Cliometric Approaches to Creativity: Patents, Prizes, Copyrights, and Trademarks

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Abstract

This chapter surveys recent cliometric research on technological and cultural creativity in Europe and the United States between 1750 and 1930. Empirical analyses of patents, prizes, copyrights, and trademarks have added to our knowledge of the nature and sources of inventive activity and cultural innovation and their impact on economic growth. Far more attention has been directed toward patents and the economic history of technological change, resulting in more conclusive findings. In the United States, property rights in patented inventions facilitated markets in ideas and ensured that returns were aligned with productivity and market demand. European growth models assumed useful knowledge was scarce and limited to special groups, so an array of administered rights and rewards were directed to elites and "great inventions." Nonmarket-oriented incentives such as innovation prizes typically failed as inducements for inventive activity and were associated with rent-seeking and governance problems. An increasing number of studies examine copyrights and trademarks, but their general conclusions are less evident, suggesting a need for more empirical

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attention to cultural markets. This extensive body of research underlines that quantitative analysis is only as good as the underlying data, that credible conclusions require close attention to variation in institutional details, and that excellence in cliometrics requires both good economics and good history.

Keywords

Patents · Prizes · Copyrights · Trademarks · Intellectual property · Technological innovation

Introduction: Cliometrics and Creativity

Cliometric approaches to creativity have added significantly to the stock of economic knowledge about technology and culture. For, although few would dispute that new ideas and innovations in expression are central to economic growth and social welfare, there remains a marked "neglect of creativity by economists" (Demsetz 2009). By contrast, cliometricians have shed light on the nature, sources, and consequences of creativity and provided microeconomic foundations for endogenous growth models (Romer 1993; Khan 2020a). Rather than trying to specify what creativity *is*, economic historians have usefully analyzed what creativity *does*, and thus helped to identify the systematic factors that shape advances in technology and culture at both the individual and aggregate levels. By taking advantage of variation in institutional and noninstitutional factors, cliometrics has helped to identify the role of specific incentives and mechanisms that influence the rate and direction of inventive activity, innovation, and overall human ingenuity (Engerman and Sokoloff 2005).

At the same time, a number of influential economic historians assume that creative ideas are inelastic in supply, or even the result of exogenous serendipity and luck. They propose that advances in productivity depend on the appearance of unique irreplaceable geniuses, "upper tail knowledge," and the contributions of a small minority of the population endowed with exceptional human capital. Galenson (2010) asserts, as if it were self-evident, that creativity "is largely the domain of extraordinary individuals or small groups." Similarly, according to Mokyr (2011), the modern knowledge economy emerged from an era of "industrial enlightenment" in Europe, which constituted a prerequisite for modern economic growth. Adherents of neoclassical growth models propose that economic progress depends on the ideas of great men ("cultural entrepreneurs") and great inventions ("macroinventions" or "general purpose technologies"), inspired by a small select group of (almost exclusively white and male) intellectuals and specialists (Mokyr 1990; Helpman 1998). If genius and useful knowledge were indeed exogenous, a *machina ex deo*, this would imply that inventive activity could not be induced, only recognized and rewarded by highly qualified panels of peers.

Creativity can be evaluated across many dimensions, encompassing individuals, firms, and other institutions, and at the aggregate level of societies. According to

Khan (2020a), the economic analysis of creative ideas and expression is best understood by means of a comparative institutional approach organized along a spectrum, with decentralized markets at one end and "administered innovation systems" at the other. Administered systems consist of arrangements where decisions about economic values, rewards, and the allocation of resources are made by the state, administrators, or select panels. European policies at the state and private levels featured top-down administered innovation systems that offered rewards for the favored few (Khan 2021). These institutions comprised monopsonies, in which a single buyer deals with numerous potential applicants; an arrangement which risks a misallocation of resources, including rent seeking and the potential for unfair discrimination. By contrast, American institutions regarded creativity as widely distributed in the general population and promoted market-oriented incentives, along with broad-based access to "adjacent institutions" such as education, opportunities for enterprise, and legal rules and standards.

Systematic historical approaches are a prerequisite for understanding the role of "idea gaps" in long-run economic growth (Romer 1993). A time series representation of economic gains per person over the millennia would be indistinguishable from a flatline of "secular stagnation," until the mid-eighteenth century. The recent past has therefore been unique in world history, and a crucial charge for scholars is to identify the drivers of this exponential surge that enormously enriched some countries, while resulting in persistently divergent outcomes in others. The economic history of Britain, France, and the United States shows how institutional differences accumulated and significantly influenced comparative advantage in firms and nations. Growth policies that assumed creativity were scarce and the province of narrowly defined groups had very different outcomes relative to open-access institutions that offered incentives to everyone in the population (Khan and Sokoloff 1998; Khan 2020a). However, endogenous growth theory still fails to adequately integrate the insights and complexities that economic historians have long explored. Even "unified growth" economists who attempt to incorporate such patterns into their theoretical mathematical models frequently fall short of a convincing accounting for novel ideas and their applications and consequences (Galor 2005). As this chapter shows, cliometrics has made crucial contributions to our understanding of economic growth and technological change, and their linkages to variation in the nature of institutions, ideas, human capital, and cultural creativity.

Patent Systems and Technological Change

Technological change is a concept that incorporates a sequence of discoveries from the initial conception of a new idea, through its invention and improvement (reduction to practical use), innovation (the initial application and commercialization of the invention), adoption by end users, and diffusion over time and place. Casual discussions – and sometimes even scholarly articles – tend to bundle all of these elements into the catch-all term of "innovation," which can lead to significant analytical and empirical errors. These distinctions in terminology matter critically

for the measurement, analysis, and interpretation of empirical results. For instance, patents are a demonstrably useful measure of inventive inputs, but only commercialized patented inventions can be used as a proxy for "innovation" (Griliches 1990; Khan 2020a). Similarly, scholars often propose sweeping conclusions about patent systems in general and their effects on industrialization and growth (North 1981). However, patent institutions are not homogeneous, and any data analysis must take into account variation in specific rules and standards over time and across countries (Macleod et al. 2003; Khan 2005). Moreover, "adjacent institutions," such as the legal system and its approach to enforcement, can also affect outcomes (Khan 2021). When used creatively, such institutional variation can serve as "natural experiments" that highlight specific determinants and obstacles to inventive activity and innovation.

The British Patent System initially involved royal grants of monopoly privileges to reward favorites and raise revenues for the state. The seventeenth-century Statute of Monopolies introduced a system that granted patent protection for 14 years to inventors and importers of inventions (Dutton 1984; Macleod 1988; Khan 2005, 2020a). To a large extent, this system retained its character as an award based in privilege, requiring payment of prohibitively high fees, and negotiation of a bureaucracy that added to the monetary and transaction costs. Until the middle of the nineteenth century, the diffusion of patent information was inhibited by disorganized filing systems for patent documents, the lack of publication of specifications, and the need to pay for patent searches. The term of the patent could be extended by a private Act of Parliament, which required political influence and additional expense. Such rules consciously created a filter to exclude inventors from humble backgrounds and incremental inventions and to promote supposedly high-valued technical discoveries in capital-intensive sectors.

