QUADRATIC PATENT POLICY

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INTRODUCTION

The patent system is in crisis. Everyone seems to agree on this point. The scholarly literature is littered with references to the failures of patent law, the costs it imposes upon society and the economy, and the disconnect between the modern patent system and the innovation it is meant to foster (Silbey 2014; Jaffe & Lerner 2007; Bessen & Meurer 2009; Burk & Lemley 2009). Congress considered patent reform bills for nearly a decade before finally passing one in 2011, and that bill, while widely viewed as an improvement, is also seen as inadequate to the point that many actors within the patent system are already advocating for another one. Innovative firms have supported these requests for legal change in droves, indicating that they share the belief that the laws governing patents should be amended. Numerous district court judges have similarly called for reform, joined by several prominent appellate judges as well. Indeed, the only actors with any involvement in the patent system who seemed pleased with the status quo are the judges of the Federal Circuit—and they are viewed by many as a significant part of the problem.

But for all of this agreement that the law has failed, there is precious little accord on what should be done. Some scholars have called for significant reform through legislation passed by Congress. Others have suggested that the courts are best positioned to cope with the patent system's pathologies, and in some cases they have argued that the courts have already made significant strides (Burk & Lemley 2009). Still other scholars (this author included) have argued that the best cure for what ails the patent system will come from the Patent and Trademark Office (PTO). These scholars have suggested that Congress should endow the PTO with substantive rule-making authority, and that the PTO should then should use that rulemaking authority to reform the patent system through regulation (Masur 2011; Golden 2011).

The ongoing calls for patent reform serve as an indication that none of these institutional actors has yet fulfilled its mission. Despite the myriad paths to reform, the patent system remains dysfunctional, perhaps as dysfunctional as it has ever been. If there is an institutional solution to be found, it is taking its sweet time to arrive.

The thesis of this paper is that no solution will be forthcoming, because no existing institutional actor is capable of fixing the patent system. The innovation economy is so complex, and the tools that these institutions possess are so modest, that

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they will never be able to do more than guess at appropriate solutions. And even if they are fortunate enough to guess correctly, technology and innovation markets evolve so quickly that solutions will not be workable for very long. Improvements will likely occur at the margins. In short, given the institutional mechanisms currently at our disposal, there is reason for pessimism.

What is needed is a means of accurately aggregating the many divergent interests that make up the innovation economy: the needs of basic researchers and follow-on inventors; of large technology companies and small start-ups; of for-profit enterprises and universities; of patent owners and potential infringers; of innovation consumers and innovation producers. None of the traditional governmental institutions are capable of effectively aggregating these interests, for reasons to be discussed below.

Accordingly, this article suggests a turn to a different type of solution: a popular referendum. But not just any referendum. As economists and political scientists have long understood, a traditional one person/one vote referendum is a flawed mechanism for aggregating preferences because it cannot measure the intensities of those preference. An individual who cares deeply about a particular outcome has the same voice as one who cares only very slightly. A slight majority of mostly disinterested individuals can outvote a highly passionate minority. And in the context of innovation, where some parties—particularly patent holders—will likely to care greatly, and others—particularly consumers—will likely care very little, this concern is magnified substantially.

Instead, this article proposes that patent law implement a system of quadratic voting, as developed by Glen Weyl and Steven Lalley (2013) and applied to law by Posner and Weyl 2015). Since the development of quadratic voting, scholars have proposed employing it in a variety of legal contexts, including bankruptcy and reorganization (Posner & Weyl 2013); corporate governance (2014); and a broad swath of questions of democratic governance (Posner & Weyl 2015). A second claim of this paper is that quadratic voting will not only be useful as applied to IP, it might be as useful or even more useful than in any other area of law, precisely because intellectual property is so resistant to more standard modes of policy analysis and decisionmaking.

The article proceeds in two Parts. Part I describes the inherent limitations of intellectual property policymaking through Congress, the courts, and an administrative agency, particularly in contrast to other areas of law. Part II sketches out a process by which quadratic votes on intellectual property questions might be scheduled, held, and then implemented.

I. THE SHORTCOMINGS OF TRADITIONAL INSTITUTIONS

The problems with patent law are large and systemic. The Patent and Trademark Office grants too many patents, and in particular too many bad patents (Merges 1999). It is possible to patent too many types of inventions, including inventions that are little more than basic ideas or pure research. Patents are often too easy to obtain, even when an innovator has not truly succeeded in inventing the subject matter at issue; and

occasionally they may be unduly difficult to obtain, frustrating basic research. Patent damages are typically too high, except in cases when they may be too low (Masur 2015; Malani & Masur 2013). And they are largely random, with courts and juries lacking any concrete guidance as to how to calculate them. The result is a patent system that, in many areas of technology, may be doing as much or more to hinder innovation as it does to promote it.

