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## Nuisance Law and the Doctrine of Equivalents in Patent Law

Min-Chiuan Wang

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## NUISANCE LAW AND THE DOCTRINE OF EQUIVALENTS IN PATENT LAW

*Min-Chiuan Wang*<sup>†</sup>

*Professor Henry E. Smith claims that the doctrine of equivalents in patent law is similar to nuisance in the area of property law but does not provide many details. Following Smith's theoretical perspectives and the distinction between the exclusion and the governance strategies in particular, this Article explains why the doctrine of equivalents is similar to nuisance under Smith's theoretical framework. The similarity between these sets of doctrines is then explored through the Coase theorem and Pareto optimality, which can account for both doctrines in a similar fashion. However, using different concepts of welfare improvement is in order. Regarding the legal defenses of the doctrine of equivalents, such as the prior art bar or prosecution history estoppel, these use a preexisting Pareto optimality as the basis of the defense.*

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<sup>†</sup> Associate Professor of Law, National Chiao Tung University, Taiwan; Professor Wang holds a J.S.D. from Stanford Law School (2001), an LL.M. from Harvard Law School (1996), and an LL.B. from National Taiwan University (1989).

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## INTRODUCTION

Professor Henry E. Smith, a prominent property law theorist, contends that the doctrine of equivalents in patent law is akin to the doctrine of nuisance in property law, on the basis of the following:

Consistent with the exclusion strategy is today’s “peripheral” approach to patent claims, the definition of claims focuses on the outer bounds of what is claimed as an invention, without the need to specify the interior. The earlier central claim method, in which the central case of the invention was specified and the boundaries were worked out *ex post* is more of governance regime (in our terms), as is its pale reflection in the doctrine of equivalents, under which the scope of a claim can be extended beyond the literal reading.<sup>1</sup>

However, Smith’s explanation is short, opaque, and difficult for readers unfamiliar with property law theory to understand. They might

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1. Henry E. Smith, *Intellectual Property as Property: Delineating Entitlements in Information*, 116 YALE L.J. 1742, 1807 (2007).

doubt how the doctrine of equivalents, a patent law rule regarding the right to use intangible information, could be considered similar to nuisance law, which concerns the uses of land. It is also worth asking whether the two doctrines are similar only under Smith's theoretical framework, or whether other theoretical viewpoints support their similarity. Moreover, is this similarity valuable? Can it elucidate a general understanding of the structure of property rights?

Nuisance law concerns conflicting land uses by neighboring landowners, which has long been a favorite topic of economic analysis. Nuisance disputes can be analyzed through direct cost-benefit balancing in the Hand-Posner style,<sup>2</sup> or Guido Calabresi's indirect "choosing the chooser" method.<sup>3</sup> Smith's analysis of nuisance law follows the same utilitarian tradition but takes a theoretical turn by proposing two opposing methods of delineating property rights based on the information cost theory: the exclusion strategy, which serves as the basic regime, and the governance strategy, which serves as the supplemental regime.<sup>4</sup>

Nuisance law can be characterized as a hybrid regime, exhibiting a transition from the exclusion strategy to the governance strategy. The mixture and transition between these two strategies in property law endows nuisance law with universal application: nuisance law can serve as a model to illuminate legal doctrines that have a hybrid nature in other areas of law. Based on the observation that patent infringement exhibits the same transition from exclusion and governance, this Article claims that the doctrine of equivalents is a type of governance regime that has been pushed toward formalism.

The theory underlying this Article is often highlighted in the law and economics, or property law literature: the Coase theorem,<sup>5</sup> Pareto efficiency,<sup>6</sup> and Kaldor-Hicks efficiency.<sup>7</sup> These are invoked to support the thesis that the doctrine of equivalents and nuisance law are similar, and that the affinity in principle of these two sets of legal rules can be appreciated from another theoretical context.

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2. United States v. Carroll Towing Co., 159 F.2d 169, 173 (2d Cir. 1947).

3. Henry E. Smith, *Exclusion and Property Rules in the Law of Nuisance*, 90 VA. L. REV. 965, 969 (2004).

4. Smith, *supra* note 1, at 1745-46.

5. Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1 (1960).

6. VILFREDO PARETO, *MANUAL OF POLITICAL ECONOMY* 1-19 (Aldo Montesano et al. eds., John Cairncross et al. trans., Oxford Univ. Press 2014) (1906).

7. John Hicks, *The Foundations of Welfare Economics*, 49 ECON. J. 696 (1939); Nicholas Kaldor, *Welfare Propositions in Economics and Interpersonal Comparisons of Utility*, 49 ECON. J. 549 (1939).

Part I of this Article follows the context of Smith's theory, questioning how nuisance law can be considered similar to the doctrine of equivalents and finding that both have a hybrid or transitional nature.

Part II engages with another theoretical perspective. Ronald Coase's seminal article, *The Problem of Social Cost*,<sup>8</sup> has profoundly affected property law in general and nuisance law in particular. The connection is obvious: Coase's article uses cases in nuisance law to illustrate his economic theory.<sup>9</sup> Part II restates the Coase theorem, Pareto optimality, and Kaldor-Hicks efficiency.

Part III reiterates the theories often used to analyze nuisance law—the Coase theorem, Pareto optimality, and the balancing of costs and benefits—as a foundation for showing the similarities between nuisance law and the doctrine of equivalents in patent law. Nuisance law is a typical example of cross-boundary allocations of property rights. Whether courts can make cross-boundary allocations requires the weighing of costs and benefits, which is reflected in elements such as reasonableness or substantial interference. In addition, nuisance law uses preexisting Pareto optimality as the grounds for defending against infringement, based on the rationale that the parties expressly or implicitly consented to the conditions of the location.<sup>10</sup> The location rule (i.e., the character of the neighborhood) is an example.<sup>11</sup>

Part IV links the method for determining non-literal infringement in patent law to means of improving well-being in economics. Guido Calabresi identifies two methods of welfare improvement—“moving along the Pareto frontier” (the production possibilities frontier) and “moving the Pareto frontier outward.”<sup>12</sup> A Pareto superior move along the frontier can be made by voluntary transactions, such as licensing agreements, whereas moving the Pareto frontier outward refers to innovations that make previously impossible welfare improvements feasible.<sup>13</sup> In patent law, an accused infringer who makes a substantial change to the technology in question would move the Pareto frontier outward. Even if the accused infringer did use some technological ideas from the claimed invention, the court would find the accused product

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8. Coase, *supra* note 5.

9. See Thomas W. Merrill & Henry E. Smith, *Making Coasean Property More Coasean*, 54 J.L. & ECON. S77, S84 n.5 (2011) (listing the cases related to nuisance law in Coase's *The Problem of Social Cost*).

10. Richard A. Epstein, *Nuisance Law: Corrective Justice and Its Utilitarian Constraints*, 8 J. LEGAL STUD. 49, 87-90 (1979).

11. *Id.* at 87.

12. Guido Calabresi, *The Pointlessness of Pareto: Carrying Coase Further*, 100 YALE L.J. 1211, 1212 (1991).

13. *Id.* at 1212, 1231.

or process not substantially similar to the claimed invention, and reallocate property rights to the resource (i.e., the inventive concept of the claimed invention) with a finding of non-infringement.

The finding of non-infringement under the doctrine of equivalents, similar to the test of reasonableness, is a process by which courts weigh the benefit of the defendant's act against its cost.<sup>14</sup> The difference is that, in patent law, the well-being improvement that justifies judicial reallocation of rights is even narrower; only "moving the frontier outward" can justify the court's reallocation of rights under the doctrine of equivalents.

#### I. SMITH'S THEORY: FROM NUISANCE LAW TO THE DOCTRINE OF EQUIVALENTS

In this section, this Article follows Professor Smith's theoretical insight, especially the contrast between the exclusion strategy and the governance strategy, to discuss why, under his theoretical framework, the doctrine of equivalents in patent law can be seen as resembling the doctrine of nuisance in property law, and the value of this likeness.

##### A. *Smith on Nuisance: Following the Utilitarian Tradition*

Nuisance is the conflict between neighboring land owners regarding how they use their respective land. Nuisance occurs when the defendant's acts on his own land interfere with those of the plaintiff.<sup>15</sup> Typical examples of such interferences include emissions of odors, smoke, or vibrations, and such a dispute "pits two landowners against one another."<sup>16</sup> "Conflicting" is the defining characteristic of nuisance disputes, specifically a conflict between one landowner's interest of use and the other's exclusion right.<sup>17</sup> A treatise on the relations of neighboring owners defines the doctrine of nuisance as "[t]he basic legal mechanism for resolving disputes between neighbors in their capacity as property holders" with "conflicts arising from the physical proximity of [the] parties [...]."<sup>18</sup> Nuisance disputes occur

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14. *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 609-10 (1950).

15. JAMES H. BACKMAN & DAVID A. THOMAS, *A PRACTICAL GUIDE TO DISPUTES BETWEEN ADJOINING LANDOWNERS—EASEMENTS* § 9.03 (2017).

16. Robert G. Bone, *Normative Theory and Legal Doctrine in American Nuisance Law: 1850 to 1920*, 59 S. CAL. L. REV. 1101, 1104 (1986); Jeff L. Lewin, *Compensated Injunctions and the Evolution of Nuisance Law*, 71 IOWA L. REV. 775, 775, 780 (1986).

17. Lewin, *supra* note 16, at 788.

18. JAMES C. SMITH & JACQUELINE P. HAND, *NEIGHBORING PROPERTY OWNERS* § 2:1 (2016).

between lands subject to various types of use, such as residential, agricultural, or industrial use, and combinations thereof.<sup>19</sup>

The development of modern nuisance law has been deeply influenced by the economic analysis of law and can be considered to begin with Coase's seminal article *The Problem of Social Cost*.<sup>20</sup> Thus, Smith's discussion on nuisance law inevitably starts with the economic concerns of the nuisance disputes: how the externalities caused by an actor can be internalized.<sup>21</sup> "When the question is how to internalize pollution externalities or whether people bargain under the shadow of property rules and liability rules, economic models present the dispute as a conflict between plaintiff and defendant [...]."<sup>22</sup> This initial observation combines Coase's reciprocity of causality with the two-by-two matrix of Calabresi and Melamed concerning who shall have the entitlements (the perpetrator or the victim) and what remedy shall be given (injunction or damages).<sup>23</sup> "[W]hen conflicts between actors and their activities arise, a court's job, particularly where transaction costs are high, is to decide which use shall prevail."<sup>24</sup>

Efficient resource allocation assumes that actors are responsible for the costs caused by their own acts, instead of transferring the cost to others who are neither consenting nor reimbursed for the loss, which would become an external cost.<sup>25</sup> Traditionally, economists assume that an actor should be responsible for the external costs imposed on others and account for such externalities in pricing decisions.<sup>26</sup> Coase proposes that we should shift the focus to considering which of the two conflicting uses the society should opt for.<sup>27</sup> In addition, using the least

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19. *Id.*

20. See Jeff L. Lewin, *Boomer and the American Law of Nuisance: Past, Present, and Future*, 54 ALB. L. REV. 189, 191 (1990) (noting that the development of nuisance law was influenced by the law and economics movement in the 1970s). See also Lewin, *supra* note 16, at 785 (attributing the origin of modern nuisance law to Coase's article).

21. See, e.g., Robert C. Ellickson, *Alternative to Zoning: Covenants, Nuisance Rules, and Fines as Land Use Control*, 40 U. CHI. L. REV. 681, 684-86 (1973) (discussing the thesis that nuisance law services as a mechanism of internalizing negative externalities); M. Theresa Hupp, *Efficient Land Use and the Internalization of Beneficial Spillovers: An Economic and Legal Analysis*, 31 STAN. L. REV. 457, 464 (1970).

22. Smith, *supra* note 3, at 966.

23. Compare Coase, *supra* note 5, at 2 (reciprocity of causality), and Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089, 1090-92 (1972), with Thomas W. Merrill & Henry E. Smith, *What Happened to Property in Law and Economics?*, 111 YALE L.J. 357, 391-94 (2001) (disagreeing with the thesis of reciprocal causality and criticizing "causal agnosticism"). See also Lewin, *supra* note 16, at 785-86, 789.

24. Smith, *supra* note 3, at 967.

25. *Id.* at 967-69.

26. See Coase, *supra* note 5, at 1-2. See also Smith, *supra* note 3, at 968-69.

27. Eric R. Claeys, *Jefferson Meets Coase: Land-Use Torts, Law and Economics, and*

cost avoider strategy, the law can allocate the liability to the party who could avoid the loss with the least cost, rather than require a non-least-cost avoider to adopt precautionary measures.<sup>28</sup> Clear economic consideration is evident in the elements of liability and the remedies of modern nuisance law. Courts use various balancing tests to find either that the defendant's act is not a nuisance or to limit the plaintiff to the remedy of damages.<sup>29</sup> Since Coase's seminal article, the legal rules of nuisance have been significantly influenced by the Coasean approach to the economic analysis of law.<sup>30</sup>

In addition to conflict, another defining feature of nuisance law is its emphasis on reasonableness; the resolution of conflict is tied to the reasonableness of the behavior.<sup>31</sup> The idea of reasonableness in nuisance law originated in the incorporation of tort principles during the nineteenth century.<sup>32</sup> Adopting the balance of utilities test or the totality of circumstances test to define reasonable use, the courts impose liability on a defendant's activity characterized as unreasonable.<sup>33</sup> The doctrine of reasonableness has become a means for courts to harmonize and adjust parties' rights and privileges, and

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*Natural Property Rights*, 85 NOTRE DAME L. REV. 1379, 1385-86 (2010) (observing that Coase refuted the Pigouvian view of how to internalize externalities).

