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ARTICLE

PRIVACY AND TRADE SECRET LAW APPLIED TO DRONES: AN ECONOMIC ANALYSIS†

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The growing number of commercial and consumer drones, combined with their ability to fly quietly at low altitudes with cameras and other monitoring equipment, raises concerns about privacy and property rights. This Article focuses on two primary questions. First, how will the balancing of privacy concerns and the interests of drone operators influence the emergence of new rules governing minimum drone operating altitudes above private property? And, second, once those new rules are set, how will the large volume of drone operations affect existing laws? An economic analysis of intrusion upon seclusion and trade secret law helps answer these questions.

Permitting drones to fly above private property without the property owner's consent provides efficiency gains by enabling drones to fly more directly to their destinations. And, as with planes flying at high altitude, most landowners are unlikely to notice overhead drones operating at an altitude of at least 200 feet. Thus, the benefits of reducing vertical property rights to create a 200- to 400-foot high public highway for drones, as the Federal Aviation Administration is considering, are likely to far exceed the costs. However, at sufficiently low altitudes, drones impose significant privacy costs because of their surveillance capabilities and unsettling proximity. Permitting drones to fly at less than 200 feet would provide only minimal additional economic benefits to the

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drone industry while significantly increasing potential privacy costs for individuals. Accordingly, because the privacy costs imposed by drone operations below 200 feet would exceed efficiency benefits gained, drone operations below this height should be considered a trespass and property owners should be permitted to exclude them.

Operations above 200 feet present a different set of challenges because drones operating at that height are, or soon will be, capable of capturing detailed images of property below. For those operations, individuals will still need to rely on intrusion law to protect their privacy, and firms will still need to rely on trade secret law to protect their commercial secrets. The original economic rationales for both laws continue to apply in the drone era. Intrusion law recognizes that protecting the seclusion of individuals is economically beneficial. Trade secret law recognizes that there are economic benefits to affording trade secret protection to firms that take reasonable precautions to protect their commercial secrets. Although the rise of drones need not change intrusion and trade secret legal principles, the large number of drones means that new simple rules should be issued to establish a presumption of intrusion upon seclusion. The large number of drones also means that firms may need to take additional precautions to benefit from trade secret protection both as a legal matter and for practical reasons. Another recommendation is for higher penalties and more frequent use of punitive damages.

I. INTRODUCTION

The drone era is here. Global sales of personal and commercial drones[1] were projected to reach 3.0 million in 2017, a 39 percent increase over the year before.[2] When small hobbyist drones are included, the figures are much higher, with U.S. sales alone estimated at 3.4 million units in 2017.[3] The size of the U.S. drone fleet already exceeds that of the commercial and private aircraft fleet by a factor of ten, and the gap will increase in the years ahead.[4]

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1. Drones are categorized as unmanned aerial vehicles (UAVs) or unmanned aerial systems (UAS). This Article's focus is on small UAS (sUAS), which are defined as "an unmanned aircraft weighing less than 55 pounds on takeoff, including everything that is on board or otherwise attached to the aircraft." 14 C.F.R. § 107.3 (2018).

2. Press Release, Gartner, Gartner Says Almost 3 Million Personal and Commercial Drones Will Be Shipped in 2017 (Feb. 9, 2017), https://www.gartner.com/newsroom/id/3602317.

3. Press Release, Consumer Tech. Ass'n, 2017 Tech Growth Exceeds Expectations: Industry Revenue to Reach Record Levels as Emerging Categories Soar, Says CTA (July 19, 2017), https://www.cta.tech/News/Press-Releases/2017/July/2017-Tech-Growth-Exceeds-Expectations-Industry-Re.aspx. Different sources classify drones in different ways. The primary distinctions are government, commercial, and personal. The personal category sometimes excludes drones that do not connect to the internet or weigh under 200 grams. See other categorizations and descriptions of drone usage in Roger Clarke, *Understanding the Drone Epidemic*, 30 COMPUT. L. & SEC. REV. 230, 236 (2014).