Scholars have suggested a range of institutional solutions to these problems. Some have argued that the federal courts—and in particular, the Federal Circuit—could serve as the prime movers in fixing what ails patent law (Burk & Lemley 2009). Others have called for greater congressional intervention. And still others (including this author) have suggested that the Patent and Trademark Office is best positioned to make whatever changed are necessary (Masur 2010; Golden 2011). The unfortunate reality, however, is that none of these institutional bodies is well-equipped to find a solution. Other areas of law might be amenable to productive intervention by the usual institutional actors. But patent law, with its combination of technical and economic complexity, is not—or at least not to any workable degree. This Part lays out that argument, beginning with the courts and then proceeding to Congress and the PTO.

A. The Federal Courts

For the past three decades, the federal courts—and in particular the Federal Circuit—have been the primary locus of patent lawmaking. Congress has not significantly altered the substantive rules governing patentability since 1952, and in the interim the federal courts have evolved a complicated body of doctrine to govern every aspect of patent law. It is natural, then, that scholars have turned first to the courts as a potential solution to the problems that plague the patent system. If it is the courts that have built the system, then perhaps the courts can repair it.

Yet as comforting as it would be if the courts were up to the task, there is much reason for pessimism. Part of the source of this pessimism is familiar: patent law is frequently too complex for courts to properly manage or understand. The district courts, the Federal Circuit, and of course the Supreme Court are staffed by generalist judges, very few of whom have technical degrees or even backgrounds in patent law. (Clerks with technical backgrounds are also relatively rare outside of the Federal Circuit.) Courts regularly make hash out of technically complicated patent cases, with results that are predictably incoherent from a scientific perspective.

Consider, as just one example, the Supreme Court's relatively recent decision in *Association for Molecular Pathology v. Myriad Genetics* (2013). There, the Court was faced with the question of whether isolated DNA and cDNA sequences constituted patentable subject matter under section 101 of the Patent Act. The Court held that the isolated DNA sequences were not patentable because they were "products of nature"—they occurred within the human body. But it held the cDNA sequences patentable because they did not occur in nature but were instead produced in a laboratory through human ingenuity. This conclusion, which sounds plausible on its face, had the

unfortunate quality of being incoherent as a scientific matter, which any skilled biologist could have told the Court—and many did (Burk 2013).

Yet although the courts' struggles with technical subject matter is the most frequently adduced complaint, it is likely overstated. The courts' scientific errors, and the legal errors they generate, are problematic only if the underlying doctrine is sound. That is, it is only significant that the Supreme Court incorrectly believed that cDNA was not naturally occurring if the patentable subject matter rule that prevents patents on naturally occurring substances is itself sensible policy. If the distinction between products of nature and human-made inventions is not functionally important, then it matters very little whether the court correctly adjudicated that distinction in any given case. Perhaps the court was correct to effectively split the difference in *Myriad*, denying patent protection to one of the inventions at issue while granting it on the other.

Is the doctrine of patentable subject matter sound, and does it lead to socially beneficial results? The theory behind patentable subject matter jurisprudence is that products of nature are frequently the building blocks of other inventions. If the courts were to allow patents on products of nature, the holders of those patents might inhibit follow-on innovation by other inventors and researchers. Denying patents on products of nature will allow a multiplicity of subsequent researches to produce innovations building upon the products of nature; granting patents on the human-made inventions that follow will help to create incentives to generate those subsequent inventions.

Stated in those terms, the doctrine appears rational. But there is a large gap between legal doctrine that appears reasonable on its face and doctrine that actually functions as desired. Many discoveries of products of nature, such as Myriad's isolation of the breast cancer gene, require tremendous upfront investment in research and development. In some cases, firms may be unwilling to make those investments without the promise of patent protection for fear that others will free-ride off of their efforts. (That is, the same concerns about incentives and free-riding that animate the reward theory of patent law can apply equally to discoveries of products of nature as to human-made inventions.) What is more, some scholars believe that it is economically productive to award patents at a very early stage in the lifecycle of an innovation in order to short-circuit wasteful races to patentable technology (Kitch 1977; Grady & Alexander 1992). This "prospect" or "rent dissipation" theory of patent law maintains that the first firm to receive a patent will be able to bargain with subsequent inventors to produce further technological development.

Which of these sets of arguments is correct? There is simply no way to know with any degree of certainty. What empirical evidence exists is sparse (Moser 2005; Williams 2013; Budish et al. 2015), and the courts have shown no ability or inclination to interpret it. And of course they cannot even begin to gather more. So it is possible that the Supreme Court's pragmatic solution—patents on cDNA, but not on isolated DNA—was wrong, and that it should have allowed patents on isolated DNA sequences as well.

It is also possible that the Court should not have permitted patents on either type of DNA. Part of the Court's motivation for allowing patents on cDNA appeared to be the concern that disallowing patents on all related inventions would leave biotechnology companies without adequate incentives to innovate. The patent system needed to provide some type of reward lest research grind to a halt. But as one commentator has observed, there are a wide variety of non-patent research incentives available to innovative firms, particularly in the area of biotechnology (Ouellette 2015). The Court was either ignorant of these incentives, or perhaps it considered them irrelevant. And indeed it is difficult to gauge their significance. But if there is any party well-equipped to assess their relevance, it is surely not the Court. All of this is to say that the Court's decision to allow some patents but not others is difficult to defend on economic grounds, if not on doctrinal ones.