28. See generally GUIDO CALABRESI, *THE COST OF ACCIDENTS: A LEGAL AND ECONOMIC ANALYSIS* (1970) (proposing the cheapest cost avoider concept for the first time). See also Guido Calabresi & Jon T. Hirschoff, *Toward a Test for Strict Liability in Torts*, 81 YALE L.J. 1055, 1060-61 (1972) (advocating that the cheapest cost avoider strategy should serve as the test for strict liability). This term "cheapest cost avoider" denotes someone who can avoid the accident with the least cost. It is suggested that a legal rule that imposes the liability on the cheapest cost avoider is efficient and can promote the efficient allocation of resources. See Stephen G. Gilles, *Negligence, Strict Liability, and the Cheapest Cost-Avoider*, 78 VA. L. REV. 1291, 1306 (1992). See also Lewin, *supra* note 16, at 787-88.

29. Lewin, *supra* note 16, at 775.

30. *Id.* at 775, 785 (noting that the approach to modern nuisance law originated from Coase's 1960 article). Some commentators, however, prefer to base the explanation of nuisance law on natural rights morality rather than on Coasean economic analysis. Claey's, *supra* note 27, at 1409-11; Bone, *supra* note 16, at 1105-06 (proposing three natural-rights-based nuisance models).

31. Hupp, *supra* note 21, at 463-64; Jeff L. Lewin, *Comparative Nuisance*, 50 U. PITT. L. REV. 1009, 1018 (1989); George P. Smith, II, & Matthew Saunig, *Reconceptualizing the Law of Nuisance Through a Theory of Economic Captivity*, 75 ALB. L. REV. 57, 60-62 (2012); Paul J. Heald & James Charles Smith, *The Problem of Social Cost in a Genetically Modified Age*, 58 HASTINGS L.J. 87, 116 (2006). See Claey's, *supra* note 27, at 1419 ("Nuisance is often defined as a direct interference with a landowner's use rights that causes harm and is unreasonable.").

32. Lewin, *supra* note 16, at 779 ("In the nineteenth century America witnessed a profound evolution of nuisance doctrine from its roots in property law into a doctrine of tort law, imbued with the concepts of 'fault' and 'reasonableness.'").

33. *Id.* at 780 (Except for a minority of "nuisance per se" cases, reasonableness is considered under the totality of circumstances, including "the nature and location of the offending activity, the character of the neighborhood, the frequency and extent of the intrusion, and the effect on life, health, and the enjoyment of property.").

even to reach “intermediate solutions” to their legitimate but incompatible activities.<sup>34</sup>

From the perspective of law and economics, the reasonableness of the behavior would most likely be analyzed in terms of balancing costs and benefits. As one commentator put it, “‘Reasonable’ activity could be defined merely as cost-effective activity;”<sup>35</sup> “weighing the utility of the landowner’s use of the land and the gravity of the harm to the neighbors was a proper method of determining reasonableness.”<sup>36</sup> Economic analysis is at the “fulcrum” of the balancing test and should be used in resolving nuisance disputes to promote the common good of society—a reasonable behavior is one that could maximize the aggregate wealth.<sup>37</sup> However, this does not necessarily mean that courts have often conducted explicit cost-benefit balancing or have always made welfare-maximizing decisions. As Smith notes, judges “often have paid no more than lip service to balancing and have instead hewed to a more traditional mode of analysis.”<sup>38</sup>

According to Smith’s observation, nuisance law and torts are similar from the perspective of economic analysis.<sup>39</sup> Two types of economic analysis are relevant here. The first approach, which has become the mainstream view in nuisance law, is the direct balancing of costs and benefits, as exemplified by Posner and Judge Learned Hand.<sup>40</sup> The tenet of this approach is to seek the optimal resource allocation or precautionary measures to maximize the welfare of society.<sup>41</sup> This criterion of weighing and balancing, as applied to nuisance disputes, is supported by the Restatement of Torts and scholarly commentaries.<sup>42</sup> The second approach, primarily proposed by

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34. Lewin, *supra* note 20, at 202-05; Lewin, *supra* note 31, at 1011-12 (describing nuisance law as “a series of adjustments and compromises to limit the rights and privileges of both parties” and pointing to the possibility of intermediate solutions to incompatible economic activities).

35. Hupp, *supra* note 21, at 463.

36. *Id.* at 463 n.22. See *Keys v. Romley*, 64 Cal. 2d 396 (1966).

37. Smith & Saunig, *supra* note 31, at 62-63.

38. Smith, *supra* note 3, at 967.

39. *Id.*

40. *Id.* at 967-69. Judge Learned Hand developed the Carroll Towing formula in 1947. See *Carroll Towing Co.*, 159 F.2d at 173. However, the test came to prominence at the hand of Judge Richard Posner. See generally RICHARD A. POSNER, *ECONOMIC ANALYSIS OF LAW* 63 (7th ed. 2007). See also Richard A. Posner, *Wealth Maximization and Juridical Decision-Making*, 4 INT’L REV. L. & ECON. 131, 132-33 (1984) (discussing how cost-benefit analysis can be utilized as a tool of social choice and a guide in the governmental and judicial decision-making processes, for the purpose of maximizing the society’s well-being).

41. Smith, *supra* note 3, at 969.

42. RESTATEMENT (FIRST) OF TORTS §§ 826-828 (AM. LAW INST. 1934); RESTATEMENT (SECOND) OF TORTS §§ 827-828 (AM. LAW INST. 1977). See also Lewin, *supra* note 20, at 264 (observing that Posner’s view in the area of nuisance law comes primarily from Coase, Calabresi,

Calabresi, is an indirect approach of “choosing the chooser”—finding the cheapest cost avoider or the best decision maker, who can best use the information at hand to calculate the efficiency of available alternatives to reach an optimal point of deterrence, where the sum of the cost of the accident and the cost of precaution is the smallest.<sup>43</sup> Instead of directly looking for the optimal allocation of resources, courts would place the liability on the least cost avoider among the group of possible avoiders.<sup>44</sup> Thus, if a polluter is considered the cheapest cost avoider, its neighboring pollutee obtains the entitlement to be free from pollution.<sup>45</sup>

### B. Exclusion Strategy and Governance Strategy

Although he followed the path of utilitarian analysis, Smith took a theoretical turn to focusing on the information costs of delineating property rights. His unique contribution lies in formulating a model that contains the “exclusion strategy,” the “governance strategy,”<sup>46</sup> and hybrids (as in a “spectrum”) of the two strategies<sup>47</sup> to explain the composition of the doctrines in nuisance law. He observes that the doctrines in nuisance law are one of the hybrid regimes that combine the exclusive and governance strategies.<sup>48</sup> The economic analysis of

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Melamed, and Ellickson).

43. Smith, *supra* note 3, at 968; Lewin, *supra* note 20, at 243.

44. See Calabresi & Hirschhoff, *supra* note 28, at 1060. See also Calabresi & Melamed, *supra* note 23, at 1096-97; Yuval Sinai & Benjamin Shmueli, *Calabresi and Maimonides’s Tort Law Theories—A Comparative Analysis and a Preliminary Sketch of a Modern Model of Differential Pluralistic Tort Liability Based on the Two Theories*, 26 YALE J.L. & HUMAN. 59, 66-67 (2014).

45. Smith, *supra* note 3, at 969. See also Barbara Ann White, *Risk-Utility Analysis and the Learned Hand Formula: A Hand That Helps or A Hand That Hides?*, 32 ARIZ. L. REV. 77, 79 (1990).

46. See Henry E. Smith, *Property and Property Rules*, 79 N.Y.U. L. REV. 1719, 1728 (2004) (describing the exclusion strategy as one “in which very rough signals—like presence inside or outside a boundary line around a parcel of land—are used to protect an indefinite class of uses with minimal precision,” and the governance strategy as one in which “the internalization problem is solved on something close to a use-by-use basis . . . using signals that pick out and protect individual uses and user behavior”).

47. *Id.* (arguing that between the two poles—i.e., the exclusion strategy and the governance strategy—are “strategies of a mixed sort that bunch uses together under variables of intermediate precision”); Henry E. Smith, *Governing Water: The Semicommons of Fluid Property Rights*, 50 ARIZ. L. REV. 445, 446 (2008) (explaining that his information-cost theory derives a model consisting of “two poles and a spectrum of strategies for delineating and enforcing property rights” and various hybrid models in-between). Smith maintains that water laws—both riparianism and prior appropriation—are other examples of such hybrid systems. *Id.* at 458.

48. Smith traces the distinction of the exclusion strategy and the governance strategy to economist Steven Cheung and property law theorist Carol M. Rose. Henry E. Smith, *Exclusion versus Governance: Two Strategies for Delineating Property Rights*, 31 J. LEGAL STUD. S453, S455-56 (2002).

law, seemingly more consistent with the governance strategy, considers nuisance law from the perspectives of cost–benefit balancing and the reasonableness of use.<sup>49</sup> Traditional legal analysis, nonetheless, focuses more on the paradigm of *in rem* rights—which is more consistent with the exclusion strategy—and looks for signs of intrusion into boundaries. As Smith observes, the Coasean approach of building property rights stick by stick “is not at all how the law usually proceeds” with nuisance disputes.<sup>50</sup> Courts often simply ask whether the plaintiff’s rights are violated, and then to inquire into whether the plaintiff’s rights are infringed, they often look into whether the defendant’s act physically invades the plaintiff’s land.<sup>51</sup>

Professor Thomas W. Merrill, in a paper coauthored with Smith, disparages the “bundle-of-rights” view of property that has become dominant in American property law since the last century.<sup>52</sup> Influenced by legal realism and the economic analysis of law, the bundle-of-rights concept incorporates rights into ownership in a stick-by-stick manner. “Coase assumed that property is the result of decisions over use-conflicts and that property is, in essence, a list of use rights.”<sup>53</sup> Yet as Merrill and Smith observe, the bundle-of-rights view is not a unique creation by Coase but the consensus of the American legal academia in the mid-twentieth century.<sup>54</sup> In this view, the question of what rights should be given to whom is not predetermined, but determined in an *ad hoc* manner and then incorporated into the concept of ownership.<sup>55</sup> For Merrill and Smith, however, this *ad hoc* manner of composing property rights imposes high transaction costs on participants in the economy.<sup>56</sup> The *in rem* nature of property imposes on all others the duty of noninterference.<sup>57</sup> The *ad hoc*, stick-by-stick method of composing

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49. Smith, *supra* note 3, at 973.

50. *Id.* at 969-70.

51. *Id.* (noting that courts and the commentators, based on corrective justice, often place emphasis on the physical invasion aspect of nuisance cases).

52. See Merrill & Smith, *supra* note 9, at S90-92.

53. Smith, *supra* note 3, at 1001.

54. Merrill & Smith, *supra* note 9, at S80-81 (noting that the “bundle-of-rights” view of property was a “thoroughly modern notion” at the time when Coase created his seminal works, and that property was considered as a “minisovereignty” of the owner over a thing during the nineteenth century or earlier).

55. Smith, *supra* note 3, at 969; Merrill & Smith, *supra* note 9, at S82 (describing the legal realist concept of property as “a bundle of rights or sticks,” with the term “property” serving as a label attached to a set of rights and duties. The contents of the bundle “vary from thing to thing, from place to place, and even from person to person.”).

56. Merrill & Smith, *supra* note 9, at S78.

57. *Id.* at S81.

rights heavily burdens the addressees of the rights discourse (i.e., the potential infringers of rights).<sup>58</sup>

Both exclusion and governance are means of internalizing externalities.<sup>59</sup> Smith argues that it makes sense, according to information cost theory, to treat exclusion as the basic regime and governance as the supplemental regime.<sup>60</sup> The exclusion strategy, which defines the property right as an *in rem* right that entitles the owner to exclude the interference of all others, focuses on the enforcement of boundaries.<sup>61</sup> This is to entrust the information problem to the owner, who serves as the “gatekeeper” of the resource.<sup>62</sup> Boundaries are the special feature of the exclusion regime, since the exclusion strategy uses coarse proxies, particularly boundaries.<sup>63</sup>

The exclusion rule serves as the “baseline” for evaluating nuisance cases. For example, in cases of substantial harm caused by the defendant’s behavior, the court does not need to measure the attributes of an individual use but applies the exclusion rule directly. The rule of *nuisance per se* shows the use of exclusion rules in nuisance disputes.<sup>64</sup> Nuisance cases are also related to the location of the use conflict in question, for several reasons. First, traditionally, to evaluate whether nuisance occurs, the disturbance must originate from the defendant’s land and cause harm on the use of the plaintiff’s land. In other words, whether the defendant’s behavior enters into the space of the plaintiff’s land is defined by the *ad coelum* rule.<sup>65</sup> Second, whether a use constitutes nuisance is highly relevant to the characteristics of the neighborhood; the community standards become the threshold of nuisance liability.<sup>66</sup> Smith considers both the boundaries and the

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58. *Id.* at S89-90.

59. Smith, *supra* note 3, at 980-81.

60. *Id.* at 975-76, 988-92, 1006-07, 1032, 1046-49.

61. *Id.* at 972-73, 978-79.

62. *Id.* at 972-73. The exclusion strategy sees the owner as the “gatekeeper” of the resources. *See* Smith, *supra* note 48, at S454-55, n.3 (quoting the view of James E. Penner).

63. Smith, *supra* note 48, at S454-55 (the right of exclusion uses rough proxies such as boundaries and the *ad coelum* rule).

64. Smith, *supra* note 3, at 997-98 (explaining that when the disturbance caused by the defendant’s use is significant or obvious, the defendant constructively deprives the plaintiff of his or her possession and, consequently, the court can apply the exclusion rule directly and need not evaluate the context of use). Nuisance *per se* is an act that causes material harm so that the contextual information regarding the location of the act and the parties is very unlikely to change the result of the decision; in such a situation, there is little benefit for the court to incur more costs by inquiring into contextual factors of the use. *See id.*

65. *See id.* at 998 (noting that “nuisance is about invasions of a more ethereal sort”). *See also id.* at 999 (“Traditionally . . . location and physical invasion are very important informational variables in the law of nuisance.”).