British inventors and inventive activity were responsive to institutional factors and market conditions (Khan and Sokoloff 1998; Bottomley 2014). Patentees were drawn from elite social classes, disproportionately including inventors with wealth, connections, and influence (Khan and Sokoloff 2004, 2006; Khan 2011). Trade in intellectual property rights, which might have eased the financial concerns of impoverished applicants, was also constrained by restrictions on the number of owners for a patent right, by the uncertainties inherent in a registration system without centralized examination to ensure patent validity, and by arbitrary judicial holdings. The rate of patenting per capita soon fell behind that of the United States, and this pattern also reflected lower overall inventive activity. It is not surprising that, perhaps as early as 1840, the United States experienced significantly higher industrial productivity than in the UK (Broadberry and Irwin 2006). The British preference toward highly capital-intensive technologies promoted biased technical change and unbalanced economic growth that inhibited the capacity to generate economy-wide increasing returns (Khan and Sokoloff 1998).

Finally, after two centuries, significant patent reforms were implemented in 1852 and 1884, in an effort to emulate the successful American system. The costs of patenting were reduced, and a renewal system allowed fees to be paid in installments (Sullivan 1994; Khan 2005). These institutional innovations had an immediate and

observable impact, by generating benefits for credit-constrained patentees and increasing the rate of patenting relative to the population (Nicholas 2011c; Kuegler 2016; Khan 2005, 2020a). However, efforts to rationalize the entire system in the direction of the American model never succeeded until well into the twentieth century. For instance, there was no means of determining the novelty of an application, owing to a shortage of qualified staff with the required technical expertise. Adjacent institutions such as the legal system and technology markets remained inhospitable toward ordinary inventors, so it is not surprising that, as the U.S. patent intermediary Munn & Co. noted, their agency dealt with more patents in a single year than the entire British Patent Office.

The French patent system shared many institutional features with its British counterpart (Khan 2005, 2020a; Galvez-Behar 2008). Early French technology policies employed an arbitrary array of rewards and incentives, ranging from aristocratic titles, pensions and support for spouses and offspring, loans, grants, subsidies and tax credits, and prizes (Khan 2020a, 2021). French patent laws of 1791 and subsequent amendments also established a registration system which did not require novelty, and the first introducer of a foreign invention could obtain property rights for themselves. Applicants were required to pay high fees through a renewal system, in which the term could be extended through legislative action. The invention had to be put into practice within 2 years or the patent could be repealed, although the inventor could document unforeseen events which inhibited commercialization. The diffusion of information was minimal owing to restrictions placed on access, including prohibitions on disclosure until after the patent had expired. The market for patent rights was also thin because of the significant transaction costs, and the fees for the entire term of the patent had to be paid upfront if the patent was assigned. For both buyer and seller, the uncertainties associated with a registration system and judicial unpredictability likely reduced the net expected value of trade. The rules and their enforcement favored the wealthy and owners of manufacturing enterprises (Khan 2016). French patent laws had a global influence, through their effects on the Spanish system, as well as their adoption in their respective colonies (Khan 2005; Sáiz 1999).

The German unified patent system was introduced in 1877, and influenced legislation in a number of other jurisdictions, including Argentina, Brazil, Poland, Russia, and Sweden. Several key elements were taken from the American model, which other countries acknowledged as the most advanced patent system in the world. Just as in the United States, patents were required to be new and nonobvious, and the German Patent Office employed examiners who were expert in their field. Patent disclosure rules encouraged the diffusion of information, and the courts strongly enforced existing patent rights. However, as in much of Europe, patent fees in the German renewal system were deliberately set high to eliminate protection for trivial inventions, and the grant of a patent was subject to working requirements and compulsory licenses. Patents were not allowed for food products, pharmaceuticals or chemical products, although processes could be protected. According to Richter and Streb (2011), German inventors were adept at imitating the more advanced U.S. technologies, and the administration of German patent institutions

supported domestic efforts by discriminating against American and other foreign applicants. Despite such barriers, foreign patenting helped to facilitate technology transfers and domestic inventive efforts (Donges and Selgert 2019).

The Japanese patent system was deliberately designed to emulate intellectual property institutions in Western nations, in an effort to catch up with the leading industrial economies (Khan 2005). The first national patent statute was passed in 1888 and copied many features of the U.S. and German systems, including the patent examination procedures. Protection could not be obtained for fashion, food products, or medicines, patents that were not worked within 3 years could be revoked, severe criminal remedies were imposed for infringement, and for the first decade Japanese patents were not granted to foreigners. Even after this stricture was lifted, the system remained somewhat biased against foreigners, beyond the natural barriers of language. This emphasis on domestic technological capabilities and property rights for ideas likely served to promote rapid modernization and facilitated the advances that occurred after the Second World War (Nicholas 2011a; Nishimura 2011).

The Patent System in the United States stands out as the first modern patent system and was acknowledged as the most successful in the world (Khan 2005, 2020a). The nineteenth century proved to be an era of patented invention, and the United States led all other countries in patenting and technological innovation. The democratic American system was designed to offer property rights for all novel inventions that satisfied the legal criteria for patentability, regardless of the identity of their inventors. Technically qualified employees of the patent office objectively examined submissions for conformity with the rules, and this centralized process created economies in certification as well as a valuable stock of inventive knowledge. Patent fees were deliberately kept affordable, and applications could be submitted by mail free of postage. The basic parameters of the U.S. patent system were transparent and predictable, which also aided applicants for property rights in their ideas.

The disclosure function of patents played an important role in the diffusion of information and was especially significant for creative individuals without adequate financial resources. In addition, specific institutional mechanisms were set in place to ensure that information about the stock of patented knowledge was freely accessible. The U.S. Patent Office maintained repositories throughout the country, where anyone could consult records with detailed information about current and expired patents, including records on foreign patents. Moreover, the Patent Office invested in productive outreach programs in both the agricultural and manufacturing sectors (Olmstead and Rhode 2008). Such policy measures motivated advances in inventive activity through knowledge spillovers and lower transaction costs, and positive effects of Patent Office strategies on diffusion were likewise experienced even in the modern era (Furman et al. 2021; Graham and Hegde 2015).