Even the courts' apparent successes are not long-lived. In the aftermath of the Court's decision in *Alice v. CLS Bank* (2014), commentators noted the decline in patent suits, particularly suits brought by non-practicing entities, and suggested that *Alice* might have substantially mitigated (if not cured) the "troll" problem in patent law. This was taken as evidence that the courts were responsive to perceived systemic problems in patent law and could act effectively to cure them when they arose. As an initial matter, it is not self-evident that the decline in filings truly represented a solution—there might have been more licensing (causing equally great problems), or the suits that were not filed might have been the least significant ones. But beyond even that, the trend did not last long. Patent lawsuit filings are back up, and commentators are once again beginning to discuss the need for legislative action to ameliorate the troll problem. This does not mean that the Court's decision in *Alice* was incorrect or misguided. Nor should it be taken as an indication that *Alice* is somehow to blame for the recent trend. The point is that the courts cannot devise cures for major patent problems quite as easily as their defenders would like to believe.

It is not by accident that most areas of law with technical complexity even approaching patent law have long since been divested from the courts and bestowed upon administrative agencies or other more expert bodies—consider environmental law, banking and securities regulation, and workplace health and safety, to name just a few. The courts, well-intentioned as they may be, are simply not up to the task.[1]

B. Congress

As judicial efforts appear to have fallen short, ever greater attention has shifted to Congress. Congress has not traditionally been heavily involved in the regulation of patent law; again, with few exceptions, it has not significantly altered the substantive rules of patentability and infringement since 1952. But in recent years it has entered into the patent fray in more assertive fashion. Patent reform bills were introduced in Congress every year beginning in 2002, and many of those bills progressed out of committee or further. Finally, in 2011, Congress passed the America Invents Act. Although it was the

[1] And it is not entirely clear how well-intentioned they are. The Federal Circuit is notorious for claiming that its job is to interpret the Patent Act, not to make patent policy. In so stating, the court is either disingenuous or hopelessly naïve.

most significant congressional action related to patent law since 1952, it nonetheless fell well short of what many interested parties had hoped for. Its changes, while important, were largely procedural: most notably, it created new processes for re-examining patent validity within the PTO and modified the rules regarding joinder of parties within the same lawsuit for infringement. The only substantive modification to the patentability rules was to switch the United States from a first-to-invent to a first-to-file regime. This is a minor change that does not touch upon the patent system's most significant pathologies.[2]

In any event, the America Invents Act barely curtailed calls for reform, and congressional action slowed only briefly. New reform bills have been introduced in every session of Congress since 2011, and one bill passed the House of Representatives during the 113th Congress. It is entirely possible that Congress will again intervene in the patent system, and so it is natural to look to Congress as a source of solutions to patent problems. But is Congress well-equipped to provide these solutions?

As an initial matter, the concerns regarding an institution's ability to make complex technical and economic decisions, which loomed large in the context of courts, apply with some (though less) force here as well. In theory, Congress could draw upon as much expert guidance as any institution. It can hold hearings; it can conduct empirical studies (or provide funding for others to conduct them); and it can hire significant numbers of expert staff members, particularly if the issue warranted it. In practice, however, Congress almost never does any of these things. Its hearings are little more than political theater, with zero learning taking place. For every study there is a counter-study, and Congress does not appear to make any attempts to adjudicate between them in systematic fashion (Letter of Law Professors 2015). And while Congress is staffed by legions of lawyers who are no doubt expert in law, members of Congress hire relatively few staff members with scientific or economic expertise. All told, Congress is operating far below its potential. It is not by accident that Congress has traditionally delegated to agencies the hard work of regulating in technically complex areas of law.

Yet this is not the only reason why Congress is ill-suited to manage patent law, or even the primary one. Congress's primary deficiency is in the area where one might expect to find a strength: it is overly subject to the political process. This is not a complaint that Congress is gridlocked and unlikely to act; rather, the problem is that patent law is the type of legal field in which Congress is especially prone to decisions that represent neither the will of the majority nor an overall improvement in social welfare.

The political economy of patent law does not favor social welfare-enhancing reforms. The texture of intellectual property law will affect a large number of variegated parties, both great and small, including basic researchers, innovative firms, and consumers. But standard public choice theory suggests that Congress will be much more responsive to the interests of some of these parties than others (Olson 1965). Large, well-financed corporations—Pfizer and Merck, or Apple and Google—are likely to have their

[2] For that matter, the switch from first-to-invent to first-to-file might be best understood as a modification of evidentiary standards for proving novelty.

views heard. Dispersed individuals—the consumers of biotechnology or electronics—are less likely, even when those individuals collectively have as much or more at stake as the corporations. Individuals do not have the power or ability to lobby Congress, and it is more difficult for them to convey their views on individual issues even when they elect to make monetary donations. They can sign petitions, and they can offer public comments on matters of importance. But these mechanisms offer only limited access and ability to sway public decisionmakers. There is ample evidence that it is money that talks: members of Congress follow their donors.