66. *See, e.g., id.* at 1002-04 (describing the locality rule).

location as the essential and typical variables of the exclusion strategy.<sup>67</sup> Finally, the remedies for nuisance cases include injunctions, applying the property rule and exclusion to protect the “delegation” to the property owner to decide how to use the resource.<sup>68</sup>

At the other pole of the spectrum of the “organizational dimension” of property rights,<sup>69</sup> the governance strategy often functions as a supplemental strategy.<sup>70</sup> The governance strategy measures some essential uses of the resource, and considers the appropriateness of each use. This is a more precise and delicate method but incurs higher measurement costs.<sup>71</sup> The governance strategy corresponds to a view of property rights closer to that of legal realism or Coase.<sup>72</sup> The use of the governance strategy is often justified when the resource at issue has a higher value or when the transaction cost is high because of the higher information cost involved.<sup>73</sup>

The major distinction between the exclusion strategy and the governance strategy lies in that, in the former, the court focuses on the enforcement of boundaries, with entry into boundaries serving as a coarse information variable to define the rights and to indirectly protect various uses within the boundaries.<sup>74</sup> In the governance strategy, the court focuses on defining the reasonable scope of the right. The court looks into whether the use is reasonable or proper, and even conducts cost-benefit balancing.<sup>75</sup> a governance regime is “a set of rules of proper use.”<sup>76</sup> In defining the reasonable scope of rights, the court has more room to coordinate the conflicting interests of the right owner and the user. Therefore, the governance strategy is more likely to emerge in areas that require balancing of the interests of the right owner and the user.<sup>77</sup> When multiple uses become more necessary, coarse variables (such as entry into the boundaries) are inadequate to handle

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67. *Id.* at 1004-05.

68. *Id.* at 1005.

69. Smith, *supra* note 48, at S454-55, S467 (arguing that this spectrum “reflects the costs and benefits of proxy measurement”); *accord* Claeys, *supra* note 27, at 1405 (a spectrum between limited rights of use and unlimited rights of possession).

70. Smith conceives the exclusion strategy as the major mode of property composition, while the governance strategy serves as a supplemental strategy to further refine property rights. *See* Smith, *supra* note 48, at S456.

71. *Id.* at S467.

72. Smith, *supra* note 3, at 976.

73. *Id.* at 996-97 (noting that the governance strategy is used when “high[er] stakes” are present or when the costs of contracting are high).

74. *Id.* at 972-73.

75. *Id.* at 973-74.

76. *Id.* at 975-76.

77. Fair use in copyright law is a typical example of the governance regime. Smith, *supra* note 1, at 1812-14.

the conflicting multiple uses; thus, the court requires more precise variables to measure the uses directly.<sup>78</sup>

At the remedy stage of nuisance cases, a shift from the exclusion strategy to the governance strategy is often evident. The exclusion strategy is often combined with property rules and injunctions, whereas the governance strategy is more likely when the value of coexisting uses becomes higher. The governance strategy allows the parties to adjust their relation by contracting, and it also allows the court to measure the attributes of each individual use and to tailor the remedy accordingly. “As multiple uses become more important, a governance regime of some sort should tend to emerge [...]”<sup>79</sup>

Smith proposes that nuisance law is a mixture of the exclusion strategy and the governance strategy, or a transitional scheme shifting from exclusion to governance.<sup>80</sup> He suggests that “nuisance is not so much a mess or a mystery as a hybrid between different methods of delineating rights, which reflects the information costs incurred in employing these strategies.”<sup>81</sup> Smith’s further contribution is to explain the choice between the exclusion strategy and the governance strategy with the information cost theory.<sup>82</sup> He contends that the exclusion strategy is the lower-cost strategy between the two.<sup>83</sup> The same result is evident in Richard Epstein’s contention of “the dominance of property rules.”<sup>84</sup> Quoting Hume, Epstein states that the stability of possession is “one of the dominant rules of society.”<sup>85</sup> In nuisance cases, as Epstein observed, injunction is the basic rule in the situation of substantial nuisance.<sup>86</sup> The law normally attempts to deter invasion, and property rights can be changed only through voluntary transaction.<sup>87</sup>

### *C. Nuisance Law and Patent Infringement as Two Hybrid Regimes*

The foundation of nuisance law is primarily the exclusion regime, which is supplemented with the governance regime. According to

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78. Smith, *supra* note 3, at 981-82.

79. *Id.* at 1005-06.

80. *Id.* at 996-97, 1002.

81. *Id.* at 970.

82. *Id.* at 974, 981-82, 996-97.

83. *Id.* at 980-85.

84. Richard A. Epstein, *A Clear View of the Cathedral: The Dominance of the Property Rules*, 106 YALE L.J. 2091, 2096-2105 (1997).

85. *Id.* at 2097.

86. *Id.* at 2101.

87. *Id.*

Smith, this is a relatively low-cost method of delineating rights.<sup>88</sup> “Nuisance employs this exclusion regime when it comes to gross invasions of clear boundaries, but supplements the exclusion regime with fine-tuned governance rules.”<sup>89</sup>

The universal applicability of nuisance law lies in the coexistence of the exclusion strategy, the inherent governance strategy, and its clear transition from exclusion to governance.<sup>90</sup> “Nuisance rests on a foundation of exclusion, [...] but it also fine-tunes this hard-edged regime where the stakes are high enough and courts have some advantage in providing off-the-rack governance rules.”<sup>91</sup> Shifting from the exclusion model to the governance model—that is, shifting from boundaries as the information variable to the attributes of use—this type of transition can also be observed in easement by necessity or water law. When this sort of shifting occurs is an empirical question.<sup>92</sup>

Portraying nuisance as where “property law encounters tort law” clearly indicates the transition from the exclusion strategy to the governance strategy.<sup>93</sup> Whereas the traditional approach of nuisance law was based on the physical invasion test<sup>94</sup> and focused on intrusion across boundaries, the modern approach of nuisance law focuses on evaluating the attributes of uses.<sup>95</sup> The transitional nature of nuisance law, as demonstrated by Carol M. Rose in her essay on the historical evolution of water rights, entails a change from monopoly (absolute rights) to vaguely-defined, commonly-owned group rights.<sup>96</sup> In light of Smith’s theory, the early stage can be construed as an exclusion regime focused on the boundaries, and the later stage as a governance regime focused on the direct evaluation of the attributes of uses. Using a fine-tuned governance model, judicial governance can create greater benefits of multiple uses of the same resource. The intersecting area near the boundaries is often where the court can exercise governance.

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88. Smith, *supra* note 3, at 976.

89. *Id.*

90. *Id.* at 976, 1045.

91. *Id.* at 1024.

92. *Id.* at 1024-25.

93. Epstein, *supra* note 10, at 49 (“Nuisance is a very old branch of tort law.”); *accord* William L. Prosser, *Nuisance Without Fault*, 20 TEX. L. REV. 399, 410-16 (1942).

94. *See* Claeys, *supra* note 27, at 1409 (“[A] nuisance suit ordinarily requires some physical invasion.”). *See also* Epstein, *supra* note 10, at 53 (“Nuisances are invasions of the plaintiff’s property that fall short of trespasses”); *id.* at 57 (“[O]nly physical invasion of protected interests gives rise to a prima facie case of liability.”).

95. Smith, *supra* note 3, at 974.

96. CAROL M. ROSE, *PROPERTY AND PERSUASION: ESSAYS ON THE HISTORY, THEORY, AND RHETORIC OF OWNERSHIP* 166, 179-80 (1994) (Water law played an important role in the later nineteenth-century nuisance law, which shows an evolution process from absolute rights to commonly-owned correlative rights).

To elucidate Smith's claim that the doctrine of equivalents is similar to nuisance law, this pronouncement must be placed in the context of his theory that distinguishes the exclusion strategy and the governance strategy. Two forms of patent infringement exist, literal infringement and infringement by equivalency. Infringement by equivalency is considered the "second prong" of patent infringement.<sup>97</sup> For literal infringement, the exclusion strategy is applied, as it is for the cause of action of trespass: a literal infringement has occurred if the patent claim reads on the accused device, substance, or procedure.<sup>98</sup> For infringement by equivalency, as with nuisance, the governance strategy is applied. The judicial role in the determination of equivalency, just as in nuisance cases, is twofold: the court must exercise contextual judgment, making an integrated decision based on a series of relevant factors, and as a result, the decision of equivalency must draw fair boundaries of the patentee's rights.<sup>99</sup>

The determination of equivalency must be context based. As the U.S. Supreme Court indicated in *Graver Tank Mfg. Co. v. Linde Air Products Co.*, "[w]hat constitutes equivalency must be determined against the context of the patent, the prior art, and the particular circumstances of the case."<sup>100</sup> One particular distinction that exemplifies the contextual nature of equivalency decisions is interchangeability being listed by the *Graver Tank* court as an "important factor" that supports the finding of equivalency;<sup>101</sup> however, it is only one factor to be considered among others. "Equivalency, in patent law, is not the prisoner of a formula and is not an absolute to be considered in a vacuum."<sup>102</sup> This famous pronouncement by the *Graver Tank* court reveals the contextual nature

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97. See generally *Sage Prods., Inc. v. Devon Indus., Inc.*, 126 F.3d 1420, 1423, 1443 (Fed. Cir. 1997); *Penwalt Corp. v. Durand-Wayland, Inc.*, 833 F.2d 931, 952 (Fed. Cir. 1987) (distinguishing literal infringement and infringement by equivalency); *Cybor Corp. v. FAS Techs., Inc.*, 138 F.3d 1448, 1459 (Fed. Cir. 1998); *Abraxis Bioscience, Inc. v. Mayne Pharma (USA) Inc.*, 467 F.3d 1370, 1378-79 (Fed. Cir. 2006); Sean T. Moorhead, *The Doctrine of Equivalents: Rarely Actionable Non-Literal Infringement or the Second Prong of Patent Infringement Charges?*, 53 OHIO ST. L.J. 1421, 1424 (1992).

98. Clyde F. William & Joseph S. Miller, *Muddy Waters: Infringement Analysis after Markman and Warner-Jenkinson*, 7 FED. CIR. B.J. 227, 227 (1997) (assimilating patent infringement to trespassing on the territory over which the patentee can exercise his power of exclusion).

99. Mark D. Janis, *Who's Afraid of Functional Claims? Reforming the Patent Law's § 112, ¶ 6 Jurisprudence*, 15 SANTA CLARA COMPUTER & HIGH TECH. L.J. 231, 263 (1999) ("equivalency as a flexible tool for advancing 'general fairness'").

100. *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 609 (1950).

101. *Id.* See *Ring & Pinion Serv. Inc. v. ARB Corp. Ltd.*, 743 F.3d 831, 834 (Fed. Cir. 2014) (known interchangeability as a factor to be considered); *Abraxis Bioscience, Inc.*, 467 F.3d at 1382.

102. *Graver Tank*, 339 U.S. at 609.

of decisions concerning equivalency, which must be determined “against the context of the patent” and is “not an absolute.”<sup>103</sup> All of these statements characterize the doctrine of equivalents as a governance regime.

The doctrine of equivalents as a governance regime is most clearly revealed in the Federal Circuit’s decision in *Hilton Davis Chemical Co. v. Warner-Jenkinson Company, Inc.*<sup>104</sup> *Hilton Davis*, an *en banc* decision by the Federal Circuit to resolve the issues related to the doctrine of equivalents,<sup>105</sup> proclaimed to “restate” rather than to “revise” the test for infringement under the doctrine of equivalents in previous case law.<sup>106</sup> *Hilton Davis* elevated the substantiality of the difference to the primary criterion for assessing equivalency.<sup>107</sup> By tying equivalency to a somewhat vague standard,<sup>108</sup> the *Hilton Davis* court paved the way for judicial exercise of governance in the determination of equivalency.

The *Hilton Davis* decision first quoted Justice Story’s opinion in *Odiorne v. Winkley*<sup>109</sup> to establish that equivalency denotes nonsubstantial or “[m]ere colorable differences, or slight improvements, [which] cannot shake the right of the original inventor.”<sup>110</sup> To avoid constituting infringement under the doctrine of equivalents, the accused product or process must embody a substantial, not merely colorable, change of the claimed product or process.<sup>111</sup> The court also cited the Supreme Court’s *Graver Tank* decision for the same principle: “the doctrine [of equivalents] applies if, and only if, the differences between the claimed and accused products or processes are insubstantial.”<sup>112</sup>

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103. *Id.*

104. *Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc.*, 62 F.3d 1512, 1516-28 (Fed. Cir. 1995).

105. *Id.* at 1515 n.1.

106. *Id.* at 1516. See James K. Folker, *A Legislative Proposal to Clarify and Simplify Patent Infringement Analysis under the Doctrine of Equivalents*, 6 FED. CIR. B.J. 211, 212 (1996).

107. *Hilton Davis*, 62 F.3d at 1518 (holding that “the application of the doctrine of equivalents rests on the substantiality of the differences between the claimed and accused products and processes, assessed according to an objective standard”); *id.* at 1517 (treating insubstantial differences as “the necessary predicate” for constituting equivalency).

108. Moorhead, *supra* note 97, at 1428 (noting that “there are no bright lines” in the determination of equivalency).

109. *Hilton Davis*, 62 F.3d at 1530.

110. *Id.* at 1517 (citing *Odiorne v. Winkley*, 18 F.Cas. 581, 582 (C.C.D. Mass. 1814)).

111. See, e.g., *Sanitary Refrigerator Co. v. Winters*, 280 U.S. 30, 42 (1929) (no substantial departure from the patent, a mere colorable departure therefrom).

112. *Hilton Davis*, 62 F.3d at 1519 (citing *Graver Tank & Mfg. Co. v. Linde Air Prods. Co.*, 339 U.S. 605, 610 (1950)).