Property rights are only as valuable as their enforcement, and U.S. patents were authorized by the first article in the U.S. Constitution. The American patent system was based on the presumption that social welfare coincided with the individual welfare of inventors, and patent laws were enforced by a federal judiciary and Supreme Court that recognized the crucial importance of property rights in ideas

for economic and social progress (Khan 1995). Restrictions on patents were held to be incompatible with the U.S. Constitution's objectives in granting patent rights, and legislators rejected working requirements or compulsory licenses as an expropriation of the rights of "meritorious inventors." Disputes naturally occurred because inventive ideas in expanding markets involved enormously valuable rights, and courts mediated competing claims in all areas of the law – property, contracts, torts, crime – surrounding patents and patented technologies (Khan 1995, 2008). The large and growing scale of patent litigation in federal courts illustrated how effectively adjacent institutions interacted with the patent system (Khan 1995, 2014, 2020a; Beauchamp 2015).

Harmonization of international patent laws was directly related to efforts by U.S. patentees to penetrate global markets. By the second half of the nineteenth century, American patentees and multinational companies with large portfolios of patented technologies were licensing their intellectual property overseas, as well as taking stakes in direct and indirect investment ventures (Khan 2013a). As global trade in patented ideas and innovations grew, the costs of differences in national patent rules as well as inconsistent and weak legal enforcement became more burdensome, and motivated efforts toward harmonization of intellectual property laws (Gooday and Wilf 2020). At the same time, such treaties also involved rent-seeking and attempts at redistribution in addition to effecting frictionless economic transactions (Rodrik 2018). The first international patent convention was held in Austria in 1873, because the U.S. patent lobby wanted to be certain that their rights would be enforced during the International Exposition in Vienna that year. The Vienna Convention complied by rejecting working requirements for patent holders, but compulsory licenses were retained in defiance of strong American objections.

It is not surprising that patent harmonization implied convergence toward the American model. The U.S. patent system was universally acknowledged to be successful, the United States was the most prolific patenting nation in the world, and a large number of the major American multinational enterprises owed their success to patent portfolios. Nevertheless, the goal of complete uniformity in patent laws was not practicable, given the different objectives, ideologies, and economic circumstances of many developing countries. Most participants in international negotiations feared that their domestic industry would be overwhelmed by American patents and patent-based firms unless discriminatory legal barriers were maintained. For instance, during the Paris Convention of 1880, the French argued that harmonization measures would prove to be "disastrous" unless they were counterbalanced by protective tariffs and import substitution strategies. The resistance to uniform intellectual property laws across the globe highlighted the extent to which patent institutions belonged to a broader social and economic "ecosystem."

Patents, Markets in Ideas, and Inventive Activity

Patents offer property rights in ideas, whose value is a multiplicative function of the legal property right, the technical contribution of the associated idea, and the market

value of its commercial application. For economists, patent counts provide an index of inventive activity and technological change, although these statistics have well-understood limitations (Griliches 1990). In particular, the value of all quantitative measures of inventive activity varies enormously in accordance with legal rules, institutional features, and enforcement efforts (Khan 2020a). Such qualitative complexities differ over time and place, implying that effective research into intellectual property requires both economic skills and detailed historical knowledge and insights. Economic historians have notably invested heavily in creative efforts to boost the signal from these data, by exploiting linkages to supplementary information. Patent records, for instance, have provided valuable insights when matched to inventor characteristics from manuscript population censuses, patent renewal information, litigation records, forward patent citations, and biographical information on so-called great inventors.

Kenneth Sokoloff's pioneering article in 1988 demonstrated how the quantitative analysis of historical patent data could be productively employed to shed light on inventive activity and economic growth. This landmark study examined both time-series and panel patent data in the antebellum United States and showed how inventive activity responded to market expansion, in keeping with Adam Smith's hypothesis of the virtuous growth cycle. Improved market access, measured by proximity to navigable waterways, was associated with significant increases in patenting per capita. Sokoloff and Khan (1990) found that the observed surge in patented invention was largely due to the influx of relatively ordinary individuals in formerly isolated rural areas. The occupational distribution of patentees revealed that the skills and knowledge for novel technological creativity were widely available in the general population during the early industrial era. Subsequent studies of patenting and patent systems in other countries, such as Japan, Sweden, Spain, Germany, and France, explored variation in local conditions, institutions, and outcomes (Nicholas and Shimizu 2013; Andersson and Tell 2016; Pretel and Sáiz 2012; Burhop 2010; Galvez-Behar 2008).

Markets in ideas and inventions are rife with asymmetrical information and contractual problems, but cliometric research has amply demonstrated that these transactions costs did not inhibit market efficiency. The founders of the U.S. patent system intended to promote an active market in patents and patented ideas and, right from the earliest decades, extensive licensing and assignments of U.S. patent rights in secondary and tertiary markets enhanced the liquidity and financing of new inventions and innovations (Khan 1995, 2005, 2013a). Deep and wide national and global markets for ideas developed, allowing for the appropriation of returns, and for the financing of firms and other mechanisms that facilitated the commercialization of inventions and new ways to satisfy consumer demand (Khan 2013a; Arora and Gambardella 2010). By the start of the second industrial revolution, this process was especially well-articulated in the United States, where markets in patents and patented technologies, aided by specialized patent agents and attorneys, helped to transform inventive activity and innovation (Lamoreaux and Sokoloff 1996, 1999, 2000, 2001). A network of patent intermediaries drew on their specialized knowledge and practical expertise to facilitate exchanges among stakeholders. Smithian

endogenous growth in technology markets also promoted specialization and a division of labor between productive inventors, intermediaries, and suppliers of venture capital across industries and regions.

The effectiveness of markets in technology in the nineteenth century also had important implications for the emergence of modern business organizations (Lamoreaux and Sokoloff 2009). Growth in patent markets enabled talented inventors to specialize and commit to careers in technical discoveries; and, over time, many of these patentees entered into long-term contractual attachments to firms. However, businesses encountered significant difficulties in their quest to integrate creative individuals in their organizational structures and in-house R&D facilities. Such research findings pointed to a need for more complexity in the usual narrative about a linear transition from markets toward the dominant corporation creating technical advances through large-scale investments in applied research and development. Lamoreaux et al. (2013) uncovered a rich diversity in the organization of invention, ranging from large firms that housed R&D laboratories, to small, flexible, and dynamic startups with entrepreneurial inventors as principals. As such, markets for technology enabled specialization and division of labor not just among inventors, but also across firms of different scales.

The nineteenth-century era of patented creativity provided the foundation for subsequent advances in productivity and growth that emerged in the "technologically progressive" early-twentieth century (Field 2003). Nicholas (2009, 2011b) found that the majority of innovative firms in the 1920s and 1930s were involved in patenting, and to a far great extent than is currently the case. At the same time, firms with in-house patenting and technological capabilities still resorted to outside markets in ideas to obtain complementary technologies. Recent research has also cast doubt on the common assumption that governments need to subsidize or invest in basic knowledge, because private entities would not be able to capture the returns from their research investments (Khan 2020a, 2021). Arora et al. (2021) convincingly documented how corporations engaged in "quasi-academic research" which pushed the boundaries of both basic and applied knowledge, and further generated patents for novel and commercially valuable discoveries.