Of course, this problem is hardly unique to patent law. But in other areas of law and policy, non-profit interest groups have arisen to present a counter-weight to moneyed corporate interests. In the environmental context, groups like the Sierra Club and the Environmental Defense Fund serve a centralizing and organizing function, assembling funds from large numbers of private donors with strong preferences over environmental issues and using those funds to lobby and litigate in their members' interests. Labor unions, the National Rifle Association, Human Rights Campaign, and the Family Research Council perform similar functions in other areas of law—and there are countless other examples. Yet such consumer-interest groups are largely absent from patent law. There are no organized interests to represent consumers of smartphones and tablets, heartburn medication or hay fever relief.[3] Individuals with interests in these products—their continued development, and their availability—remain individuals, dispersed and largely voiceless in the lawmaking arena.

The reasons for this lacuna are not clear, and one can do little more than speculate. But at least two plausible candidate explanations present themselves. The first is that IP may simply be less emotionally and ideologically resonant than the many other public policy issues around which citizen interest groups have formed. Few people, even scholars who care deeply about IP, become as exercised about intellectual property policy issues as they do about other areas of public policy. If intellectual property is not an issue about which enough people feel strongly, then it is unlikely that any popular movement will arise.

The second possible explanation—which may have a causal relationship with the first—is that both the costs and benefits of intellectual property are well-concealed. When a consumer purchases a product, the additional cost due to the existence of patents is not noted in a separate line on the bill, as a tax on the product might be (Hemel & Ouellette 2014). The consumer has no idea how much of the cost is due to the materials and labor required to create the product and how much of it is due to the intellectual property contained within. The one contrary example is prescription drugs, which become noticeably less expensive when their patents expire and generics enter the market. Yet even in this context, consumers resist acknowledging those costs. Many

[3] It is notable that even organizations that would seem to fit the bill, such as the Coalition for Affordable Drugs, do not play such a role. For instance, the inaptly named Coalition is actually a company run by hedge fund manager Kyle Bass that exists to challenge valuable pharmaceutical patents. The Coalition for Affordable Drugs might in fact serve the interests of consumers in some cases, but it is not a patent lobbying group.

consumers have insurance plans that cover prescription drugs, so they do not observe (or pay) the full patented price. Others resist purchasing the cheaper generic drugs in favor of their more expensive brand-name counterparts even after the patents have expired, obviously believing that there is some value to the higher price above and beyond the costs of a patent. And this is just one example; nearly every other product available shrouds the cost of IP in secrecy.

The same is true for intellectual property benefits. Consumers may understand at some level that patents are meant to promote innovation, but it is impossible to say that any particular invention would not exist but for the patents surrounding it. It is difficult to imagine a consumer staring at a shelf of analgesics, grateful for the fact that patents once spurred the development of so many useful drugs (which may or may not actually be true). Moreover, recognizing this fact requires confronting a hypothetical alternative universe that has never existed in the United States. Patent benefits are based upon a counterfactual that no one has ever seen; the same cannot be said for environmental law, social policy, public safety, or nearly any other area of public policy. It is little wonder that citizens are not rushing to mail donations to the Intellectual Property Consumers' Association.

This is not to say that one view of patent law or the other will necessarily prevail within Congress. For years, patent law at the legislative level has remained largely in equipoise, with powerful interests on both sides. Brand-name pharmaceutical firms are balanced by generic manufacturers; some high-tech firms such as Google and Microsoft are likely net "buyers" of IP, while others such as Texas Instruments and Apple are likely net "sellers." Influence has balanced influence. Rather, the point is that Congress will not function as an effective aggregator of overall preferences and general social welfare because it will be under-influenced by the views of the individual consumer. This problem is not unique to patent law, but it is especially acute in that field. Regardless of the political decisions Congress makes and the bargains it strikes, there is little reason to be confident that it has reached the correct outcomes.

C. The Patent and Trademark Office

In light of the apparent shortcomings of courts and Congress as prime movers in patent law, several scholars (including this author) have suggested that Congress should endow the Patent and Trademark Office with the authority to make substantive patent law. Placing the primary responsibility for legal reform in the hands of an expert administrative agency would bring patent law into alignment with most other technically complex legal fields, including environmental law, securities and banking regulation, and workplace health and safety regulation. Yet while it still possible to believe that the PTO is better suited than the courts or Congress to shepherd patent law, the PTO will also confront nearly insuperable hurdles that will prevent it from playing as effective a role in patent law and policy as comparable agencies do in their areas of expertise.