The Federal Circuit in *Hilton Davis* also proclaimed that equivalency is fundamentally the determination of substantial difference, and that the tripartite test of means, function, and result is a method to measure the difference.<sup>113</sup> However, although these three factors contribute to determining equivalency, additional factors exist.<sup>114</sup> The tripartite test is without a doubt the most prevalent approach,<sup>115</sup> with function, way, and result serving as proxies for the substantiality of differences because “similarity of function, way, and result leaves little room for doubt that only insubstantial differences distinguish the accused product or process from the claims.”<sup>116</sup> Other factors related to the determination of equivalency include known interchangeability,<sup>117</sup> evidence of copying, and evidence of circumvention designs.<sup>118</sup> The court also emphasized that all evidence concerning the substantiality of differences, if presented by the record of the case, should be considered by the fact finder.<sup>119</sup>

The *Hilton Davis* approach to the doctrine of equivalents presents a typical governance regime, employing a standard-based mode of adjudication. As a clear voice of the governance strategy, the Federal Circuit proclaimed, citing the majority opinion of the Supreme Court’s *Graver Tank* decision, that “equivalency, in patent law, is not the prisoner of a formula.”<sup>120</sup> The standard-based approach to determining equivalency was previously revealed by the *Graver Tank* majority opinion.<sup>121</sup> The governance strategy allows courts, through weighing multiple factors in a standard-based adjudication, to simulate the Pareto optimality that would be reached under the ideal conditions. The approach to determining equivalency in the Federal Circuit’s *Hilton*

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113. *Hilton Davis*, 62 F.3d at 1518.

114. *Id.*

115. *Id.*

116. *Id.*

117. For known interchangeability as a factor weighing in favor of finding infringement under the doctrine of equivalents, see *Graver Tank*, 339 U.S. at 609; Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co., 520 U.S. 17, 36 (1997); Corning Glass Works v. Sumitomo Elec. U.S.A., Inc., 868 F.2d 1251, 1261 (Fed. Cir. 1989); Interactive Pictures Corp. v. Infinite Pictures, Inc., 274 F.3d 1371, 1383 (Fed. Cir. 2001).

118. *Hilton Davis*, 62 F.3d at 1519-20.

119. *Id.* at 1518.

120. *Id.* (citing *Graver Tank*, 339 U.S. at 609).

121. See John R. Thomas, *Claim Re-Construction: The Doctrine of Equivalents in the Post-Markman Era*, 9 LEWIS & CLARK L. REV. 153, 156 (2005) (contrasting the Supreme Court majority’s standards-oriented approach in *Graver Tank* with the dissenting opinion’s rules-based approach to the doctrine of equivalents). See also 4 R. CARL MOY, MOY’S WALKER ON PATENTS § 13:68 (4th ed. 2017) (characterizing the different approaches to the determination of factual equivalency as rules versus standards).

*Davis* decision is similar to how reasonableness is determined in nuisance law.

Nevertheless, the governance strategy may be formalized for several reasons and turned into a rules-based mode of adjudication, which can be embodied in an exclusion regime in property law.<sup>122</sup> One of the reasons courts develop formal concepts and rules is to reduce the information costs of measuring multiple proxies.<sup>123</sup> In addition, an increase in the value of the asset brings the need to enhance the predictability of judicial decisions, pushing the rule system further toward the direction of formalism and the exclusion strategy.<sup>124</sup> However, because a rule covers more limited facts than a standard does, it often requires combining several rules—some serving as the boundaries of the right (as baselines in property) and some serving as defenses to the right (as exceptions in property)<sup>125</sup>—to achieve what a standard-based mode of adjudication can do, which is to approximate Pareto optimality under the ideal conditions.

Through its decision in *Warner-Jenkinson Company, Inc. v. Hilton Davis Chemical Co.*,<sup>126</sup> the Supreme Court, sharing the anxiety that the dissenters in *Graver Tank* and *Hilton Davis* felt toward the standard-based mode of adjudication,<sup>127</sup> effected a formalistic turn in the doctrine of equivalency. The *Warner-Jenkinson* decision used several rules (in the end, a myriad of rules) to replace the standard-based adjudication model established in *Graver Tank* and *Hilton Davis*. If the approach pronounced by the Federal Circuit in *Hilton Davis* was able to continue its path, the determination of equivalency today would probably resemble how the likelihood of confusion is determined in trademark law. However, the Supreme Court's formalistic turn in *Warner-Jenkinson* wove a complicated web of rules, consisting not only of rules (the all-elements rule, the function-way-result test, the insubstantial differences test),<sup>128</sup> but also exceptions to the rules (prosecution history estoppel, claim vitiation),<sup>129</sup> as well as exceptions to the exceptions (several exceptions to prosecution history

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122. Henry E. Smith, *On the Economy of Concepts in Property*, 160 U. PA. L. REV. 2097, 2105-06 (2012) (the right of exclusion and “owner-as-the-gatekeeper” are formal concepts). Smith defines formalism as relative indifference to context; a rule system more formal in its application and interpretation is less dependent on context. *Id.* at 2105.

123. *See id.* at 2108.

124. Smith, *supra* note 1, at 1815-17.

125. For the distinction of baselines and exceptions in property, see Smith, *supra* note 122, at 2120-27.

126. *Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co.*, 520 U.S. 17 (1997).

127. *Id.* at 28-29.

128. *Id.* at 39-40.

129. *Id.* at 40-41.

estoppel).<sup>130</sup> The Supreme Court's decision in *Festo Corporation v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.* continued this path of constructing a complex rule system, admitting three exceptions to prosecution history estoppel.<sup>131</sup>

The Supreme Court's formalistic turn since the *Warner-Jenkinson* decision shows the Court's anxiety concerning the vague boundaries of rights under a governance regime, and represents the Court's pursuit of the value of certainty, which could be the virtue of an exclusion regime. Ultimately, the doctrine of equivalents, much like nuisance law, consists of a hybrid regime of exclusion and governance. Nonetheless, the doctrine of equivalents since *Warner-Jenkinson* has been pushed further toward formalism and rules-based adjudication.<sup>132</sup>

## II. ANOTHER INTERPRETATION OF NUISANCE AND THE DOCTRINE OF EQUIVALENTS

This section adopts another interpretive approach, based on economist Ronald Coase's seminal article *The Problem of Social Cost*, and incorporates related annotations and extensions by other scholars, to explore the issue put forward by Professor Smith: the similarity between nuisance law and the doctrine of equivalents.

### A. Basic Theory: Coase Theorem, Pareto Optimality, and Kaldor-Hicks Efficiency

In *The Problem of Social Cost*, Coase uses an example of nuisance law to illustrate his critique of the externality theory. Later, the theoretical literature on nuisance law, having been heavily influenced by law and economics, rather naturally started the discussion with Coase's theoretical insight.<sup>133</sup>

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130. *Id.*; *id.* at 39 n.8 (for the rule of claim vitiation).

131. *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 535 U.S. 722, 740-41 (2002). The three exceptions to prosecution history estoppel are: (i) equivalents unforeseeable at the time of the amendment, (ii) the rationale underlying the amendment bearing merely a tangential relation to the equivalent in question, and (iii) some other reason "suggesting that the patentee could not reasonably be expected to have described the insubstantial substitute in question." *Id.*

132. See generally John R. Thomas, *Formalism at the Federal Circuit*, 52 AM. U. L. REV. 771, 792 (2003) ("Patent jurisprudence increasingly reflects a trend towards adjudicative rule formalism.").

133. See generally Christopher Essert, *Nuisance and the Normative Boundaries of Ownership*, 52 TULSA L. REV. 85, 92 (2016) (Coase placed nuisance law at the center of law and economics); Keith N. Hylton, *A Missing Markets Theory of Tort Law*, 90 NW. U. L. REV. 977, 979 n.11 (1996) (Coase used nuisance law to illustrate his critique of the externality theory); Gideon Parchomovsky & Peter Siegelman, *Selling Mayberry: Communities and Individuals in Law and Economics*, 92 GA. L. REV. 75, 93 (2004) (Coase challenged the Pigouvian approach to externalities).

One of Coase's major points is the reciprocal nature of harm: if two conflicting uses of a resource exist, the nonowner's use does not necessarily cause damage to the owner.<sup>134</sup> This occurs because if the law enjoins the nonowner's use, the nonowner could suffer loss; moreover, if the law allows the nonowner's use, the owner could suffer loss.<sup>135</sup> Since either party could suffer loss, the question then becomes which party the law chooses to sacrifice in order to avoid the more serious harm; the law could choose to permit the nonowner's use and let the owner suffer, or vice versa.<sup>136</sup> Therefore, it is not necessarily the case that someone may not use another's property. The reciprocal nature of harm presupposes the separation of ownership with some privileges of use.

Another major point is that, if the world were frictionless (i.e., without transaction costs),<sup>137</sup> parties would solve use conflicts by themselves through their bargaining and contracting, and society as a whole would be better off.<sup>138</sup> In a frictionless society where transaction costs are absent, "Pareto optimality or economic efficiency will occur regardless of the initial entitlement."<sup>139</sup> In other words, if the market is well-functioning, resource allocation would reach the point of equilibrium through the operation of private bargaining, regardless of how the law defines the rights and duties initially.<sup>140</sup>

Scholarly commentary reveals two important corollaries of the Coase theorem. First, given the initial allocation of property rights and under certain conditions (including the condition of a world without transaction costs), private bargaining would move resource allocation

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134. See Essert, *supra* note 133, at 88-92 (restating and critiquing the reciprocal nature of harm).

135. Gregory C. Keating, *Nuisance as a Strict Liability Wrong*, 4 J. TORT L. 1, 2 (2012).

136. Kenneth R. Vogel, *The Coase Theorem and California Animal Trespass Law*, 16 J. LEGAL STUD. 149, 150 (1987); Essert, *supra* note 133, at 89.

137. Brett Frischmann & Evan Selinger, *Utopia?: A Technologically Determined World of Frictionless Transactions, Optimized Production, and Maximal Happiness*, 64 UCLA L. REV. DISCOURSE 372, 375-76 (2016) (Coase's frictionless world).

138. Herbert Hovenkamp, *Fractured Markets and Legal Institutions*, 100 IOWA L. REV. 617, 619 (2015) (private bargaining would solve the problem of conflicting use); Parchomovsky & Siegelman, *supra* note 133, at 93.

139. Calabresi & Melamed, *supra* note 23, at 1094-95. See Calabresi, *supra* note 12, at 1215.

140. Coase, *supra* note 5, at 6; Harold Demsetz, *R.H. Coase and the Neoclassical Model of the Economic System*, 54 J.L. & ECON. S7, S11 (2011) (agreeing to Coase's neoclassical claim under the assumption that the transaction cost is zero). See R.H. Coase, *The Federal Communications Commission*, 2 J.L. & ECON. 1, 26-27 (1959) (discussing an example within the case *Sturges v. Bridgman*, [1879] 11 Ch. D. 852, in which private bargaining leads to equilibrium); Robert Cooter, *The Cost of Coase*, 11 J. LEGAL STUD. 1, 14 (1982).

to an equilibrium.<sup>141</sup> This is known as the efficiency thesis.<sup>142</sup> Second, the agreement by the parties would move the resource allocation to an equilibrium regardless of how the law assigns rights and duties initially. This is known as the invariance thesis.<sup>143</sup> According to Coase, under the condition that bargaining is costless and with an initial definition of property rights, parties would reallocate resources by their consent and reach an efficient outcome.<sup>144</sup>

However, the market requires costs, and Coase was the first to admit it.<sup>145</sup> After transaction costs are considered, the parties may not transact and reach an agreement as easily.<sup>146</sup> Even if a rearrangement of property rights could cause an increase in the value of production, the parties' failure to bargain because of the transaction costs may require the government (through legislature, courts, or administrative agencies) to rearrange rights for them, and the initial allocation of rights also matters.<sup>147</sup> "In these conditions the initial delimitation of legal rights does have an effect on the efficiency with which the economic system operates. One arrangement of rights may bring about a greater value of production than any other."<sup>148</sup>

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141. See Donald H. Regan, *The Problem of Social Cost Revisited*, 15 J.L. & ECON. 427, 427 (1972) (the preconditions of the Coase theorem include full competition, zero transaction cost, full information, etc.); Elizabeth Hoffman & Matthews L. Spitzer, *The Coase Theorem: Some Experimental Test*, 25 J.L. & ECON. 73, 73 (1982) (identifying eight preconditions of the Coase theorem). See also Herbert Hovenkamp, *Marginal Utility and the Coase Theorem*, 75 CORNELL L. REV. 783, 785-87 (1990) (further simplifying the preconditions of the Coase theorem).

142. For the meaning of the efficiency thesis and the invariance thesis, see Hovenkamp, *supra* note 141, at 785 (stating the two sub-theses under the Coase theorem); Cooter, *supra* note 140, at 15; Regan, *supra* note 141, at 427 (restating the efficiency thesis and the invariance thesis); Hoffman & Spitzer, *supra* note 141, at 73 (combining the efficiency thesis and the invariance thesis and proposing the preconditions to Coase theorem); Hovenkamp, *supra* note 138, at 628-29.

143. See Demsetz, *supra* note 140, at S11; Cooter, *supra* note 140, at 15 (discrediting the invariance thesis); Vogel, *supra* note 136, at 151 (criticizing the invariance thesis); Calabresi, *supra* note 12, at 1222-23. James M. Buchanan calls the invariance thesis allocational neutrality. See J. M. Buchanan, *The Coase Theorem and the Theory of the State*, 13 NAT. RESOURCES J. 579, 580, 584-85 (1973) (allocational neutrality means that if the parties can voluntarily transact under ideal conditions, the initial allocation of property rights is irrelevant). See also Hovenkamp, *supra* note 138, at 628.

144. Coase, *supra* note 5, at 8.

145. *Id.* at 15. See Demsetz, *supra* note 140, at S11 (stating that "[b]read does not fall like manna on the dinner table. It comes at a cost. Similarly, transactions are not free."); Parchomovsky & Siegelman, *supra* note 133, at 94.

146. See Demsetz, *supra* note 140, at S12 (the existence of transaction costs could cause the inefficiency of the market).