It was undoubtedly true that the nature of technology had altered by the time of the second industrial revolution, and that inventive activity and productivity were based on greater investments in human and financial capital (Khan and Sokoloff 2004, 2006; Lamoreaux and Sokoloff 2009; Sutthiphisal 2006). These changes likely ultimately reduced the comparative advantage of independent inventors who were not employed or associated with firms, leading to a decline in their relative importance by the 1920s. Still, despite the common impression that the modern era was dominated by technological change in corporations, the contributions of independent inventors persisted well into the twentieth century. Nicholas (2010), for instance, found that independent inventors were responsible for over half of U.S. patents by 1930, and these tended to be disproportionately of high quality, as gauged by patent renewals and citations. This pattern was also observed in the Japanese economy, especially in the capital and in highly urbanized areas. At the same time, results were more variable in countries like Spain and Italy that were at

the technological and economic periphery. For instance, inventors outside of firms accounted for significant numbers of patents but were less competitive in terms of the quality of their discoveries and success at commercialization (Sáiz 2012; Nuvolari and Vasta 2015). It should be noted that, even in the twenty-first century, firms continue to tap into an external market for ideas, highlighting the inherently complementary nature of independent inventive activity and corporate innovation (Arora et al. 2016; Khan 2020a).

Although patents are often considered as a mechanism for exclusion to allow inventors to capture returns from their ideas, or as a tradeable property right, it may be argued that a primary purpose is to diffuse information (Kultti et al. 2007). American patent institutions in particular were introduced to "promote the progress of science and useful arts," and policies have always been implemented to disclose and disseminate information. Khan (2020a) applied spatial econometrics to study externalities from patented inventions and prize-winning innovations. The results indicated that patents were associated with knowledge spillovers whereas unpatented prize-winning innovations did not, owing in part to the lack of specific mechanisms to transmit relevant information in prize systems. Studies of German patents find that spillovers at the level of both industries and countries promoted technological change, and regional comparative advantages (Streb et al. 2006; Richter and Streb 2011). The overall consensus from a multitude of studies supports the conclusion that knowledge spillovers from the stock of patents contributed significantly to productivity and economic growth across countries (Madsen 2008).

Knowledge flows could also be generated by clusters of institutions, in addition to invention-specific externalities. Lamoreaux and Sokoloff (2000) argue that markets for technology, and associated networks of institutions and intermediaries, generated spillover effects that helped to increase productivity. Besides its function as a repository for patent information, it should be noted that the U.S. Patent Office often served as an intermediary for agricultural extension initiatives and strategies to promote innovation. Olmstead and Rhode (2008) also provide extensive evidence regarding the private and public institutional and noninstitutional mechanisms that allowed for the diffusion of unpatentable biological innovations for crops and livestock in American agriculture. Similar spillovers and initiatives occurred in agricultural regions in other countries and were magnified by enhanced communications that accompanied the extension of transportation networks.

Inventors and Inventions, Great and Small

Patent institutions provided incentives for a "democratization of invention," encouraging the creative efforts of a broad cross-section of the population (Khan 2005). Access to basic education for the general population also played an important role in enhancing technological capabilities. When Claudia Goldin (2001) linked American economic leadership to the "human-capital century," she was largely evoking the prevalence of local investments in public mass education at the high-school level. This focus on literacy and general education was associated with the potential for

technological creativity among a broad range of the U.S. population, and many of the most successful U.S. inventors such as Thomas Edison possessed little beyond basic schooling (Khan 2005; Sokoloff and Khan 1990; Khan and Sokoloff 2006). For both "great inventors" and ordinary patentees, knowledge and skills were relatively unspecialized during the early industrial era. Well into the second half of the nineteenth century, even the most productive inventors were able to acquire productive skills from learning on the job and from apprenticeships, and few possessed advanced degrees in science or engineering.

Cliometrics has also helped to illuminate debates that previously depended on potentially unrepresentative case studies, including claims that "great inventions" and "general purpose technologies" radically transformed the economic landscape, whereas patents simply represented economically minor incremental inventions. Khan and Sokoloff (1993, 2001); Khan (2005, 2011, 2020a); Sokoloff and Khan (1990) analyzed samples of over 800 "great inventors," and all of their inventions, in the United States and Britain. The majority of American great inventors were patentees, and were similar to "ordinary inventors" in terms of their backgrounds and patterns of inventive activity. Successful inventors were not especially distinctive in terms of age, education, or occupational background and, rather than being random geniuses, most made sustained long-term investments in invention. Both "great inventors" and "ordinary inventors" exhibited similar behavior, quickly responding to institutional changes and market opportunities. Patentees were exceptionally mobile compared to the general population and tended to migrate to more profitable markets (Khan and Sokoloff 1993, 2006). From the earliest years through to the present, the cadre of productive inventors has tended to be disproportionately of immigrant origin (Khan and Sokoloff 2006; Ciriacono 2005; Moser et al. 2014; Akcigit et al. 2017; Diodato et al. 2022).

Study of the European experience has led some scholars to attribute technological change and economic growth to "upper tail knowledge," net additions to specialized human capital, and scarce supply inputs (Mokyr 1990; Diebolt and Hippe 2022). However, at the aggregate level, Crafts (2021) emphasized that British technological change and capabilities were modest, even well into the nineteenth century, which is consistent with a pattern of gradual change rather than revolutionary advances in knowledge, productivity, and innovation. Such conclusions have been confirmed by an array of sector-specific findings, such as those related to coal mines (Murray and Silvestre 2015), cotton spinning (Maw et al. 2022), and steam engines (Crafts 2004). Maw et al. (2022), for example, show that productivity advances from "micro-inventions" exceeded gains from supposed "great inventions" in the UK cotton spinning industry. Corliss steam engines, similarly, were hardly radical general purpose technologies, still less engines of growth (Abrams et al. 2008).

A significant body of literature finds that, despite all the state support for inventors from elite backgrounds, innovation and productivity gains in Europe were not closely linked to advanced education or esoteric knowledge and skills. According to Epstein (1998), European craft guilds effectively transferred skills through apprenticeships, and these institutions facilitated innovation through the diffusion of learning and information. Like their U.S. counterparts, prominent

British inventors between 1750 and 1930 acquired human capital predominantly through apprenticeships and learning on the job, rather than from formal specialized training as scientists, engineers, or technicians (Khan 2018). Studies of Prussia in the nineteenth century likewise highlight the significant impact of basic education and literacy (Cinnirella and Streb 2017; Becker and Woessmann 2009). In the case of Spain, de la Escosura and Rosés (2010) estimated that advanced human capital made a positive but minimal contribution.