For more than thirty years, through five presidential administrations (three Republican, two Democratic), the touchstone of administrative policy-making has been

cost-benefit analysis (Bronsteen, Buccafusco & Masur 2013). When deciding upon a policy or regulation, agencies are expected to quantify and tabulate the costs and benefits of that policy and compare them. The agency should act only when benefits exceed costs—or, to be more precise, it should take the action that maximizes benefits net of costs. Cost-benefit analysis has been controversial since its inception, and it remains so today. But no critic has been able to devise a workable decision procedure that does not involve comparing costs and benefits in some form. The basic structure of the inquiry—maximize benefits net of costs—has persevered.

In most regulatory contexts, agencies are able to perform cost-benefit analysis with relative acuity. Take, for example, an EPA regulation banning the use of hazardous chlorine-based chemicals in the manufacture of paper and wood pulp (Masur & Posner 2010). The benefit of such a regulation is that it will save lives: if pulp and paper manufacturers no longer use the dangerous chemicals, which often find their way into the food chain, several fewer people per year will become ill and die from cancer. The costs are monetary: the safer alternative chemicals are more expensive, and pulp and paper manufacturers will likely pass the additional costs along to consumers in the form of higher prices. The EPA need only estimate these costs and benefits, translate them into dollars or (preferably) units of well-being (Bronsteen, Buccafusco & Masur 2013), and compare them. For a slightly fuller and more dynamic picture, the EPA might additionally calculate the regulation's effect on unemployment and incorporate the costs (benefits) of job loss (gain) into the analysis (Masur & Posner 2012). One should not overstate the ease with which agencies can perform these calculations, but neither should they be viewed as excessively complex or unattainable. Relatively sound cost-benefit analysis has been well within the reach of expert administrative agencies for several decades—at least when it comes to most areas of law and regulation.

Yet this analysis, which has become so routinized in the context of environmental or workplace safety law, will be anything but routine when applied to patent law. Patent law is a dynamic system whose effects depend upon the interlocking actions of a broad spectrum of private parties. There is substantial uncertainty surrounding how any given actor will respond to a change in the law, which makes it especially difficult even to calculate the likely effects of that law, much less its costs and benefits. The analysis is far less straightforward than simply adding up the costs of switching to another chemical and comparing that figure to the number of people who will not contract cancer if the switch occurs.

For instance, imagine that the PTO has rulemaking authority and is considering changing the patentability rule of nonobviousness.[4] Until 2007, a court could not hold an invention unpatentable as an obvious combination of two pre-existing inventions without a specific "teaching, suggestion, or motivation" that suggested the combining those two inventions. In *KSR v. Teleflex* (2007), the Supreme Court upended this rule, holding courts could invalidate patents as obvious even without a particular "teaching, suggestion, or motivation." This naturally made it more difficult to obtain a patent.

[4] 35 U.S.C. § 103.

Imagine that the PTO were to consider returning to the pre-2007 rule, which would again make patents easier to obtain and more difficult to invalidate.

The primary benefit of such a change is that greater numbers of patents would, in theory, create greater incentives for firms to innovate. However, calculating this benefit is far from trivial. The PTO would be required to determine not only how many more patents would be granted under the new law, but how many of those patents would represent research and development that would not have taken place but for the change in the law. That, in turn, would require examining the alternative incentives available to innovative firms—including simply the desire to be able to market the new invention—in order to ascertain the marginal benefit of adding patents to the mix (Hemel & Ouellette 2014). This is an undeniably complex inquiry, and one that may be beyond the ability of experts even were they armed with all of the available data.

The cost side of the equation is no easier. There are two principal negative consequences of making it easier to obtain patents: increased costs to consumers, and increased costs to subsequent inventors. Yet neither of these is a direct societal cost, unlike the higher price of a more expensive chemical being substituted for a less expensive one. Patents permit innovative firms to suppress competition and thus charge higher (monopoly) prices for their patented goods. By itself, this is only a transfer—consumers forfeit some of their wealth to producers. The social cost is the possibility of deadweight loss: some consumers who would purchase the product at competitive prices cannot (or will not) afford it at monopoly prices. Determining the increase in deadweight loss from a legal change that makes patents easier to obtain would require the PTO to calculate five quantities: (1) the number of additional patents that will exist because of the change in the law; (2) the number of products affected; (3) the price increase that the additional patents would permit (which requires estimating likely marketplace alternatives); (4) the number of people who will not purchase the product at the higher price but would purchase it at a competitive price (which requires estimating the demand curve for the product); and (5) the social cost of these foregone purchases. These calculations range from complicated but manageable—for example, economists already perform step #4 when they estimate employment effects of regulations—to probably impossible. And even if not impossible, these calculations at minimum represent a significant step beyond the types of calculations agencies are currently asked to undertake in the course of cost-benefit analysis.