147. Hovenkamp, *supra* note 138, at 619 ("[T]ransaction costs make a legal system important to social ordering.").

148. Coase, *supra* note 5, at 16. See Cooter, *supra* note 140, at 18; Hovenkamp, *supra* note 141, at 809.

Therefore, in the realistic setting where a transaction requires costs, the government could, subject to some conditions, attempt to rearrange rights to approximate what the parties would have agreed to in a zero-cost transaction.<sup>149</sup> To restate the proposition, based on a certain initial definition of rights, the government could rearrange and thus change the initial definition of rights if doing so would result in an increase in the value of production.<sup>150</sup> However, the government's best effort to approximate the equilibrium would not be the same, because true equilibrium is defined by the parties' consent in no-cost bargaining, which is an "unreachable goal."<sup>151</sup> When the costs of government intervention—as well the motive and capacity of courts or agencies—are considered, no guarantee exists that the governmental rearrangement of rights would approach an ideal result, rather than a "false optimum."<sup>152</sup>

Although Coase does not specifically identify the concept of equilibrium he used in *Social Cost*, some commentators have identified the equilibrium concept here as Pareto optimality.<sup>153</sup> Thus, it is appropriate to introduce Pareto optimality in the context of this paper. The discussion on Pareto optimality typically starts with the scenario of a bilateral monopoly.<sup>154</sup> Assuming that a society consists only of two persons A and B, and only of two types of consumption goods x and y, all the consumption goods (x and y) are distributed to A and B.<sup>155</sup> Pareto optimality is a situation containing no Pareto superiority, such that a situation with no further distribution of resources and goods would make one individual better without making another individual worse.<sup>156</sup> In other words, Pareto optimality is a status without resource

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149. See Guido Calabresi, *Transaction Costs, Resource Allocation and Liability Rules – a Comment*, 11 J.L. & ECON. 67, 69 (1968) (arguing that the aim of governmental relocation of resources is an attempt to approximate the result of zero-cost bargaining as closely as possible and at low cost).

150. By contrast, some commentators hold that Coasean analysis suggests that little or no government intervention would be the best approach. Calabresi, however, disagrees, and contends that the Coasean analysis can be used to justify government actions. *Id.* at 73.

151. *Id.* at 69.

152. *Id.*

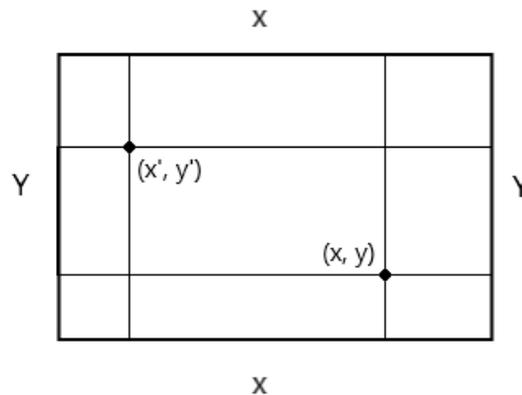
153. *Id.* at 68; Regan, *supra* note 141, at 428-29; Vogel, *supra* note 136, at 151; Hoffman & Spitzer, *supra* note 141, at 75-76.

154. See ROBERT COOTER & THOMAS ULEN, *LAW AND ECONOMICS* 17 (4th ed. 2004).

155. The scenario that Coase presupposed is akin to this situation, where two persons vie for control of a scarce resource. See Demsetz, *supra* note 140, at S12.

156. See Barbara White, *Coase and the Courts: Economics for the Common Man*, 72 IOWA L. REV. 577, 585 (1987); Calabresi & Melamed, *supra* note 23, at 1094 (describing Pareto optimality), 1095-96 (different initial allocations of rights result in different Pareto optimalities); Jules L. Coleman, *Efficiency, Utility, and Wealth Maximization*, 8 HOFSTRA L. REV. 509, 513 (1980) (the relation of Pareto superiority to Pareto optimality).

misallocation, typically represented with an Edgeworth box shown in Figure 1:



**Figure 1:** Edgeworth Box

Consider the initial allocation of property rights as  $(x, y)$ , and the new allocation of rights, achieved either by private bargaining or by government intervention, as  $(x', y')$ . The parties' bargaining, assuming transaction costs are zero or low, is the most efficient means of moving from  $(x, y)$  to  $(x', y')$ , which is true Pareto optimality and an equilibrium. Substitutes for transaction (such as some type of government intervention) have costs, so the optimal result they achieve may approximate, but not necessarily be the same as, true optimality  $(x', y')$ .<sup>157</sup>

Torts on property rights can be seen as unilaterally taking some uses of a resource owned by another.<sup>158</sup> B's conduct causing damage to A's use of property (thus reducing the value  $x$ ) can be seen as B unilaterally taking more of A's use of property ( $x$ ) than was originally distributed between A and B. Therefore, B's conduct deviates from the original equilibrium  $(x, y)$  and violates the unanimous consent requirement of the Pareto ethic.<sup>159</sup> If the parties were voluntarily

157. See Calabresi, *supra* note 149, at 69 (asking "have we instead approached a false optimum by a series of games which are not worth the candles used?").

158. For the concept of the terms "thing" and "use" here, see Henry E. Smith, *Property as the Law of Things*, 125 HARV. L. REV. 1691, 1693 (2012).

159. For the principle of consent under the Pareto ethic, see Richard A. Posner, *The Ethical and Political Basis of the Efficiency Norm in Common Law Adjudication*, 8 HOFSTRA L. REV. 487, 488 (1980).

transacting, B would be obliged to pay more of her use of property (y) to obtain more of A's use of property (x), such that A and B would agree to a new allocation of property rights (x', y'), which represents a new Pareto optimality.<sup>160</sup> In the end, if B's conduct has not changed the constraint on the decision (i.e., a set of transaction costs),<sup>161</sup> the court would enforce the original property right, refuse to create a new allocation, and demand that B return to the original allocation of resources (x, y),<sup>162</sup> which represents the original Pareto optimality prior to B's conduct.<sup>163</sup>

However, if B's conduct had caused the constraint on the decision to be changed—for instance, if B's conduct were innovative<sup>164</sup>—the court would be willing to rearrange property rights to achieve a new Pareto optimality. As Coase shows, an increase in the value of production can trigger a rearrangement of rights.

In a world with positive transaction costs, Coase adds two more conditions.<sup>165</sup> First, because rearranging rights requires costs, only when the increase in value resulting from the rearrangement is greater than the associated costs would a rearrangement of rights occur.<sup>166</sup> Second, rearrangement by the parties bargaining privately and rearrangement by government intervention are alternative mechanisms.<sup>167</sup> The cost of private bargaining must be greater than the cost of government invention for the government to step in to rearrange rights.<sup>168</sup>

In summary, if a governmental rearrangement of property rights (including by courts) can result in an increased value of production, and the increased value is greater than the costs incurred during this

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160. See Hovenkamp, *supra* note 141, at 627 (in Coasean markets, moving resources requires the unanimous consent of the relevant parties).

161. See Calabresi, *supra* note 12, at 1212 (given a set of transaction costs, Pareto optimality will always and immediately be reached).

162. Otherwise it would not be a Pareto improvement, because B would be made better off but A would be made worse off. See Posner, *supra* note 159, at 488.

163. This is because the status quo—here, the state of affairs before B's conduct—is a Pareto optimality until a new, better, and achievable arrangement is found. Calabresi, *supra* note 12, at 1215-16. See Mark A. Geistfeld, *Risk Distribution and the Law of Torts: Carrying Calabresi Further*, 77 L. & CONTEMP. PROBS. 165, 166 (2014).

164. An innovation can shift the Pareto frontier outward and thus change the utility possibility frontier. Calabresi, *supra* note 12, at 1212.

165. Coase, *supra* note 5, at 15-18.

166. See Hovenkamp, *supra* note 138, at 623 (for a transactional or nontransactional move of resources, if the transaction cost is higher than the increased value, the move would not occur).

167. Coase, *supra* note 5, at 17-18.

168. Calabresi, *supra* note 149, at 71-72 (using public highways and rubber bumpers as examples); Frischmann & Selinger, *supra* note 137, at 375-76 (using a frictionless world as the baseline to evaluate and compare different mechanisms in the real world).

process, which are lower than the costs of private bargaining, then the government can intervene to rearrange the initial definition of property rights. This *ex post* redefinition of property rights adjusts the uses of resources belonging to the relevant parties. Finally, the result of this adjustment of property rights by the government could approach, but would still not be the same as, the result of the parties' bargaining and contracting, which is the only means of producing true optimality.

Therefore, the increase in the value of production is key; with certain conditions, such an increase could result in the rearrangement of rights by the government. However, "increase in the value of production" must be defined.

Calabresi presents two means for welfare improvement centered on the concept of a Pareto frontier: moving "along the frontier" and "shifting the frontier outward."<sup>169</sup> The Pareto frontier (production possibilities frontier) is a set of feasible allocations given a certain technological level.<sup>170</sup> Moving along the frontier is one "in which there are winners and losers," and it improves well-being so long as the winner wins more than the loser loses.<sup>171</sup> Shifting the frontier outward as a result of innovations or technological advances "create[s] winners and may or may not create losers as well."<sup>172</sup>

Both moving along the Pareto frontier and shifting the frontier outward can increase the value of production. The innovations that can shift the Pareto frontier outward include not only material and technological ones but also "moral, aesthetic, and altruistic" ones.<sup>173</sup> For instance, Geistfeld argues that legal innovations, such as an innovation in the compensatory tort system, can shift the Pareto frontier outward from the status quo.<sup>174</sup> Nonetheless, as Calabresi notes, improving well-being by shifting the frontier outward is a much less discussed topic in the economic literature than moving to or along the frontier.<sup>175</sup>

In reality, as a principle of unanimous consent under ideal conditions, Pareto optimality cannot be easily achieved. It is argued that most legal institutions implement Kaldor-Hicks efficiency, a

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169. Calabresi, *supra* note 12, at 1230-31.

170. See Geistfeld, *supra* note 163, at 166 (noting that transactions costs and existing technology define the Pareto frontier); Matthew Dimick, *Should the Law Do Anything About Economic Inequality?*, 26 CORNELL J.L. & PUB. POL'Y 1, 13, 33 (2016) (discussing technologically feasible allocations located within and on the Pareto frontier).

171. Calabresi, *supra* note 12, at 1221, 1229-30.

172. *Id.* at 1230-32.

173. *Id.* at 1235.

174. Geistfeld, *supra* note 163, at 168, 187-88.

175. Calabresi, *supra* note 12, at 1227, 1235-36.

criterion of hypothetical consent under nonideal conditions.<sup>176</sup> Judge Posner observes that “when an economist says that free trade or competition or the control of pollution or some other policy or state of the world is efficient, nine times out of ten he means Kaldor-Hicks efficient.”<sup>177</sup> Matthew Adler also observes that Kaldor-Hicks efficiency dominates administrative regulation.<sup>178</sup>

Kaldor-Hicks efficiency, also known as “potential Pareto superiority,”<sup>179</sup> is a less austere concept of efficiency.<sup>180</sup> It is a criterion of hypothetical compensation: it requires only that “the increase in value be sufficiently large that the losers *could be* fully compensated”<sup>181</sup> and is ultimately not concerned with whether the winners actually do compensate the losers.<sup>182</sup> Serving as the basis of cost–benefit analysis,<sup>183</sup> the Kaldor-Hicks criterion is “the relationship between the aggregate benefits of a situation and the aggregate costs of the situation,” “without regard to how those costs and benefits are distributed among different individuals.”<sup>184</sup>

An obvious problem of Kaldor-Hicks efficiency is that, even if a reallocation promotes the collective welfare, the losers are left to bear the loss.<sup>185</sup> Though theoretically the winners *could* compensate the losers, in reality when the law assigns rights to the winners, the winners have no incentive to compensate the losers.<sup>186</sup> By contrast, the Pareto criterion requires that the winners actually compensate the losers.<sup>187</sup> The governmental *ex post* rearrangement of rights can be seen as a type of compulsory exchange, approximating the outcome of private

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176. W. KIP VISCUSI ET AL., *ECONOMICS OF REGULATION AND ANTITRUST* 80 (4th ed. 2005); Posner, *supra* note 159, at 495; Matthew D. Adler & Eric A. Posner, *Rethinking Cost-Benefit Analysis*, 109 *YALE L.J.* 165, 170 (1999).

177. POSNER, *supra* note 40, at 13.

178. Matthew D. Adler, *Beyond Efficiency and Procedure: A Welfarist Theory of Regulation*, 28 *FLA. ST. U. L. REV.* 241, 244 (2000).

179. Posner, *supra* note 159, at 491; POSNER, *supra* note 40, at 13 (arguing that Kaldor-Hicks efficiency has the potential of becoming Pareto optimal if the losers are fully compensated by the winners).

180. Geistfeld, *supra* note 163, at 170.

181. Posner, *supra* note 159, at 491 (emphasis added).

182. Dimick, *supra* note 170, at 46 (stating that if the compensation does occur, then the situation also satisfies Pareto efficiency).

183. Geistfeld, *supra* note 163, at 170.

184. Adler, *supra* note 178, at 245 n.13.

185. Calabresi, *supra* note 12, at 1223 (observing that an involuntary and uncompensated Kaldor-Hicks improvement is not really an “improvement”).

186. Jules Coleman, *The Normative Basis of Economic Analysis: A Critical Review of Richard Posner’s the Economics of Justice*, 34 *STAN. L. REV.* 1105, 1109 (1982) (observing that, following Posner’s approach, assigning the right to the polluter would free the polluter from the obligation to purchase the right to pollute from its neighbors).