Studies of diversity and inclusion by gender and race and status provide another important perspective on creativity and socioeconomic progress. Khan (2020a) compiled information on over 100,000 inventors of patented and unpatented inventions, including 12,000 women in Britain, France, and the United States. Specific features of institutional design, such as the cost of patenting, significantly influenced the composition of inventors in terms of gender, occupation, and social standing. For instance, the exorbitant patent fees in Britain and France functioned as a filter that led to a greater prevalence of women from elite social and occupational classes among female European patentees than was the case in the United States. Kuegler (2016) similarly found that the fall in British patent fees in 1884 was associated with a disproportionate increase in inventors with lower wealth. In all countries, women inventors and innovators, especially nonpatentees, were more likely than men to be associated with improvements in consumer final goods and design-oriented products at the boundary of art and technology. The overall patterns suggest that framing women's creativity in terms of a "gender difference" rather than a "gender gap" might yield more useful analytical insights into their social and economic contributions.

Patent laws in the United States were inclusive and did not differentiate on the basis of inventor characteristics, in a manner that makes it difficult to identify the gender or race of patentees. Data on the racial composition of patentees are limited, so research results in this area are necessarily more speculative. According to Cook (2011) a lack of social capital and segregation laws negatively affected the patenting abilities of black inventors. Although women patentees were not discriminated against at the federal level, in the nineteenth century an array of state laws deprived married women of rights to their property and earnings, and constrained their market participation. Khan (1996, 2000) found that, like their male counterparts, female patentees were motivated by potential profits and were responsive to market incentives, but women inventors were inhibited by such discriminatory laws. When states passed legal reforms granting women greater economic rights, their inventive activity increased significantly, and the subsequent responses were disproportionately higher in metropolitan centers where property rights were of greater concern.

Women and other disadvantaged groups undoubtedly faced institutional impediments to their social and economic activities. At the same time, other institutional substitutes such as family-based apprenticeships and personal networks played a central role in overcoming some of these obstacles. For instance, European patent systems and legal institutions featured rules and standards that negatively affected ordinary women, but more privileged women and those associated with family firms and networks were able to circumvent or reduce the attendant barriers (Khan 2016,

2020a). Many women directed their creativity to novel ideas that proved to be valuable in the market for inventions. However, women were significantly more likely than men to be associated with unpatentable innovations regarding the look and feel of consumer final goods. Both their patented and unpatentable creativity were often directed to promoting welfare within the household.

Even if women were not equally represented in the patent system, their patenting rates still far exceeded participation and recognition in other innovation institutions. In particular, women were significantly less likely to be awarded prizes for their innovations, in all institutions and in all countries (Khan 2020a). The Franklin Institute of Philadelphia, for instance, administered the Scott Prize that the donor designated to benefit "ingenious men or women," but prize-winners were overwhelmingly male, and no woman was recognized with an award of any sort in the antebellum period. Just five women received prizes from the institute's Committee on Science and the Arts over the entire nineteenth century. It is not surprising that women and other disadvantaged groups internalized the anticipated bias and generally opted not to participate in these administered innovation systems.

Invention Outside the Patent System

Extensive debates have always flourished about the role of patent protection and whether patent systems ought to exist at all (Machlup and Penrose 1950; Khan 2014). Moreover, scholars have been skeptical about the extent to which patents measure inventive activity and their relationship to productivity and growth. Patent laws specify the sorts of technological ideas that can be protected through legal rights of exclusion, and patentable inventions vary by sector, country, and time. Moreover, not all eligible inventions are actually patented, for a number of reasons ranging from net expected benefits, to the ability to appropriate returns through alternative means such as trade secrecy. At the same time, while some firms or individuals might rationally decide to refrain from patenting, this does not signify that the right to legally protect their ideas is unnecessary or irrelevant for other inventors. Despite this, some observers assume that the existence of some forms of creativity without patents serves as an indictment of all patent institutions.

Part of this reductionism appears in the literature on "collective invention," a concept popularized by Allen (1983) to indicate sharing of information and ideas among firms. Allen presents a historical (but not cliometric) account of the British iron and steel industry, in which he identifies incidental innovations such as the dimension of a blast furnace, that were unpatentable and also impossible to conceal from other firms. He contends – without any supporting quantitative evidence – that these unpatentable collective inventions were "probably the most important source of inventions," but adds that the practice likely died off as more formal R&D institutions emerged in the twentieth century. Despite the scarcity of systematic quantitative evidence, this persuasive anecdote has proven to be more enduring than a thousand spreadsheets. Nuvolari (2004) found that Cornish mining firms freely exchanged information about new steam engine technologies. Unlike Allen,

he assumes a binary choice between patents and collective invention, in which the industry rejected patented inventions. Kitsikopoulos (2016) refutes this conclusion and shows how inventive activity and innovation in Cornwall mining in the first half of the nineteenth century was actually closely linked to the patent system.

Other efforts to assess creativity outside the patent system draw on exhibits at world's fairs. Such evidence, it is argued, demonstrates that the vast majority of inventions were not patented, most inventors were rejecting patent protection, and patenting did not respond to variation in patent laws (Moser 2012). Closer examination of these records indicates that exhibits provide an inadequate measure of both patenting and inventive activity (Khan 2013b, 2015, 2020a). International exhibitions were commercial and entertainment fairs, and did not offer a representative draw of the population of inventions. U.S. patents, in particular, cover novel inventions by "the first and true" inventor, but no exhibition had the resources or ability to gauge novelty, and certainly none (including the Crystal Palace Exhibition of 1851) required technical novelty. Patentability of exhibits can be confirmed through a knowledge of patent laws, careful reading of the jury reports, and by searching the patent records to determine if any such patent had ever been granted. All such events featured exhibits with enormous variance, predominantly comprising manufactured goods and an array of items that could not remotely be regarded as patentable technological inventions. Counts of such exhibits – even those in a particular category – cannot measure actual inventive activity on par with patented inventions.

Moser (2012) uses these data as the basis for the claim that over 80% of inventions were unpatented, and the vast majority of inventors were "rejecting" the patent system. However, the "propensity to patent" should estimate the number of patented items, relative to some precisely specified total population of patentable inventions in the same period. In exhibitions data, both the numerator and denominator are measured with significant error (Khan 2020a, pp. 415–419). The point should be obvious: after all, a single printing press on display at an exhibition could embody hundreds of unidentifiable patents. The vast majority of exhibits were presented by manufacturers rather than by the patentee, in which case the inventor could not be identified, but this is still recorded as "unpatented." Even if it were possible to identify patented exhibits with zero error, a straightforward explanation for not patenting an exhibited good is that most were simply not patentable. It is therefore not surprising if exhibits were uncorrelated with variation in patent laws. As for suppositions that inventors at fairs were opting for trade secrets, it seems unlikely that the objective of secrecy would be promoted by participating in a public exhibition.