Determining the additional costs to subsequent inventors will be no easier. After determining the number of additional patents that would issue under the new rule and the number of products those patents would affect, the PTO would then be forced to ascertain what the patent holders would do with those patents. Will the patent holders actively work to suppress innovation, or will they license the patents to other firms? If the latter, at what price, and what effect will these additional costs have on incentives to perform follow-on research? For that matter, will the patents be cheap or costly for future productive firms to discover (Masur 2010)? Will the environment be rife with transaction costs or largely frictionless? Even if the PTO can answer all of these questions, they will not provide a measure of actual costs—many of these "costs" are

actually transfers. Social costs will accrue only when these additional costs to subsequent inventors result in foregone innovation, the estimation of which presents all of the difficulties described above.

None of these points should be taken to mean that the PTO will be completely ineffectual at managing patent policy, or that it will perform worse than the courts or Congress might. The PTO's expertise will still be useful in setting patent policy, and the agency is still a superior repository of patent authority than either the courts or Congress precisely because of that expertise. Rather, the point is that without the ability to perform plausible cost-benefit analysis, the PTO will have greater difficulty formulating sound patent policy than the EPA does in formulating environmental policy, or than OSHA does in formulating workplace safety policy, and so forth. The PTO has a comparative advantage over the courts and Congress, but any agency addressing the patent system will be at a disadvantage compared with agencies that operate in other areas of law. These difficulties are inherent to patent law, and there is little that the PTO or any other institution can do to overcome them.

II. QUADRATIC PATENT VOTING

The fundamental problem facing any actor seeking to develop patent policy is one of aggregation. The patent system involves interactions among a wide range of private parties, all of whom have occasionally concordant and occasionally divergent interests. Sound policy must balance the short- and long-term needs of basic researchers and subsequent inventors; producers and consumers; large firms and small; and so forth. But the basic aggregative institutions within American government are not up to the task. Congress is too likely to be swayed by well-organized and well-financed parties, to the exclusion of more disparate individual preferences. Agencies, for their part, cannot employ typical cost-benefit tools effectively because of the economic complexity and dynamic interactions that patent law involves. And courts cannot overcome the technical and economic challenges. What is needed is a more effective mechamism of aggregating the preferences of the various parties who rely upon innovation policy (or its fruits).

Quadratic voting is that mechanism. Quadratic voting and patent law are not an obvious match in large part because patent law has never involved voting of any type—unlike corporate governance, bankruptcy, or the many democratic contexts to which scholars have previously suggested applying quadratic voting. However, this should be taken as a point in quadratic voting's favor. There is widespread belief that the institutional arrangements governing patent law are no longer functioning effectively (if they ever did). Given the poor record of these institutions, new solutions seem called for. And given quadratic voting's advantages over not just the democratic process but also common-law adjudication and cost-benefit analysis (Posner & Weyl 2015), it is possibly a first-best solution for patent policy.

Despite the departure from current practice, quadratic voting in intellectual property would be relatively straightforward. As an initial matter, it would require an act of Congress. Congress could pass a law calling for a quadratic vote on a particular issue.

Alternatively, it might pass a law that authorizes the Director of the PTO to call for a quadratic vote on a given issue of patent law. Or Congress could even enact a law providing the Supreme Court, or the *en banc* Federal Circuit, with the power to call for a quadratic vote on a given question. This last option might seem especially outlandish, but in fact it is not particularly different than the federal courts' ability to certify questions of state law to state supreme courts (Nash 2003). Here, the Supreme Court or Federal Circuit would effectively be certifying a question of law to the (quadratic) voters, rather than to another court. These various procedures need not be mutually exclusive. Congress could allow any or all of these actors—the PTO, the Federal Circuit, or the Supreme Court—to certify a question for a quadratic vote while still preserving its own authority to do the same.

The next issue would be settling on precisely what question would be subject to the vote. To ground this inquiry, suppose that it is the year 2012 and the litigation in *Association for Molecular Pathology v. Myriad* is making its way through the courts. That case raised several critical issues, including whether either isolated DNA sequences or cDNA sequences (or both) could be patented. At any stage of that litigation, the Supreme Court or the Federal Circuit (if so empowered), or Congress, could call for the question to be decided by a quadratic vote. The institution calling for the vote would then choose how to frame the question. This exercise is similar to how the Supreme Court grants certiorari with respect to one or more questions presented (Hartnett 2000). The courts or Congress might state the issue as follows:

> Question 1: Are isolated DNA sequences eligible for patenting under § 101 of the Patent Act?
>
> Question 2: Are cDNA sequences eligible for patenting under § 101 of the Patent Act?

A quadratic vote would then take place, with these two questions on the quadratic ballot. Voters could purchase votes for either or both of the questions, just as a voter in a standard election can choose to vote on all or only some of the offices or ballot questions at issue.[5] The vote would be administered by the PTO and would take place over a period of time—perhaps a month. At the end of the vote, the PTO would announce which side had won and distribute the money paid to buy votes back to the voters.