4. FAA, FAA AEROSPACE FORECAST FISCAL YEARS 2017–2037 23–32 (2017).

Based on applications submitted to the Federal Aviation Administration (FAA), the largest commercial use of drones is for photography.[5] A recent analysis of the industry reports that "[t]he most mature applications . . . involve short-range surveillance and associated photographs or videos."[6] The sheer number of drones, combined with their ability to fly quietly at low altitudes with cameras and other monitoring equipment, raises concerns about property rights and privacy. These are not theoretical issues. In several recent cases, landowners have shot down drones they believed to be trespassing on their property and invading their privacy.[7]

Prior work has examined vertical property rights and privacy with respect to drones.[8] This Article focuses on the interrelation between property rights and privacy, applying an economic perspective. The fundamental questions addressed here are how will the balancing of privacy concerns and the interests of drone operators influence the emergence of new rules governing minimum drone operating altitudes above private property? And, once those new rules are set, how will the increasing volume of drone operations affect privacy? An economic analysis of privacy law helps answer these questions.

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5. ARTHUR HOLLAND MICHEL & DAN GETTINGER, CTR. FOR THE STUDY OF DRONES AT BARD COLL., ANALYSIS OF U.S. DRONE EXEMPTIONS 2014–2015 5–6 (2016), http://dronecenter.bard.edu/files/2016/03/Analysis-of-U.S.-Drone-Exemptions-2014-2015.pdf.

6. Pamela Cohn et al., *Commercial Drones Are Here: The Future of Unmanned Aerial Systems*, MCKINSEY & CO. (Dec. 2017), https://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/commercial-drones-are-here-the-future-of-unmanned-aerial-systems. For a good sense of drone photographic capabilities, see DRONESTAGRAM & AYPERI KARABUDA ECER, DRONESCAPES: THE NEW AERIAL PHOTOGRAPHY FROM DRONESTAGRAM (2017).

7. *See, e.g.*, Nick Bilton, *When Your Neighbor's Drone Pays an Unwelcome Visit*, N.Y. TIMES (Jan. 27, 2016), https://www.nytimes.com/2016/01/28/style/neighbors-drones-invade-privacy.html.

8. *See, e.g.*, Eric R. Claeys, *On the Use and Abuse of Overflight Column Doctrine*, 2 BRIGHAM-KANNER PROP. RTS. CONF. J. 61 (2013); Bradley W. Foster, *Warrantless Aerial Surveillance and the Right to Privacy: The Flight of the Fourth Amendment*, 56 J. AIR L. & COM. 719 (1991); Benjamin D. Mathews, Comment, *Potential Tort Liability for Personal Use of Drone Aircraft*, 46 St. MARY'S L.J. 573 (2015); Richard A. Posner, *Privacy, Surveillance, and Law,* 75 U. CHI. L. REV. 245 (2008); Troy A. Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155 (2015).

The scope of this Article is limited to studying the property rights and privacy issues arising from two scenarios.[9] In the first, drones operate near or fly directly over private residential property and, while doing so, take photos, record sound, or collect other information without the consent of the property owner. In the second, drones conduct the same activities from the same vantage points but with respect to property and facilities operated and owned by a corporation. The first scenario is covered by the tort of intrusion upon seclusion, while the second is covered by trade secret law.

This Article does not provide an exhaustive review of the laws of vertical property rights, personal privacy, and trade secrets. The goal is to provide enough detail to permit an economic analysis of the issues raised by the growth of commercial drones. Part II summarizes the vertical property rights issues raised by the growth of commercial aviation, and discusses the new issues raised by drones. Part III sets out the underlying legal principles and economic rationale for the intrusion upon seclusion tort and analyzes their application to aerial surveillance using drones. Part IV does the same with respect to trade secret law. Part V discusses inadvertent intrusions. Part VI summarizes the conclusions reached about vertical property rights and privacy in the drone era.

