated and non-litigated US patents between 1976 and 2003.[214] They conclude that the EPO equivalents of litigated US patents are weeded out not because the EU patent system has lower grant rates or less favorable opposition outcomes, but because the EPO opposition procedure is more likely to invalidate these patents. Therefore, this adoption in the US "can achieve substantial net welfare gains" by reducing the social costs of invalid patents.[215]

[207] Cotropia and Quillen (2001), pp. 18–19.

[208] Harhoff (2016), p. 196.

[209] de Rassenfosse and Zaby (2016), pp. 9, 21–22, 29.

[210] de Rassenfosse and Zaby (2016), p. 4.

[211] Graham et al. (2002), p. 23.

[212] Hall and Harhoff (2004), pp. 1000–1002.

[213] Dolin (2015), pp. 886–887.

[214] Graham and Harhoff (2014), p. 1649.

[215] Graham and Harhoff (2014), p. 1650.

However, since minor variations in the design of post-grant proceedings could have a substantial impact on outcomes,[216] adopting an institution that works well in the EU does not necessarily result in similar positive effects in the US. First, even before the implementation of this reform, Logan forewarns that if the new proceedings are not carefully designed, they may be employed to harass the small and independent firms that are crucial to the economy and innovation.[217] Unfortunately, this prophecy seems to have come true. Dolin claims that instead of reducing abuse against patentees, the post-grant proceedings actually increase such maltreatment.[218] These abusive behaviors include rent-seeking, evasion of estoppel and time bars, seriatim attempts at invalidation, and retaliation and pressure.[219] Among these behaviors, a former interim USPTO director admitted that serial challenges are notorious for being used as a harassment tool.[220] Based on data collected in 2018, roughly 30% of the patents challenged through IPR proceedings face more than one petition.[221] As a result, harassed innovators are weighed down with serial petitions and forced to continue investing energy and money in disputes rather than in their enterprises and subsequent innovations.[222] Furthermore, Galasso and Schankerman show that patent invalidation at the US Federal Circuit leads small firms to sharply reduce subsequent patenting or even exit patenting, while big firms are less impacted.[223] While this finding is based on judicial decisions, the similar chilling effect on small firms could also arise from post-grant invalidations.

In addition, although post-grant proceedings are becoming a "favored weapon" of patent practitioners due to rapid resolution, expansive claim construction, and a lower bar for invalidity,[224] the benefits of this weapon seem to be limited. Dolin contends that they not only fail to reduce low-quality patents and high litigation costs but also result in undesirable and exorbitant costs for patentees.[225] Chien further alleges that post-grant reviews, as the main measure of post-grant patent quality control, do not offer adequate improvement because of the expensive fees, restricted grounds or circumstances to initiate the proceeding, and the small proportion of patents subjected to these proceedings.[226] The argument regarding costs aligns with Graham and Harhoff; in particular, although they highly recommend that reforms adopt the EPO post-grant opposition, they caution that low cost is crucial for this reform to result in the desired improvement.[227] Moreover, Harhoff et al. further find that the presence of patent thickets or highly dispersed

[216] Chien et al. (2019), pp. 838–843.

[217] Logan (2006), pp. 994–997.

[218] Dolin (2015), pp. 931–932.

[219] Dolin (2015), p. 932.

[220] Chien et al. (2019), p. 840.

[221] Chien et al. (2019), p. 840.

[222] Dolin (2015), pp. 932–936.

[223] Galasso and Schankerman (2018), p. 84.

[224] Mock (2015), pp. 34–35.

[225] Dolin (2015), pp. 947–948.

[226] Chien (2018), pp. 127–128.

[227] Graham and Harhoff (2014), pp. 1658.

patent ownership significantly reduces the incidence of post-grant opposition at the EPO, especially in the complex technology sectors most affected by the patent quality issue.[228]

Given its undesirable and unsatisfactory outcomes, this reform is criticized for failing to consider benefits and costs scrupulously.[229] Chien further proposes transitioning the focus from a limited number of contested patents to the majority of "patents that are not challenged in court or through an administrative process."[230] Similarly, Harhoff et al. suggest that the under-utilization of post-grant opposition in complex technologies highlights the importance of focusing on examination quality.[231] This implies that improving patent quality relies on the pre-grant proceedings more than post-grant proceedings. After exerting extended and extensive efforts, this suggestion indicating a return to square one can be extremely frustrating.

The investigation regarding reforms in pre- and post-grant proceedings reveals a frustrating prospect. These reforms likely represent the most pragmatic approaches available, yet they are not sufficient enough to achieve the objective of improving the quality of individual patents. In addition to the limited effect, they are even more questionable for being abused as a harassment tool. The most discouraging consideration is that these attempts seem to be stuck in a loop in which all efforts lead back to the starting point. More significantly, the scrutiny of proposals and reforms designed to enhance legal validity demonstrates that reducing patent quality encompassing multifaceted dimensions to solely legal validity is insufficient to achieve the intended objectives. This reiterates the complexity of patent quality, calling for further scrutinization of this very concept.

7 Conclusion

This article highlights that studies concerning patent quality encounter a conceptual predicament. Patent quality is neither new nor irrelevant, but an old and vexing problem of patent law. It evolves with time, as does our understanding of it; however, this richer understanding can muddy the waters. Its complexity and ambiguity hinder the exploration of a comprehensive understanding and effective resolutions from the outset. Despite its potential as a valuable analytical concept, it becomes a rabbit hole into which scholars, as well as law- and policy-makers, are liable to fall. Just like Alice could not explain who she was, patent quality is difficult to define, although it seems to be straightforward. The problem of patent quality distresses most stakeholders, yet no consensus has yet been reached regarding how to define patent quality. Definitions are more likely to be based on stakeholders' various discontents and perspectives, rather than clear and well-defined concepts. In addition, the measurement of patent quality suffers from a lack of validity, like the

[228] Harhoff et al. (2016), p. 719.

[229] Dolin (2015), p. 947.

[230] Chien (2018), p. 128.

[231] Harhoff et al. (2016), p. 719.

Mad Hatter's watch which is unreliable since it is unable to accurately indicate the specific hour of the day and provides an incorrect date. As demonstrated, the indicators used for this measurement can hardly accurately represent patent quality, either in theory or in practice. The underlying ambiguity of definitions and measurements results in diagnoses that are based on observed symptoms rather than a solid grasp of what the disease is. The direct consequences are problematic proposals and ineffective reforms. These proposals highlight that resource constraints strictly curtail the effectiveness of intensive examination through exploding patent applications. This is akin to the scene in which no matter how tall Alice grows, she is stuck in a house and cannot enter the garden. Massive reform endeavors only appear to point back to the starting point, which is not substantially different from the situation faced by the Red Queen, who had to run with all her strength to remain in place.

Thus, the debate regarding patent quality is belied by substantively differing conceptions of patent quality. Any attempts to break the current impasse must begin with an appreciation of the different senses in which patent quality is used and an assessment of the legitimacy of their underlying normative frameworks. It is imperative to thoroughly examine the definitions of patent quality employed in various arguments to produce a map for navigating this conceptual labyrinth. In addition, the legitimacy of normative frameworks underlying different definitions must be assessed prior to suggesting any reforms or remedies. Without clarifying these two points, any reforms or remedies proposed are likely to struggle, fail, or even backfire.

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