[5] One critical issue in conducting a quadratic vote is preventing vote fraud. It costs $4 for one individual to purchase 2 votes, but only $2 for two individuals (or corporations) each to purchase 1 vote. This creates a significant incentive for individuals or corporations to attempt to manipulate the vote either by paying others to vote a certain way or by setting up fake corporations—in essence, creating additional legal persons. Of course, the problems with individual voter fraud are similar whether it is a standard vote or a quadratic vote that is being conducted, so the usual rules and practices that prevent voter fraud in the typical democratic context would most likely suffice here. The issue of corporate voting is more difficult and would require additional voting rules and legal intervention. The PTO could limit the types of corporations allowed to vote—for instance, requiring a minimum amount of assets or revenues—in order to screen out shell corporations that exist only for the purposes of casting votes. Or it might allow only parent corporations to vote, preventing further votes from their subsidiaries. There are a number of potential solutions; the central point is that agency supervision of a quadratic election will not be trivial.

Here is a stylized example of how such a vote might proceed. Imagine that Myriad, the company whose interests are most immediately at stake, pays $1 million for 1,000 yes votes on each question. Suppose there are three additional upstream biotechnology firms with an interest in patents on all forms of DNA. They each pay $10,000 for 100 "yes" votes on each question. Now imagine that there are twelve downstream biotechnology firms that use DNA as a building block in the development of their drugs; each of these firms pays $10,000 for 100 "no" votes on each question. Suppose finally that there are 500 individuals who believe they have an interest in the issue of DNA patents because they expect to be consumers of drugs derived from DNA innovations. They are divided, however, on whether patents will be good for them in the net—because they will produce more innovation—or counterproductive—because they will lead to higher prices. Of the 500 individuals, 350 of them pay $1 each to cast 1 vote against patents on isolated DNA sequences, while the other 150 pay $1 each to cast 1 vote in favor of patents on isolated DNA sequences. With respect to cDNA sequences, the vote is more split; 200 pay $1 to cast 1 vote against patents, 150 pay $1 each to cast 1 vote in favor of patents, and 150 decide not to vote on this measure. The vote totals are as follows:

Question 1 (Isolated DNA Sequences)									
"Yes" votes					"No" votes				
Entity	# voting	Dollars spent	Votes purchased	Total votes	Entity	# voting	Dollars spent	Votes purchased	Total votes
Myriad	1	1,000,000	1000	1000	Downstream biotech	12	10,000	100	1200
Upstream biotech	3	10,000	100	300	Individuals	350	1	1	350
Individuals	150	1	1	150					
Total votes:				1450	Total votes:				**1550**

Question 2 (cDNA Sequences)									
"Yes" votes					"No" votes				
Entity	# voting	Dollars spent	Votes purchased	Total votes	Entity	# voting	Dollars spent	Votes purchased	Total votes
Myriad	1	1,000,000	1000	1000	Downstream biotech	12	10,000	100	1200
Upstream biotech	3	10,000	100	300	Individuals	200	1	1	200
Individuals	150	1	1	150					
Total votes:				**1450**	Total votes:				1400

In this stylized example, "no" voters prevailed on Question 1 (patents on isolated DNA sequences), while "yes" voters prevailed on Question 2 (patents on cDNA sequences).[6] The result of the vote would then be treated as if it were the text of a law passed by Congress. Suppose that there were a greater number of votes cast for "no" on question 1 and "yes" on question 2. The vote would be legally equivalent to Congress passing a law that stated:

> § 1: Isolated DNA sequences are not eligible for patenting under § 101 of the Patent Act.
>
> § 2: cDNA sequences are eligible for patenting under § 101 of the Patent Act.

Of course, the text of these newly created "laws" would not answer every salient question, nor would they be self-executing. There might be room for interpretation or ambiguity, particularly as applied to future inventions—for example, does a particular

[6] To illustrate the final step of the vote, in which the money spent on votes is returned to the voters: the total amount spent on the vote on Question 1 was \$1,000,000 + (\$10,000 × 3) + (\$10,000 × 12) + (\$1 × 150) + (\$1 × 350) = \$1,150,500. There were a grand total of 516 voters, and so each voter would be retuned approximately \$2,229.65. This return of funds provides a significant incentive for more voters to participate, which is useful in a system of quadratic voting. Lalley and Weyl (2013) prove that as the number of voters increases, the likelihood that the election will generate the efficient result similarly increases and approaches unity.

sequence qualify as a cDNA sequence? It would then be left to the courts to interpret and apply the new laws, as if they were acts of Congress.[7]

The overwhelming advantage of such a system is that it allows for the effective aggregation of the views and preferences of diverse individuals and corporate entities. Each voter has an incentive to vote honestly and reveal her true preference with regard to the patent issue at hand. And a firm that participates in the vote likely has much better information regarding the effects of the change in law on its own business than an agency such as the PTO could assemble. As Part I.C described, it will be nearly impossible for the PTO to determine with any confidence the effect of allowing DNA patents on upstream and downstream producers. The economic questions are too complicated, and the firms themselves have all of the useful expertise and hold all of the critical information. Quadratic voting creates incentives for those firms to divulge the relevant information through the votes they cast. Quadratic voting will likely lead to patent policy that is superior to what an agency or court could generate.