187. Calabresi, *supra* note 12, at 1222-23.

bargaining and contracting. In other words, based on the initial definition of property rights, the parties can bargain by themselves to reach an equivalency, or—as a less costly alternative—the government can arrange their rights, mimicking<sup>188</sup> but not necessarily attaining the equivalency reached by private bargaining.<sup>189</sup> Although the governmental reallocation may not be identical to the optimality reached by the parties themselves, the Pareto criterion that requires the losers to actually be compensated would bring the outcome closer to true equilibrium than the Kaldor-Hicks criterion would.<sup>190</sup>

### B. Explaining Neighboring Relations

#### 1. General Principles

In a world with zero transaction costs, the law cannot only clearly define the rights and let the parties voluntarily transact; if the transaction cost is too high, contracting may not begin or be consummated. The situation may therefore require the court to allocate the rights among the parties directly. This type of reallocation of rights and duties occurs across the boundaries of property.<sup>191</sup> Ellickson proposes handling externality by redefining property rights—that is, cross-boundary allocation of rights and duties—and the law of nuisance is an example of this approach.<sup>192</sup>

If (x, y) represents the initial allocation of rights between two neighboring owners A and B, the initial definition of property rights is A(x, y) and B(x, y). The assumption here is that all of A's use of property (x) belongs to A, and all of B's use of property (y) belongs to B. This allocation of rights can be termed the “geometric-box allocation of rights,”<sup>193</sup> or the Blackstonian default package.<sup>194</sup>

However, sometimes between neighboring owners, even if A seems to conduct his affairs within the boundaries of his property, he still takes some of the use of B's property. For instance, even if A's house is completely constructed on A's land, A still needs the lateral

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188. See Coleman, *supra* note 186, at 1108 (stating Posner's thesis that the law should mimic the market).

189. Coase, *supra* note 5, at 18 (claiming that governmental regulation may or may not increase efficiency).

190. Coleman, *supra* note 186, at 1109 (noting that it is highly unlikely that assigning rights by the Kaldor-Hicks criterion would produce Pareto optimal outcomes).

191. Ellickson, *supra* note 21, at 683; Smith, *supra* note 3, at 1002 (cross-boundary allocation of rights and duties based on the relative value of two uses).

192. Ellickson, *supra* note 21, at 683.

193. Stewart E. Sterk, *Neighbors in American Land Law*, 87 COLUM. L. REV. 55, 55 (1987) (describing the “geometric-box’ allocation of rights”).

194. Smith, *supra* note 3, at 1002.

support of B's land. In other words, A still takes one use of B's land—the lateral support.<sup>195</sup> A's domain of control contains part of B's use of property (y); likewise, B's domain of control contains part of A's use of property (x). Thus, the initial allocation of rights between two neighboring owners should be A(x, y) and B(x, y). Here, x and y are each more than or equal to zero. (Henceforth, this paper assumes a scenario in which B interferes with A's use of property. Thus, A may be referred to as the plaintiff, and B may be referred to as the defendant.)

Nonetheless, quoting the tort law scholar Prosser, Coase states, “a person may make use of his own property or . . . conduct his own affairs at the expense of some harm to his neighbors.”<sup>196</sup> For instance, B may conduct his activity within the boundaries of his property, but his activity may cause damages to his neighbor A. In other words, B by his conduct takes some of A's use of property, and by his unilateral conduct B reduces the amount of A's property use from x to x'. A is damaged by B's conduct since the new amount of property use (x') is less than the original amount of his property use (x). Some of A's property use is taken by B. If the parties could voluntarily transact (for instance, if the transaction cost is zero or extremely low), the parties would adjust B's amount of property use from y to y'. In other words, B should pay some of his property use to A in order to compensate A for his loss. Ultimately, they would arrive at a new allocation of property use (x', y'), which would become the new equilibrium. In summary, based on the initial allocation of property rights, the parties conduct transactions by contracting and reach equilibrium.

According to the Pareto test, if B's activity takes more of A's use of property, B must compensate A. If the parties cannot reach an agreement by themselves, the law can simulate the result of the parties' possible transaction and distribute the reimbursement to A. The court would determine the value that B takes from A's use of property (that is, the reduction of the value of x), and determine the value that should be subtracted from B's use of property (y) and given to A to compensate A for the loss of property use (x).<sup>197</sup> After this process, the benefits are raised for all, but the parties are still in the optimal status.

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195. Ellickson, *supra* note 21, at 719; Smith, *supra* note 48, at S469 (exclusion does not mean to control all the use of the resources); SMITH & HAND, *supra* note 4, § 4:2 (neighboring landowners have the mutual obligation of lateral support).

196. Coase, *supra* note 5, at 19.

197. More precisely, the value of y that should be deducted may not be only the value of the reduction in x. This is because if B profits from using of A's property, the court may have to distribute the profits as the fruits of their “cooperation.” See Regan, *supra* note 141, at 429 (benefits of cooperation should be divided in a variable-sum game).

In brief, based on the initial allocation of property rights, the government conducts a cross-boundary reallocation of rights. This *ex post* allocation of rights deviates from the original “geometric-box allocation of rights” or the Blackstonian default package.<sup>198</sup>

Nonetheless some legal rules allow B to obtain more of A’s use of property without compensating A. These rules reduce only the value of x (A’s use of property) but make no change to the value of y (B’s use of property). Coase, still quoting Prosser, states, “The world must have factories, smelters, oil refineries, noisy machinery and blasting, even at the expense of some inconvenience to those in the vicinity, and the plaintiff may be required to accept some not unreasonable discomfort for the general good.”<sup>199</sup> These rules follow Kaldor-Hicks efficiency.

## 2. Nuisance Law as an Example

Private nuisance is an interference in which the defendant’s conduct causes damage to the plaintiff’s use and enjoyment of land.<sup>200</sup> In other words, by a unilateral act, the defendant takes part of the plaintiff’s use of the land (represented by x), thus reducing the value of x.

To determine whether a private nuisance exists, the court considers factors such as the substantiality and the reasonableness of the defendant’s interference with the plaintiff’s enjoyment and use.<sup>201</sup> Reasonableness is determined with reference to the totality of circumstances surrounding the defendant’s conduct.<sup>202</sup> Courts often use a list of factors to scrutinize this conduct; some refer to the severity of harm (such as the extent and the character of harm), whereas some evaluate the utility of the defendant’s conduct (such as the social value of the defendant’s primary purpose).<sup>203</sup> This approach is championed

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198. Sterk, *supra* note 193, at 55. Nonetheless it should be noted that the government’s second allocation (in contrast to the initial allocation) of rights may either compensate or not compensate the loser. Cross-boundary allocation of rights was considered to be incompatible with the *laissez-faire* distribution of property rights. Nonetheless, Ellickson believes that in some circumstances, to depart from the *ad coelum* rule and distribute property rights across the boundaries is a more equitable and efficient approach to dealing with externalities caused by property uses. Ellickson, *supra* note 21, at 719.

199. Coase, *supra* note 5, at 19-20.

200. See Claeys, *supra* note 27, at 1419.

201. See *id.* (listing causation, harm, and reasonableness as the elements of nuisance liability).

202. HERBERT HOVENKAMP & SHELDON F. KURTZ, PRINCIPLES OF PROPERTY LAW 424 (6th ed. 2005).

203. RESTATEMENT (SECOND) OF TORTS § 826 (AM. LAW INST. 1979).

by the Second Restatement of Torts.<sup>204</sup> The court should make a case-by-case evaluation of the total benefit and total loss caused by the defendant's use of land.<sup>205</sup>

In terms of allocative efficiency, reasonableness means that the total benefit of the defendant's act that takes the neighboring owner's use of property outweighs the loss suffered by the plaintiff from such taking. If the defendant's act is reasonable, the court should allow it and realign the parties' property rights, giving rise to a new allocation (x', y'). If the defendant's act is unreasonable, which means the loss it causes outweighs its benefit, the court should enjoin the defendant's act and return to the original allocation between the parties (x, y).

Nonetheless, one factor for determining reasonableness, the character of the neighborhood, represents a Pareto optimal point previously reached when the party purchased the property within the neighborhood.<sup>206</sup> The character of the neighborhood is the threshold of liability in nuisance law, which means that an activity considered normal in the neighborhood should not be treated as a nuisance (but it may be a nuisance at another place).<sup>207</sup> This rule, known as the locality rule, makes the character of the neighborhood a decisive factor of, or even a defense to, the liability of nuisance.<sup>208</sup>

Ellickson argues that the character of the neighborhood as a threshold of liability imposes a restriction on internalization of externalities suffered by neighboring landowners.<sup>209</sup> The concept of normalcy (or neighborliness) refers to the standard of the contemporary community and is empirically established. In a community, people often have a rough consensus on normal conduct, such as what constitutes normal land uses.<sup>210</sup> This local consensus shows that the locality rule relies on a Pareto optimal point already reached among the

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204. *See id.* §§ 827-28 (1977) (providing major factors to be weighed).

205. Smith, *supra* note 3, at 1003. *See* Ellickson, *supra* note 21, at 748 (making out a prima facie nuisance case should not entitle a defendant to remedies); Epstein, *supra* note 10, at 61; Claeys, *supra* note 27, at 1420 (reasonableness often requires "all-the-circumstances balancing"); Adler & Posner, *supra* note 176, at 177-84 (explaining the more precise method of cost-benefit analysis).

206. *See* Epstein, *supra* note 10, at 61.

207. Smith, *supra* note 3, at 1002-03.

208. *Bove v. Donner-Hanner Coke Co.*, 258 N.Y.S. 229, 232 (N.Y. App. Div. 1932); *Reed v. Cook Constr. Co., Inc.*, 336 So.2d 724, 725 (Miss. 1976); Smith, *supra* note 3, at 1002-03; Ellickson, *supra* note 21, at 749 n.233; Claeys, *supra* note 27, at 1421 (the locality rule is an important factor related to reasonableness).

209. Ellickson, *supra* note 21, at 728.

210. *Id.* at 729. *See* *Wade v. Miller*, 73 N.E. 849 (Mass. 1905) (the odor from henhouses and the cackling of hens and crowing of roosters in an agricultural area); *Vill. of Euclid, Ohio v. Ambler Realty Co.*, 272 U.S. 365, 388 (1926) ("[A] pig in the parlor instead of the barnyard."); RESTATEMENT (SECOND) OF TORTS § 828 cmt. g (AM. LAW INST. 1979).

neighbors regarding what is normal; normal or above-normal conduct does not entail liability. The established Pareto optimal point thus serves as a defense to liability. In addition, imposing liability only on subnormal conduct lowers administrative costs.<sup>211</sup>

Epstein's "implicit in-kind compensation" further explains why the locality rule invokes a formerly established Pareto optimal point as a defense to nuisance liability.<sup>212</sup> He explained the "implicit in-kind compensation" as follows: "the *uniformity* of activities throughout any given area makes it highly likely that benefits obtained by having each person inflict limited nuisances upon the others will more than offset the losses sustained from having to tolerate the nuisances inflicted by others."<sup>213</sup> A landowner in the community has *implicitly* received compensation, either from reciprocal harms in a "live and let live" manner or from the price of land purchase, for the loss he suffers. As Epstein states, it is "unlikely that any person will buy land in heavily industrialized regions with the idea of using it for residential property."<sup>214</sup> Thus neighborliness or normalcy expresses a consensus among the people in the community, who have implicitly consented to the character of the neighborhood at some point in time; the consensus thus becomes the basis for a defense to liability.

The requirement of substantial harm means that if the plaintiff suffers from slight or petty inconveniences, the level of interference is insufficient to impose liability.<sup>215</sup> The element of substantial harm can be explained by cost-benefit balancing and allocative efficiency. Recall that when the costs outweigh the benefits, the court does not reallocate rights between the parties. In addition, Ellickson mentions the requirement of substantial harm: "If plaintiffs are allowed to bring suits for trivial damages, the administrative costs involved are likely to exceed the efficiency gains of permitting such suits."<sup>216</sup> In other words, after administrative costs are considered, the benefits arising from the plaintiff claiming rights in situations of petty annoyances is outweighed by the costs, which include the costs to both parties and the judicial costs of making and enforcing decisions.<sup>217</sup> In contrast to Ellickson's

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211. Ellickson, *supra* note 21, at 731-32.

212. Epstein, *supra* note 10, at 90.

213. *Id.* at 88.

214. *Id.* at 89.

215. RESTATEMENT (SECOND) OF TORTS § 822 cmt. g (AM. LAW INST. 1979). *See* Rogers v. Elliott, 15 N.E. 768, 769 (Mass. 1988) (ringing of a church bell near the plaintiff's house). *See also* Lewis v. Stiles, 551 N.Y.S.2d 557, 558 (N.Y. App. Div. 1990) (holding that the "disturbances of dog barking, children frolicking, and the discordant sounds of music and outdoor summer life do not . . . rise to the level of substantial and unreasonable interference . . .").

216. Ellickson, *supra* note 21, at 737.

217. *See* Epstein, *supra* note 10, at 76 (explaining administrative costs).

focus on the costs of litigation, Rabin's analysis focuses on balancing the utilities of the defendant's conduct itself: "The substantiality of an interference depends on the benefits as well as the burdens that the plaintiff's land receives from the defendant's land."<sup>218</sup>

The Second Restatement of Torts explicitly endorses the approach in which the court in nuisance cases weighs the related benefits and costs.<sup>219</sup> In nuisance cases, the governance strategy is evident not only at the stage of liability, but at the stage of remedies as well. The governance strategy employed at the liability stage is shown by nuisance law's standard-based, rather than rules-based, approach, as evidenced by the court's implicit or explicit cost-benefit balancing.<sup>220</sup> The governance at the stage of remedies indicates that modern nuisance law allows the court to shun an "all-or-nothing" decision that merely allows or enjoins the defendant's conduct.<sup>221</sup> Even if the court finds a nuisance, it may choose not to ban the defendant's use completely but to revise the defendant's future course of conduct.<sup>222</sup> The court may choose not to enjoin a nuisance but—following Calabresi and Melamed's Rule 2—require the defendant to pay permanent damages.<sup>223</sup> This type of judgment is judicial mimicking of the Pareto optimality that the parties could have reached; in other words, it is a type of judicially coerced cooperation.