Domini (2020) concludes that the "significant mismatch" between exhibits and patents should make economists wary of using exhibits as a proxy for invention and innovation. Exhibitions can tell us a great deal about prizes and administered innovation systems, but claims that exhibits reveal much about inventive activity or patent systems in general are unfounded. This was especially true of U.S. patenting, where novelty was defined through rigorous scrutiny by professional examiners, and utility was determined in the marketplace (Khan 1995). At the same

time, it is true that a considerable and diverse amount of creativity was indeed occurring outside the formal patent system. Exhibited goods often reflected exceptional workmanship, attractive appearance, unusual size (a gigantic steam engine), and other inherently unpatentable features that could nevertheless improve marketability and commercial value (Domini 2020; Khan 2020a). These different sorts of creativity were often reflected in trademarks and designs and in innovations at the boundaries of art and technology.

Another perspective on inventive activity without patents relates to case studies of countries without patent protection. Toward the second half of the nineteenth century, patent abolitionists in Europe worked to eliminate patent systems. Patent skeptics proposed alternative rewards and incentives for inventors such as state stipends, payouts from private associations, and other means of compensation. Reference is often made to the experience of Switzerland, which did not introduce patent legislation until 1888, to support the notion of inventive activity occurring without patent protection. However, it should be noted that Swiss artisans were known for being innovative more than inventive, and in a narrow range of industries, such as hand-made watches, chocolates and specialized food products, in which novel patentable inventions were not relevant (Khan 2005).

Swiss manufacturers lobbied for their own intellectual property legislation when American enterprises employing patented inventions overtook them in international markets for such products as boots, shoes, and watches. For instance, U.S. inventors obtained more than 2000 patents on watches prior to 1890, and the U.S. watchmaking industry experienced continually falling prices and rising output. U.S. industrial and technical progress was more rapid, and technological change was rendering Swiss-style artisanal methods obsolete in products with mass markets. Thus, the Swiss endogenously introduced patent laws in 1888 because of falling competitiveness in their key industrial sectors. After the patent reforms, the rate of Swiss patenting in the United States immediately increased, and Swiss inventive activity covered a much broader range of inventions. The Swiss experience featured unique circumstances that seem to hold few useful lessons for understanding the general role of intellectual property in economic progress.

Prizing Creativity

Genius and creativity have always been associated with honorary and monetary "laurels," and today there is a dramatic increase in prize awards for both technology and culture. Prizes are especially prevalent in the cultural industries, leading to what has been deemed an "economy of prestige" (English 2005). European societies, in particular, were enthusiastic about prizes, and that enthusiasm has currently emerged in the United States in the form of both federal government and private initiatives. Nevertheless, very little empirical attention has been directed to economically identify the operation and effects of prize-granting systems. Khan (2020a) analyzes prizes as monopsonies, belonging to the class of administered innovation systems, or

top-down arrangements where decisions about economic values, rewards, and the allocation of resources are made by the state, administrators, or select panels.

In Britain and France, a vast array of administered mechanisms supported and recognized creativity, including cash and honorary prizes for technology and the arts, medals for scientists, grants, subsidies, pensions, and other payouts. For example, the Royal Society of Arts (RSA) in London, founded in 1754, is often cited as a canonical "enlightened" institution which significantly contributed to the industrial revolution (Mokyr 2011). Khan (2017, 2020a) quantitatively analyzed the RSA records and found that such claims were not supported by the evidence. Although technological prizes were high on the RSA list of *offers*, artistic works comprised the majority of awards that the committees actually *bestowed*.

The Society prohibited prize winners from applying for patents, making for a clean experiment about the nature and consequences of innovation prizes. This revealed an adverse selection process: inventors with useful ideas (including its own members) bypassed the RSA and obtained rewards in the market for patents; whereas, the individuals with lemons (unmarketable ideas) opted to apply for prizes. Prize awards were related to rank and connections rather than inventive merit, and many were conveyed to works of rather obscure artists for which there was no market. The RSA itself finally acknowledged that its efforts had been "futile" and had little relationship to the course of industrial progress. In a final indictment of its early objectives, the Society abandoned its ineffectual inducement prize system and instead switched to supporting reforms in the patent system.

A significant number of other institutions in Britain, France, and the United States presented prizes for artistic and technological creativity (Khan 2011, 2013b, 2015, 2020a; Brunt et al. 2012; Burton and Nicholas 2017). Khan (2020a) reported the results from extensive empirical analyses conducted at the individual level of over 65,000 prizes, allowing for variation over institutions and countries. Administered prize systems undoubtedly provided benefits to award panels, to sponsors, and to winning competitors, but they did not offer socially efficient incentives for creativity, and failed to identify individuals or contributions that significantly added to productivity. In all cases, their operation was idiosyncratic, and it was impossible to predict the outcome based on objective characteristics of the invention. Judges and committees typically lacked the ability to accurately gauge the market value of innovative technologies, or to appreciate the aesthetic values of new and disruptive art movements. Results were primarily determined by the identity of judges and of applicants, rather than by the productivity or quality of the innovation. Economists tend to focus on price discrimination; with prize-granting monopsonies a greater concern included nonprice discrimination. Awards were often associated with nepotism and unfair discrimination against relatively disadvantaged groups such as women, nonelite candidates, and those without personal connections.

Comparison across institutions and countries allows scholars to identify factors that are endemic to prize systems. Although administered innovation was more prevalent in Europe, several prominent examples of "improvement societies" that awarded premiums to induce inventions existed in the United States. One of the most significant was the Franklin Institute of Philadelphia, which was founded in 1824, as

a society to benefit mechanics and artisans. Just like the Royal Society of Arts, the Franklin Institute publicly proclaimed its allegedly critical contributions to technological progress and national importance, even when the organization was privately acknowledging existential internal crises and its own lack of relevance to industrial and economic outcomes.

Khan (2020a, Chap. 7) empirically evaluated their archival records for the entire nineteenth century. The Franklin Institute, like other administered innovation systems, primarily functioned as an organization managed by elites and for elites. Membership lists, as well as the records of awards and prizes bestowed, revealed that just 10% of the membership were artisans or workers and, even among these, many were quite well-off. Less than a quarter of the members were employed as mechanics, engineers, or scientists, and they accounted for just 15% of the roster of life members (a proxy for commitment). Members' interests tended toward abstract theoretical questions on a perceived "higher plane" than the pragmatic concerns of mechanics and artisans. For instance, the Franklin Institute rejected Zebulon Parker's pathbreaking work on reaction wheels in turbines. Parker's insights were based on decades of careful practical experimentation, which had resulted in landmark patented discoveries that dramatically increased productivity, and ultimately advanced scientific knowledge.