At the same time, quadratic voting dampens the influence of wealth on political decisionmaking. The diminished influence of wealth in this stylized example is striking. Five hundred individuals, who spent a grand total of $500, were able to have half as much influence as one corporation that spent $1,000,000. Those 500 individuals surely would not have fared as well in the political arena, were they outspent by a factor of 2000 by a single corporation. For this reason, quadratic voting will likely lead to patent policy that is superior to what the political process itself would produce.

At the same time, the superiority of quadratic voting to the typical congressional political process—and the extent to which quadratic voting mitigates the influence of wealth—raises a final, crucial question: why would the politically (and financially) powerful interests with outsized influence over Congress ever consent to the implementation of a system that diminishes that influence? That is, how could Congress ever be persuaded to enact a system of quadratic voting when doing so would harm the moneyed interests that influence congressional voting (Posner & Vermeule 2013)?

This is a valid concern, and one to which there may be no good answer. It is possible that Congress cannot be persuaded to act, and quadratic voting will never come to intellectual property.[8] But there is some reason for optimism. This optimism stems from the fact that the impact on the law of a system of quadratic voting is uncertain. It might be that quadratic voting would produce much stronger patent rights; it might be that quadratic voting will produce much weaker patent rights. Interested parties—including the most powerful firms with the greatest power over Congress—are operating

[7] Courts would use whatever tools of interpretation and construction they might normally use when interpreting the Patent Act. Quadratic votes would even produce their own version of legislative history—information regarding the numbers of votes cast by various individuals or corporations—which the courts could use to interpret the new legal rules, should they so choose.

[8] Of course, if this is the case, then all hope is lost that Congress might itself reform the patent system or empower the PTO to do so. The only remaining recourse would be the courts, and their decisions are subject to congressional override.

largely behind a veil of ignorance (Rawls 1961). If the winners and losers from such a system are uncertain, interested parties will only oppose quadratic voting if they prefer the status quo to the unknown quadratic outcome.

On that issue there are points to be made on both sides. On the one hand, individuals (and firms) are generally thought to be risk averse and might accordingly be inclined to oppose a system that sacrifices certainty (Dyer 1992; Hu 1990). At the same time, however, individuals are also notoriously prone to "optimism bias": they believe that they are better than average, and they believe that they are more likely than others to experience good fortune (Gilovich, Griffin and Kahnemann 2002). Behind a veil of ignorance, many of the important participants in the patent system might believe that they would be likely to prevail in a quadratic vote. They might thus favor a move to such a system.

Lastly, it is important to note that there is no reason to believe that a majority (or even a particularly large minority) of politically powerful actors favor the current patent system. Most of the important rules are judge-made, rather than congressionally prescribed. It could very well be the case that a majority of politically powerful actors oppose those rules and would like Congress to amend them, but they have been unsuccessful in catalyzing legislation due to the many veto gates and supermajority rules embedded within Congress (Clark 2008). The preponderance of politically powerful actors within the patent system might prefer a shift toward quadratic voting, which would break the institutional logjam while simultaneously depriving the courts of their near-monopoly on patent law. Of course, it would be a mistake to overstate the case: enough patent actors favor the status quo to perpetuate it as the status quo, and these same actors might oppose quadratic voting as well. But it is entirely possible that a sufficient number of interested parties will feel the allure of the unknown and opt for quadratic voting over the malfunctioning status quo. If they do not, patent law may be consigned to missteps and malfunctions for a great while longer.

CONCLUSION

There is widespread agreement that significant problems plague patent law, and for every diagnosis of the problem there is a proposed solution. Some scholars favor judicial reshaping of the law; others propose congressional intervention; and still others advise delegating authority to the Patent and Trademark Office. Yet none of these institutions will be able to cure what ails the patent system. Courts lack the necessary expertise, not only in the relevant technological areas but also in economics and innovation theory. Congress is overly responsive to the well-financed interests that dominate its agenda, with no organized group of consumers to provide a counter-balance. And the PTO will struggle to analyze the impact of regulations with the same effectiveness as similarly situated agencies, such as the EPA, because the economics and sociology of innovation are simply too complicated to be dissected by normal agency tools of analysis.

In place of these traditional institutional solutions, we should substitute quadratic voting. By creating incentives for private parties to reveal the true extent to which they value different types of legal rules, quadratic voting more successfully aggregates dispersed preferences than any mechanism currently at the disposal of the courts, Congress, or an agency. And by dulling the effects of wealth on political influence, quadratic voting will better align policy with the preferences of all interested parties, not merely well-financed corporate interests. Quadratic voting for intellectual property—or, really, for any area of law—is of course a remote prospect. But it is one well worth exploring.

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