### III. EXPLAINING THE DOCTRINE OF EQUIVALENTS

The analysis of relations between neighbors focuses on whether the user takes the proprietor's use of property, and how to compare the benefits of such taking against its costs so that the overall welfare is increased by the taking. The analysis of the doctrine of equivalents in patent law also focuses on whether the accused infringer takes the use of the patent owner's claimed invention, but it requires showing a

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218. Edward Rabin, *Nuisance Law: Rethinking Fundamental Assumptions*, 63 VA. L. REV. 1299, 1319 (1977).

219. RESTATEMENT (SECOND) OF TORTS § 826 (AM. LAW INST. 1979). See Thomas W. Merrill, *Trespass, Nuisance, and the Costs of Determining Property Rights*, 14 J. LEGAL STUD. 13, 17 (1985); *Hendricks v. Stalnaker*, 380 S.E.2d 198, 202 (W. Va. 1989).

220. See Merrill, *supra* note 219, at 17. See also *Escobar v. Cont'l Baking Co.*, 596 N.E.2d 394, 395 (Mass. 1992) (listing relevant factors to be weighed when considering whether damages should be awarded).

221. See Merrill, *supra* note 219, at 19 (characterizing nuisance law as a "judgmental entitlement-determination rule").

222. See *Daugherty v. Ashton Feed & Grain Co., Inc.*, 303 N.W.2d 64, 69 (Neb. 1981); *Eaton v. Cormier*, 748 A.2d 1006, 1008 (Me. 2000); *HOVENKAMP & KURTZ*, *supra* note 202, at 424-25; *SMITH & HAND*, *supra* note 18, § 2:20 (a court in a nuisance case may order the defendant to modify his future activities).

223. See, e.g., *Boomer v. Atl. Cement Co.*, 257 N.E.2d 870, 874-75 (1970).

different type of welfare improvement to justify the accused infringer's taking and to immunize it from liability.

The determination of equivalency is divided into two parts: factual equivalency (the test for equivalency) and legal defenses.<sup>224</sup> Factual equivalency is the determination of whether the claimed invention and the accused product or process are equivalent.<sup>225</sup> Generally speaking, factual equivalency can be determined by the insubstantial differences test,<sup>226</sup> the tripartite function-way-result test,<sup>227</sup> or the known interchangeability test.<sup>228</sup> In *Warner-Jenkinson*, the Supreme Court opined that for determining equivalency, “[T]he particular linguistic framework used is less important than whether the test is probative of the essential inquiry: Does the accused product or process contain elements identical or equivalent to each claimed element of the patented invention?”<sup>229</sup> This “essential inquiry” is whether the defendant has taken the use of the claimed invention. The use of the “thing” taken here is the inventive concept of the plaintiff's patent. As one commentator notes, the substantial differences test and the tripartite test represent “a rough attempt to identify whether the accused activity has made use of the inventive concept that the patentee was attempting to set out in the patent claim.”<sup>230</sup>

In addition, the evidence of the defense to equivalency is not necessarily related to similarity with the technology in question. The evidence of some important defenses, such as the prior art bar or prosecution history estoppel, is different from the evidence concerning the comparison of factual equivalency. A successful assertion of one of these defenses bars the infringement by equivalents, regardless of whether the accused product or process is factually similar to the claimed invention. This is because, as explained in the later sections of this paper, these legal defenses are based on a policy rationale different

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224. See M. Scott Boone, *Defining and Refining the Doctrine of Equivalents: Notice and Prior Art, Language and Fraud*, 43 IDEA 645, 649 (2003) (equivalence analysis contains two steps: the test for equivalence and legal bars to equivalence).

225. *Id.*

226. *Id.* at 650.

227. See 6 JOHN GLADSTONE MILLS, III, ET AL., PATENT LAW FUNDAMENTALS § 20:49 (2d ed. 2011) (observing that the tripartite test is one of the approaches of proving equivalency, but not the only test).

228. See 4 MOY, *supra* note 121, § 13:65; Boone, *supra* note 224, at 650 (listing the tripartite test, the substantial differences test, and the known interchangeability test as the major tests for determining equivalency). See also 6 MILLS ET AL., *supra* note 227, § 20:49 (noting that equivalency is “equated with interchangeability”).

229. *Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 40 (1997).

230. 4 MOY, *supra* note 121, § 13:63.

from that of factual equivalency. These two sets of rules are not of the same nature with respect to the functions they serve.

#### A. *Determining Factual Equivalency*

The inquiry of factual equivalency is to determine whether the accused product or process “used” the inventive concept of the claimed invention.<sup>231</sup> The Supreme Court in *Warner-Jenkinson* stated that the “essential inquiry” is whether “the accused product or process contain[s] elements identical or equivalent to” every claimed element of the plaintiff’s patent.<sup>232</sup> Different “linguistic frameworks” (denoting methods of equivalent analysis) are only the means to answer this essential question.<sup>233</sup> If we treat the inventive concept of a patent as the “thing,”<sup>234</sup> patent infringement occurs when the use of the thing owned by the patentee was taken by another. In an equivalent analysis, if the accused product or process is not substantially different from the elements of the claimed invention, the patentee’s use of the thing was taken by the infringer. By contrast, if the accused product or process is substantially different from the claimed invention, the accused infringer did not take the patentee’s use of the thing. The test of substantial differences is therefore a method of determining whether the alleged infringer has taken the patentee’s use of a thing (her inventive concept).

In determining whether a substantial difference exists, courts often ask whether the defendant has made a substantial change to the technical means.<sup>235</sup> If the means have been changed substantially, the claimed invention and the accused product or process are not in fact equivalent. However, they are equivalent if the change is insignificant.<sup>236</sup> For example, in the classic case *Sanitary Refrigerator Co. v. Winters*, the Supreme Court made the following statement: “A close copy which seeks to use the substance of the invention, and, although showing some change in form and position, uses substantially the same devices, performing precisely the same effects with no change in principle, constitutes an infringement.”<sup>237</sup> The Federal Circuit also

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231. *See id.* § 13:69.

232. *Warner-Jenkinson*, 520 U.S. at 40.

233. *Id.*

234. *See Smith, supra* note 158, at 1693.

235. 4 MOY, *supra* note 121, § 13:5 (citing *Odiome v. Winkley*, 18 F.Cas. 581, 582 (C.C.D. Mass. 1814)).

236. *See Sofamor Danek Group, Inc. v. DePuy-Motech, Inc.*, 74 F.3d 1216, 1222 (Fed. Cir. 1996); *Perkin-Elmer Corp. v. Westinghouse Elec. Corp.*, 822 F.2d 1528, 1533 (Fed. Cir. 1987); *Pennwalt Corp. v. Durand-Wayland, Inc.*, 833 F.2d 931, 934 (Fed. Cir. 1987).

237. *Sanitary Refrigerator Co. v. Winter*, 280 U.S. 30, 42 (2d Cir. 1929).

reasoned in *London v. Carson Pirie Scott & Co.* that infringement by equivalents arises “where an infringer, instead of inventing around a patent by making a *substantial change*, merely makes an *insubstantial change*, essentially misappropriating or even ‘stealing’ the patented invention . . .”<sup>238</sup>

Thus, the concept of substantial differences may encompass two facets, one addressing the substantial identity of the accused product or process to the claimed invention,<sup>239</sup> the other addressing the substantial change made by the accused infringer. Though these two facets facially seem the same, they have different connotations. The concept of substantial identity measures the degree to which the patentee’s use of the thing—the inventive concept of the claimed invention—is taken by the alleged infringer.<sup>240</sup> As stated by the Federal Circuit in *Hilton Davis*, substantial identify refers to a situation “where a device is a copy of the thing described by the patentee, ‘either without variation, or with such variations as are consistent with its being in substance the same thing.’”<sup>241</sup>

However, the concept of substantial change measures how far the accused infringer altered the means of the claimed invention, and whether such an alteration is considered significant or miniscule.<sup>242</sup> Thus, the finding of substantial change measures the degree to which the accused infringer, though perhaps a user of the patentee’s inventive concept, has made contributions to the technology in question. A finding that the change was insubstantial indicates that the infringer’s contribution to the art was minimal.<sup>243</sup> Thus, these two concepts are proxies for different activities of the accused infringer: substantial identity measures the degree of taking, and substantial change measures the contribution to the art in question. Courts often consider it as a matter of course that a finding of substantial change and a finding of substantial identity negate each other.<sup>244</sup>

Making substantial change, for example, by successfully designing around a patent,<sup>245</sup> could shift the Pareto frontier outward,

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238. *London v. Carson Pirie Scott & Co.*, 946 F.2d 1534, 1538 (Fed. Cir. 1991) (emphasis added).

239. See *Sanitary Refrigerator*, 280 U.S. at 41-42; *Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc.*, 62 F.3d 1512, 1526 (Fed. Cir. 1995); *Lear Siegler, Inc. v. Sealy Mattress Co. of Michigan, Inc.*, 873 F.2d 1422, 1425 (Fed. Cir. 1989).

240. *Hilton Davis*, 62 F.3d at 1526 (quoting *Sanitary Refrigerator*, 280 U.S. at 41-42).

241. *Id.*

242. *Sofamor Danek Group, Inc. v. DePuy-Motech, Inc.*, 74 F.3d 1216, 1221-22 (Fed. Cir. 1996).

243. *Vermont Indus., Inc. v. Reinke Mfg. Co., Inc.*, 983 F.2d 1039, 1043 (Fed. Cir. 1993).

244. See *Hilton Davis*, 62 F.3d at 1517-18. See also *Sofamor*, 74 F.3d at 1222.

245. *Hilton Davis*, 62 F.3d at 1520; Paul N. Katz & Robert R. Riddle, *Designing Around a*

because innovation is one major approach to shifting or tilting the production possibility frontier.<sup>246</sup> However, if the accused infringer merely makes use of the inventive concept of the patented invention, without modification or with only insignificant modification, even though it is possible that the benefit to the infringer could be greater than the loss to the patentee, the situation is merely moving along the frontier. If the patentee is not compensated, the result could fall to the southwest side of the Pareto frontier. This situation is what the Supreme Court termed “fraud on a patent” in *Graver Tank*.<sup>247</sup> The doctrine of equivalence ensures that this situation falls within the ambit of the patent right.<sup>248</sup>

The purpose of the patent system is to promote the progress of science and technology. The U.S. Constitution lists “to promote the Progress of ... useful Arts” as the goal of the patent system.<sup>249</sup> Given this purpose, the only case where patent law reallocates rights is where the actor promotes the progress of technology. In cases where the actor seeks only a redistribution of wealth based on existing technology, patent law does not reallocate rights. In contrast to property law, both cases where the production value is increased, whether “moving along the Pareto frontier” or “moving the Pareto frontier outward,” can trigger the government’s reallocation of rights. Patent law reallocates rights only in cases of shifting the Pareto frontier outward. In cases that only move along the Pareto frontier, patent law does not reallocate rights but requires a return to the original property right. If the parties are seeking wealth redistribution under the same technological level, the law requires the parties to reach voluntary agreements by contracting.

The primary test for equivalency is substantial difference, because substantial difference means that the accused infringer has made a substantial innovation rather than staying on the same Pareto frontier to seek redistribution. Also, in cases where the parties remain on the same frontier and the taker does not reimburse the patent holder, the result may even fall to the southwest side of the Pareto frontier.

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*United States Patent*, 45 S. TEX. L. REV. 647, 671 (2004) (a successful design-around promotes public benefits).

246. Jane R. Bambauer, *Glass Half Empty*, 64 UCLA L. REV. DISCOURSE 434, 438-39 (2016). See John Buck, *Movement of the Production Possibilities Frontier*, ECON. PERSP. (Apr. 7, 2008, 12:01 AM), <http://bit.do/econpersp>.

247. *Graver Tank & Mfg. Co., v. Linde Air Prods. Co.*, 339 U.S. 605, 608 (1950). See also *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 234 F.3d 558, 593 (Fed. Cir. 2000) (en banc).

248. See Christopher A. Cotropia, “*After-Arising*” *Technologies and Tailoring Patent Scope*, 61 N.Y.U. ANN. SURV. AM. L. 151, 159-60 (2005).

249. U.S. CONST. art I, § 8, cl. 8.

Other major tests of equivalency can be explained by the same rationale. The tripartite test is only one means of determining substantial difference, and its principle is the same as that of the substantial differences test (i.e., distinguishing whether the accused infringer is seeking redistribution based on the same technology or whether substantial innovation has been made to shift the Pareto frontier outward).<sup>250</sup> The principle is the same for interchangeability: the fact that, at the time of infringement, one skilled in the art does not know that the two elements are interchangeable, indicates that the accused infringer has made innovative contributions to the technology.<sup>251</sup> The test of substantial change measures the degree of the accused infringer's contribution; the more substantial the change, the larger the contribution, and the further the Pareto frontier is moved outward.<sup>252</sup> No matter what test the court uses—whether substantial differences, the tripartite test, or interchangeability—the real point, as pronounced by the Supreme Court in *Warner-Jenkinson*, is to determine whether the accused product or process is identical or equivalent to the claimed patent elements.<sup>253</sup> In other words, these tests are all designed to determine whether the accused infringer took the use of the inventive concept of the patent in question. Purely taking the inventive concept of a patent without making a substantial change falls under “moving along the Pareto frontier,” rather than “shifting the frontier outward.”

In patent infringement, to move along the Pareto frontier is to redistribute the same resource: the inventive concept of the claimed invention. This redistribution could improve well-being if done through transactions, but it must be premised on respecting property rights and voluntary contracting by the parties. If someone takes the inventive concept of the claimed invention without making a substantial change, the infringer profits from the taking while making the patentee worse off, and the Supreme Court calls this situation “fraud on a patent.”<sup>254</sup> Taking is not permissible unless the taker makes a substantial change to the invention, which means the Pareto frontier is shifted outward or tilted. In cases where an alleged infringer makes a substantial change, courts could find such acts non-infringing, and make a new allocation of property rights to redistribute the resource

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250. See *Warner-Jenkinson Co., Inc. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 40 (1997).