The Franklin Institute administered a number of prestigious cash prizes and medals, and their experience reveals the potential for governance problems in administered systems. Like many other prize-granting institutions, secrecy surrounded their decision-making, and all records were sealed for 50 years. Judges primarily considered the aesthetic characteristics of the entries, giving out more than 80% of the awards because of superior workmanship or beauty. The focus on visual aspects of innovations occurred because – as they candidly admitted – the committees often were incapable of adequately evaluating the technical or substantive merits of the exhibits. In addition to appearance, awards were bestowed for workmanship, cheapness, and usefulness as perceived by the members of the committee. More than a half of the patented entries were highly capital-intensive machines in transportation, power, and engines, and few of these were assigned (a proxy for success in the marketplace) or likely to be cited (a proxy for technical value). Prizes were typically conferred on the privileged classes, as gauged by wealth and occupations, and the fraction of awards to artisans or workers remained minimal.

Empirical analysis raises questions about governance in prize panels, especially when decision-making is kept secret and there is no formal right of appeal or other feedback mechanisms. A committee could not bestow an award on one of its sitting members, but there was no prohibition on applying for a prize once the individual had rotated off the panel. Prize awards were significantly related to affiliation with the Franklin Institute, especially insiders who had served on committees or in executive positions. Families and corporate associates also benefited through connections with influential members of the Institute. Such "social capture" illustrated how a panel's decisions could be unduly influenced by the expectation that current applicants might later have the ability to make decisions that would affect their welfare. Perhaps the Franklin Institute's most significant contributions arose not

from their prize system, but their lectures and classes, which benefited over 14,000 individuals during the nineteenth century.

In sum, the corpus of cliometric evidence indicates that innovation prize systems invariably failed as inducement mechanisms. The allocation of awards was typically idiosyncratic and unrelated to economic value or productivity of the invention. Such systems were far from democratic, and judges, participants, and winners generally belonged to wealthier and more privileged classes. The administration of prizes was rife with poor governance, and administrative costs often exceeded the amounts being disbursed to inventors. Rather than providing effective inducements for novel inventive activity, prizes primarily served as marketing and publicity strategies for firms that wished to commercialize already-existing innovations.

Prizes for cultural creativity similarly tended to be unrelated to productivity, or to progress in the field over the long run. Ginsburgh (2003) considered awards to books, movies, and musical performances, and found that such recognition was not closely related to quality, creativity, or the persistence of the work over time. English (2005) reached the same conclusions, but noted that popular impressions about prize systems have always proven to be impervious to empirical evidence. Nevertheless, by the end of the nineteenth century, many prize systems had given way to markets for ideas and expression. For instance, the French artists' *Salon des Indépendants* was formed in the summer of 1884 in reaction to the injustices of the existing institutions for selecting entries for exhibitions and bestowing prizes, where decisions were more often motivated by the panel's personal biases and artists' connections rather than by merit (Société des artistes indépendants 2000; Khan 2020b). Instead, the more democratic Salon ensured that success in the art world would be determined by public preferences and willingness to purchase the item in the open marketplace.

Copyrights and Trademarks

Copyrights have raised similar questions as patents, regarding the extent to which intellectual property protection is related to genius and cultural creativity, debates about the consequences of copyright rules, and the effects of lack of enforcement and piracy (Khan and Sokoloff 2001; Khan 2003, 2005). British publishers had long realized that their continual efforts to expand the scope of copyright protection would be more likely to prevail if their claims were motivated in terms of a reward for the author's creativity. The fundamental principles of U.S. copyright had little to do with offering incentives for authors' creativity; instead, copyright was granted to promote social welfare through learning and education. Both copyright registrations and litigation data indicate that, rather than authors, early copyrights were predominantly the concern of publishers and other intermediaries. However, like their European counterparts, American publishers found it expedient to maintain this useful fiction and promoted their own objectives by appealing to the inherent rights of authors, and the need for courts to ensure the just returns for genius and creativity.

Although copyrighted goods account for a large fraction of cultural markets, economic historians have not directed much attention to this form of intellectual property. The earliest application of cliometric analysis assessed international copyright piracy in the nineteenth century (Khan 2004, 2005). U.S. copyright laws encouraged legal piracy of foreign works from 1790 until 1890, because legislators deliberately calculated that the "balance on the ledger" favored weak international copyrights. Supporters of strong copyright laws contended that the absence of such protection created negative consequences for stakeholders. Empirical analysis of the nature and consequences of U.S. piracy employed data on copyright registrations, authorship, book titles and prices, lawsuits addressing copyright questions, and the financial accounts from a major publishing company.

All the evidence from the book industry was consistent with the notion that the United States benefited from piracy of foreign works, and so did the European authors who were the targets of piracy. Most cultural industries are mediated by oligopsonies which filter the excess supply of creative expression, and contrive artificial scarcity to drive up prices above marginal cost (Liebowitz 1985; Khan 2020b). In the absence of legal copyright protection, book publishers were able to maintain stable profits through cartelization and the creation of "synthetic copyrights." To some extent, the persistent refusal to alter this policy over the course of a full century, even in the face of widespread international condemnation, provides its own tacit answer to the question of the benefits and consequences of piracy. Only when the flow of funds in cultural markets moved in favor of the United States did its intellectual property policy endogenously change toward formal recognition of international copyrights.

European copyright rules have always differed significantly from the market orientation of U.S. copyright laws, and the latter remained weaker even after the demise of its legally sanctioned piracy and global harmonization of copyright laws (Khan 2003, 2005). This institutional diversity suggests that results from jurisdictions in Europe are unlikely to generalize to the American experience, and vice versa. Part of the argument in favor of copyright is that legal protection serves as an incentive for the creation of new works, although formal copyright seems to be neither necessary nor sufficient for cultural creativity. Scherer (2004, 2008) emphasized the important role of market expansion in shaping the music industry and observed that a "golden age" of composition flourished in the absence of copyright protection in Europe. A study of Italian opera during the Napoleonic era argued that the introduction of copyright legislation caused an upsurge in the number and quality of new works, whereas copyright terms that persisted beyond the lifetime of the creator were ineffectual (Giorcelli and Moser 2020). According to Li et al. (2018), an extension in copyright duration in Britain led to a remarkable jump in the prices of books whose authors were no longer alive.

Another perspective on copyright terms is that extended protection ensures that stakeholders have an incentive to make the work accessible and available to the public, as well as lowering transaction costs for the creators of derivative works who wish to build on already-published expression. Studies of cultural goods such as books, movies, and music have examined how variation in copyright terms and

protection affected their distribution and accessibility. Heald (2014, 2019) concluded that copyright inhibited public access, with works reappearing for sale only after they entered the public domain. The same author analyzed bestsellers from 1913 to 1932 and found that novels in the public domain had a greater likelihood to be printed and published relative to works still under protection. Similar patterns held for derivative works, as such books were also more frequently converted into audiobooks for the digital market. As might be expected from its public good nature, music exhibited some differences in details, but overall patterns were similar to the market for books. For instance, the expiration of the copyright term significantly increased the number of re-releases and availability of recordings in physical formats (Watson et al. 2023).