251. *Id.* at 37-38.

252. See *Hilton Davis Chem. Co. v. Warner-Jenkinson Co., Inc.*, 62 F.3d 1512, 1517-18 (Fed. Cir. 1995).

253. *Warner-Jenkinson*, 520 U.S. at 40.

254. See *Graver Tank & Mfg. Co., v. Linde Air Prods. Co.*, 339 U.S. 605, 607-08 (1950).

(the inventive concept of the claimed invention), even if the alleged infringer did use the inventive concept in question.

Behind this reasoning is the idea that patent law encourages technological innovation, which is expressed in economic terms as tilting or shifting the Pareto frontier outward, and denotes creation in technology, knowledge, or other types of innovations that “make possible improvements in well-being which previously were not feasible.”<sup>255</sup> Examples of welfare improvements listed by Calabresi include “a better wheat, cheaper solar energy, superconductors, manna.”<sup>256</sup> Patent law, nonetheless, does not require a pioneering innovation for a patent to be granted, not to mention that the threshold of sufficient innovation to avoid an infringement is lower than that of obtaining a patent.<sup>257</sup> Yet just moving along the frontier without making a substantial innovation is considered to be merely taking the same inventive concept, no matter what tests the court resorts to.

### *B. Preexisting Pareto Optimality as the Defense to Infringement*

The defenses to the application of the doctrine of equivalents are often based on separate rationales from factual equivalency itself. Courts and commentators often suggest that the defenses are founded on the public-notice function of the patent. This section suggests that several of the defenses are related to Pareto optimality, or the allocation of property rights, consented to by the patent owner and the PTO.

#### 1. Prior Art Bar

Interpreted from the contractarian view, a patent grant could be considered an agreement between the patent owner and the state (representative of the public).<sup>258</sup> This agreement is premised on two conditions: first, that the invention is fully disclosed in the specification,<sup>259</sup> and second, that the claimed invention and prior art are sufficiently different.<sup>260</sup> The second precondition indicates that prior

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255. Calabresi, *supra* note 12, at 1229.

256. *Id.* at 1229-30.

257. For the distinction between a pioneering patent and an improvement, see Jean M. Barkley, *The Doctrine of Equivalents Analysis After Wilson Sporting Goods*, 35 ARIZ. L. REV. 765, 774 (1993).

258. See Michael J. Meurer & Craig Allen Nard, *Invention, Refinement and Patent Claim Scope: A New Perspective on the Doctrine of Equivalents*, 93 GEO. L.J. 1947, 1989 (2005).

259. See *id.* at 1951 (“The enablement standard requires a person having ordinary skill in the art be able to make and use the embodiments claimed in the patent without undue experimentation.”).

260. 4 MOY, *supra* note 121, §13:80.

art serves as the background of the consent between the patent owner and the patent office regarding the patent grant; both agree that the patentee may not base her claim on prior art and that the patented invention must be sufficiently different from prior art.<sup>261</sup>

From this viewpoint, it is clear that the prior bar to patent infringement is a defense based on a Pareto optimality existing at the time of the patent grant. Two conditions—that the patentee may not claim patent coverage that would ensnare the prior art,<sup>262</sup> and that the patented invention must sufficiently differ from the prior art—are inherently contained in the parties' consent that reaches the initial Pareto optimality. The prior art bar excludes the patentee from claiming embodiments that are not novel, in addition to those obvious in light of the prior art, in view of the ordinary skill in the art.<sup>263</sup> These are all part of the allocation of property rights (P) concluded by the transaction between the patent owner and the patent office, which consents on behalf of the public.<sup>264</sup>

Using a hypothetical claim to further examine the range of equivalents<sup>265</sup> is consistent with the premise that the prior art bar represents in part the original Pareto optimality (i.e., the original allocation of property rights between the patentee and the public), because a patentee may not obtain a patent with a scope that covers prior art.<sup>266</sup> If a hypothetical claim violates the conditions of patentability (such as covering prior art), the patent holder's claim of equivalency would be considered non-P.<sup>267</sup> As the Federal Circuit stated in *Wilson Sporting Goods Co. v. David Geoffrey and Associates*: “a patentee should not be able to obtain, under the doctrine of

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261. Folker, *supra* note 106, at 218; Anand Gupta, *Patent Law: The Supreme Court Reinforces the Validity of the Doctrine of Equivalents in Warner-Jenkinson Co. v. Hilton Davis Chemical Co.*, 23 S. ILL. U.L.J. 123, 131 (1998).

262. See Glenn K. Beaton, *File Wrapper Estoppel and the Federal Circuit*, 68 DENV. U.L. REV. 283, 284 (1991) (“[E]quivalents cannot be used to expand the claims to cover the prior art.”). See Barkley, *supra* note 257, at 782 (noting that prior bar limitation restricts the range of equivalents).

263. *Key Mfg. Group, Inc. v. Microdot, Inc.*, 925 F.2d 1444, 1449 (Fed. Cir. 1991) (prior art would make the accused product obvious); Boone, *supra* note 224, at 657, 670.

264. See Timothy R. Holbrook, *Equivalency and Patent Law's Possession Paradox*, 23 HARV. J.L. & TECH. 1, 21 (2009) (stating the rationale of the prior art bar: the patent holder may not claim, by way of the doctrine of equivalents, scope which he may not obtain literally).

265. *Wilson Sporting Goods Co. v. David Geoffrey & Assocs.*, 904 F.2d 677, 684 (Fed. Cir. 1990) (noting that the court may “conceptualize the limitation on the scope of equivalents by visualizing a hypothetical patent claim, sufficient in scope to literally cover the accused product” in order to determine whether prior art limits the range of equivalents) (emphasis omitted).

266. *Id.* See also 4 MOY, *supra* note 121, §§ 13:80, 13:83; Barkley, *supra* note 257, at 772.

267. Barkley, *supra* note 257, at 773 (“[I]f the hypothetical claim would *not* have been patentable over the prior art, it forecloses a finding of infringement because the range of equivalents cannot reach the accused product without ensnaring the prior art.”).

equivalents, coverage which he could not lawfully have obtained from the PTO by literal claims.”<sup>268</sup>

The patent holder’s assertion of infringement is grounded in the original Pareto optimality and the corresponding allocation of property rights. If the scope of the patent, as asserted by the patentee through the doctrine of equivalents, violates the requirements of patentability, her assertion of the right would violate the original agreement between her and the patent office. It is obvious that one may not claim protection of her property right (P) through the doctrine of equivalents if in the end the assertion of equivalency would violate her property right (thus non-P). Prior art limitations to the doctrine of equivalents mean that the patent holder’s assertion of her property right falls into the category of non-P.<sup>269</sup> From another angle, raising the prior art bar as a defense seems to be the alleged infringer’s insistence that the patent scope should be limited to the original Pareto optimality.

## 2. Prosecution History Estoppel and the Disclosure-Dedication Doctrine

Prosecution history estoppel and the disclosure–dedication doctrine are two limitations on the doctrine of equivalents similarly based on the acts of the patentee during the course of patent prosecution. Both refer to the Pareto optimality established by consensus between the patent holder and the PTO. The optimality is embodied in an allocation of rights between the patentee and the public; thus, this allocation is considered P.

Prosecution history estoppel is based on the acts, including narrowing amendments, of the patentee during the prosecution of her patent; the subject matter relinquished for the purpose of securing a patent grant may not later be reclaimed through the assertion of the doctrine of equivalents.<sup>270</sup> Explained by the contractarian view, as in the Coase theorem, when a patent applicant surrenders part of the patent scope to secure a patent grant, the agreement she transacted with the PTO does not encompass what was surrendered.<sup>271</sup> Therefore, when

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268. *Wilson Sporting Goods*, 904 F.2d at 684.

269. Boone, *supra* note 224, at 657-85 (observing that the prior art bar is based on the requirement of patentability; allowing the patent holder to claim equivalency for the scope covered by the prior art would, ultimately, allow the patent scope which is not patentable).

270. Mark A. Lemley & Kimberly A. Moore, *Ending Abuse of Patent Continuations*, 84 B.U.L. REV. 63, 98-99 (2004); Folker, *supra* note 106, at 218-19; Gupta, *supra* note 261, at 132; Holbrook, *supra* note 263, at 22-23.

271. See, e.g., Douglas Lichtman, *Rethinking Prosecution History Estoppel*, 71 U. CHI. L. REV. 151, 153 (2004) (by correcting the claim, the applicant “recognized and emphasized” the difference between the two terms and “proclaimed his abandonment”). See also Kenneth D. Bassinger, *Unsettled Expectations in Patent Law: Festo and the Moving Target of Claim*

she asserts infringement (i.e., asserting the allocation of P), she may not base her claim on the patent scope that she surrendered and thus is not within the scope of rights allocated to her.<sup>272</sup> As the Supreme Court stated in *Festo*, the aim of file history estoppel is to require the patentee to hold a consistent position: “the purpose of applying the estoppel in the first place—to hold the inventor to the representations made during the application process.”<sup>273</sup> Only the contents of the original transaction between the patent holder and the PTO can be claimed later at the infringement stage.

From the viewpoint of the agreement between the patent holder and the patent office, the exception rules to file history estoppel considerably resemble ascertaining the parties’ true intent behind the wording of the contract. For instance, the exception rule of unforeseeability can be explained by the idea that if an embodiment was unforeseeable at the time of the prosecution of the patent, the patentee may not be considered to have given up such a later-development equivalent.<sup>274</sup> The rule of tangentialness refers to a situation where the “language in the claim amendment [...] was inadvertently too narrow” and thus fails to cover the equivalent in question.<sup>275</sup> Tangentialness focuses on the rationale for the narrowing amendment,<sup>276</sup> and it similarly indicates a situation where the patent holder’s true intent was not to relinquish the equivalent in question. As explained by Judge Rader, it “honor[s] the objective intent of the amendment.”<sup>277</sup>

The disclosure–dedication bar (the public dedication doctrine) also refers to the contents of the agreement between the patent holder and the patent office. If subject matter is disclosed in the specification but unclaimed, the disclosure–dedication bar prevents the patent holder from recapturing that subject matter through the assertion of the

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*Equivalence*, 48 HOW. L.J. 685, 689 (2005) (noting that “negotiations” between the inventor and a patent examiner become part of the public record indispensable for ascertaining the scope of a patent).

272. See Bassinger, *supra* note 271, at 700 (noting that by amending a claim, the patentee “surrenders at least some part of that intellectual territory encompassed by the original claim”).

273. *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 535 U.S. 722, 737-38 (2002).

274. 4 MOY, *supra* note 121, § 13:111; Holbrook, *supra* note 263, at 23.

275. 4 MOY, *supra* note 121, § 13:111. Examples of tangentialness include amendments not made to avoid prior art, or amendments to avoid nonanalogous prior art. See J. Andrew Lowes & David L. McCombs, *Off on a Tangent: Using Festo’s Second Criterion to Rebut the Presumption of Surrender*, 88 J. PAT. & TRADEMARK OFF. SOC’Y 579, 585-91 (2006); Peter Lee, *Patent Law and the Two Cultures*, 120 YALE L.J. 2, 50-51 (2010).

276. Lowes & McCombs, *supra* note 275, at 585.

277. *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 344 F.3d 1359, 1370, 1376, n.7 (Rader, J., concurring).

doctrine of equivalents.<sup>278</sup> The fact that the subject matter is disclosed but not claimed indicates that it is not within the scope of the agreement that formed the allocation of property rights, and it thus falls within the scope of non-P. The disclosure–dedication doctrine thus has the same function as file history estoppel, to distinguish subject matter within or outside the property rights allocated to the patentee (P or non-P). From this perspective, similar to the consensus between the patentee and the PTO, the public dedication doctrine can also be considered a type of estoppel.<sup>279</sup>

#### CONCLUSION

Smith’s brief comment on the similarity between nuisance law and the doctrine of equivalents leaves room for discussing why the two sets of doctrines have affinities. Nuisance law can be a universally applicable prototype that concerns the conflict between the owner’s right of exclusion and another’s privilege of use, with the conflict resolution tied to the reasonableness of the use in question. This prototype can potentially be applied to various issues of intellectual property law.

Inherent in nuisance law is a model for delineating property rights, which, according to Smith, is a hybrid regime mixing the exclusion and the governance strategies.<sup>280</sup> This model fulfills the function of economizing information costs. The transition from the exclusion strategy to the governance strategy allows harmonization of the owner’s right of exclusion and another’s claim to use the same asset. The key to harmonization is the reasonableness of the use. Patent infringement, involving a transition from literal infringement to infringement by equivalents, can similarly be considered a hybrid regime, with the doctrine of equivalents serving the role of harmonizing use conflicts.

Coase’s theoretical context further elucidates this topic. Inherent in both nuisance law and the doctrine of equivalents is that the government allocates property rights when doing so could enhance well-being.<sup>281</sup> The reasonableness test in nuisance law contains a cost–benefit analysis; in patent law, it requires shifting the Pareto frontier

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278. See, e.g., *Johnson & Johnson Assocs. Inc. v. R.E. Serv. Co.*, 285 F.3d 1046, 1054 (Fed. Cir. 2002) (en banc); *PSC Comput. Prods., Inc. v. Foxconn Int’l, Inc.*, 355 F.3d 1353, 1360 (Fed. Cir. 2004); *Toro Co. v. White Consol. Indus., Inc.*, 383 F.3d 1326, 1330-31 (Fed. Cir. 2004); *SanDisk Corp. v. Kingston Tech. Co. Inc.*, 695 F.3d 1348, 1363 (Fed. Cir. 2012).

279. 4 MOY, *supra* note 121, § 13:92 (“[T]he clearly better view is that the rule [of disclosure dedication] is currently a form of estoppel.”).

280. Smith, *supra* note 3, at 1046.

281. *Id.* at 969-71.

outward to prompt the government to reallocate property rights. The difference indicates that patent law places special emphasis on innovation.