Trademarks are not intellectual property, in the classical sense of a property right in patented ideas or copyright-protected expression. They represent a legal branding device for goods to signal source and quality, and to prevent tarnishment and dilution of investments in marketing and commercialization. Scholarship in this area initially was largely limited to narrative business history, rather than to cliometrics, as shown by the important representative collection of papers in Sáiz and Castro (2022). The accumulation of trademark databases has facilitated more quantitative approaches, as well as thoughtful assessments of the advantages and limitations of such statistics for the understanding of the economic history of innovation. For instance, interest among economic historians increased after the United States' Patent and Trademark offered easier access to trademark data, including over 600,000 registrations filed between 1870 and the 1960s; and after similar information was collated in other countries (Graham et al. 2013).

Trademarks are allied to advertising, innovation, and commercial applications and serve as an indicator of product differentiation. Registered brands can function as an aid to monopolistic competition and a determinant of the survival or demise of firms. Informative results have been obtained by examining trademarks at lower levels of aggregation, including sectors and industries, as well as in terms of firms of different scale and scope. Consumer goods industries in particular have attracted a large amount of scholarship about brands, ranging from beer and wines to dairy products and furniture. Lopes and Guimaraes (2014) proposed that trademarks were most closely correlated with marketing-based innovations, and their data on brands showed that consumer goods industries in Britain flourished during a period usually associated with industrial decline. The role of trademarks in the textile industry has also been frequently examined, especially in the context of business enterprises in colonies (see, for instance, Lopes et al. 2018).

At the same time, branding or product image in itself obviously cannot determine outcomes, which implies the necessity to control for other factors, a methodology that typically is not incorporated in the detailed trademark studies by business historians. As Higgins and Tweedale (1995) cautioned in an early study, trademarks represented intangible assets that could just as easily turn into liabilities. A number of careful investigations demonstrate in different contexts how branding could prove to be neither necessary nor sufficient for successful outcomes (Llonch-Casanovas 2012; Sáiz and Fernández Pérez 2012). External centralized certification, state laws,

or mandated inspections were all devices that could help to overcome problems of free-riding and asymmetrical information, and also engender economies in the maintenance of reputation and quality (Law 2006). Caracausi (2017) studied an interesting example in which trademark-like guild-mandated regulations incentivized inefficient rent-seeking, whereas private mechanisms reduced transaction costs.

Trademark counts remain somewhat problematic for empirical analysis, especially when the research is limited to the time series of registrations. However, several recent studies have linked registrations with supplementary data, while others have used variation in trademark laws, to reach insightful conclusions. For instance, Alfaro et al. (2022) applied sophisticated econometric analysis and exploited the variation in trademark protection in China during the period between 1870s and 1940s. They argued that the introduction of trademark laws encouraged investments in brands among Western firms, as well as linkages with domestic intermediaries. The results further suggested that alternative institutional arrangements proved to be less efficacious than formal legal rules protecting trademarks. By contrast, Qian (2008) found that private firm-level strategies such as self-enforcement, enhanced innovativeness, vertical integration, and price signals could effectively substitute for government-mandated protection against counterfeiting. In another particularly innovative study, Sáiz and Zofío (2022) examined the geographical spread of trademarks in Spain between 1850 and 1920 and concluded that trademark specialization was significantly linked to knowledge spillovers and market integration.

These studies all highlight that, far from being a step-child of intellectual property, future cliometric investigations about trademarks have the potential to add significantly to our understanding of the relationship between business organizations, commercialization and innovation, product quality, and consumer welfare.

Conclusion: Looking Forward

Creativity in itself is perhaps not the proper study of economics, because creativity is arguably a basic human characteristic that is not in scarce supply (Khan 2020b). However, economic analysis still has the potential to contribute to our understanding of the rate, orientation, and consequences of particular creative activities. Cliometric research has shown how, like most human behavior, creative ideas and expression were influenced by institutions and specific incentives, and the factors that led to variation in outcomes, including growth and innovation. Instead of rare supply-side "genius," exceptional performance in technology and culture tended to be related to the capacity for scalable solutions and commercialization that satisfied market demand. Property rights in patents facilitated markets and diversity in ideas and inventors, whereas innovation prizes and publishers' copyrights have functioned as administered systems that arbitrarily benefited the few rather than overall social welfare.

Cliometricians have taken up the challenge of Joseph Schumpeter (1947, p. 149) who noted that "economic historians and economic theorists can make an interesting and socially valuable journey together." Future research can profitably pursue other

features of the economics of administered innovation systems. In particular, more theoretical and empirical studies of monopsony and oligopsony are needed to address the operation and organization of such firms, especially as intermediaries in the cultural industries. Innovation prizes and state administration of awards have been shown to raise the potential for bias and lack of diversity, where outcomes were driven by the identities of participants rather than by merit or productivity. Economic historians can help to illuminate current concerns about inclusion, diversity, and social justice, by venturing beyond standard questions of price discrimination, to further assess the potential for monopsonies to engage in unjust discrimination on the basis of gender and other ascriptive characteristics.

This assessment of recent research on technological and cultural creativity underlines the extent to which excellence in cliometrics requires both good economics and good history. Quantitative analysis is only as good as the underlying data, and credible conclusions require close attention to institutional details. There is a need for more careful empirical assessments of unpatentable inventions, and other forms of technological creativity that cannot be captured through conventional measures. Future projects in this area would add value by providing transparent and accurate accounting of the nature of novel data and their specific drawbacks, and by carefully examining associated historical records to capture differences across, and variation within, institutions, legal structure, and enforcement of rules. Creative linkages, such as to textual analysis, can further enrichen and increase the economic signal from counts that offer insufficient information in themselves. Much can be learned from more extensive comparative analyses, to evaluate and identify the extent to which conclusions from studies of copyrights and trademarks or geographic indications can be generalized to other contexts and jurisdictions.

A final and manifest gap in economic accounting of creativity relates to the lack of empirical attention to transactions within the household. As the 1852 Women's Rights Convention in New York declared, "the economy of the household is generally as much the source of family wealth as the labor and enterprise of man." More than a century later, researchers still have not adequately examined productivity and creative work in the household. Social goals regarding diversity and inclusive justice would be advanced by more systematic inquiries into the demand and supply of creativity within the household economy, and how they changed over the course of the industrialization. Despite these still-unfulfilled tasks, the extensive array of cliometric scholarship on inventive activity and innovation over the past four decades has significantly enhanced our understanding of the sources of economic growth and social progress.

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