II. VERTICAL PROPERTY RIGHTS

This Part begins by discussing how the rise of commercial aviation created a conflict with existing vertical property rights, which were ultimately cut back to accommodate commercial aviation interests. Then Section B discusses the application of vertical property rights to commercial drone operations. Section C answers the general question of what economic forces cause property rights to change. Finally, Section D discusses how the rise of drones fits within the economic framework underlying vertical property rights and concludes that the benefits to society of further cutting back vertical property rights exceed the costs.

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9. Governmental drone surveillance, which is typically used for criminal investigations, is not considered in this Article. Unlike commercial and consumer operations, government surveillance is ultimately governed by the First (free speech and association), Fourth (protection against unreasonable searches), Fifth (self-incrimination), and Fourteenth (equal protection) Amendments. Similarly, drone-use by news organizations also is not covered here because of the centrality of First Amendment issues that are beyond the scope of this Article.

A. The Ad Coelum Doctrine and The Growth of Aviation

By the late 1800s, lawyers began to think of real property not as the land itself, but as the bundle of rights associated with the land.[10] Among those rights, the right to exclude others has been called the "*sine qua non* of property rights."[11] "Give someone the right to exclude others from a valued resource . . . and you give them property. Deny someone the exclusion right and they do not have property."[12] As for vertical property rights, the obvious question is how high does the right to exclude extend? Before the aviation era, the answer was well-settled—the right to exclude extended upwards without limit. *Cujus est solum, ejus est usque ad coelum*—the *ad coelum* doctrine—"whoever's is the soil, it is theirs all the way to Heaven and all the way to hell."[13] Intruding onto someone else's property either on the surface or above the surface was trespass.[14]

The most important new industry of the 1800s—the telegraph industry—abided by the *ad coelum* doctrine throughout the industry's rapid expansion. Thus, "telegraph wires avoided virtually all other privately owned airspace, because it was generally understood that wires could not cross through a landowner's air without his permission (or compensation from the government after an exercise of eminent domain), even wires stretched across a parcel untouched by any pole."[15]

With the invention of flight, however, lawyers recognized that it would be impractical for aircraft operators to obtain the consent of

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10. STUART BANNER, AMERICAN PROPERTY: A HISTORY OF HOW, WHY, AND WHAT WE OWN 58 (2011).

11. Thomas W. Merrill, *Property and the Right to Exclude*, 77 NEB. L. REV. 730, 730 (1998).

12. *Id.*

13. 2 WILLIAM BLACKSTONE, COMMENTARIES *18.

14. The same principle applied to trespasses below the surface until the discovery of oil in the 1850s. Pumping oil from a well on one property drains oil from an underground pool that often spans multiple properties. Therefore, the *ad coelum* doctrine needed to be modified for oil and gas exploration. An early response to the problem was the development of the "capture rule," which provided that the landowner acquired title to all oil produced from wells drilled on his land, regardless of where the oil originated. Colleen E. Lamarre, Note, *Owning the Center of the Earth: Hydraulic Fracturing and Subsurface Trespass in the Marcellus Shale Region*, 21 CORNELL J.L. & PUB. POL'Y 457, 462–65 (2011).

15. STUART BANNER, WHO OWNS THE SKY? THE STRUGGLE TO CONTROL AIRSPACE FROM THE WRIGHT BROTHERS ON 20 (2008). As for balloonists, Banner found no reported cases, but points to commentary suggesting that balloonists were at least technically trespassing. *Id.* at 27–28.

all landowners whose property lay underneath the flight path. "Acquisition of the appropriate easements to permit an overflight . . . would obviously entail monumental transaction costs."[16] For instance, "[t]he owner of the airplane would have great difficulty identifying the various parcels of property traversed by the flight path; the number of parties with which agreements would have to be negotiated would be immense; and the parties would face formidable difficulty detecting and proving violations."[17]

Similarly, the idea of individual states conducting property-by-property condemnation proceedings of airspace sufficient to create a high-altitude aviation highway was considered and rejected as impractical.[18]

In response to these issues, Congress enacted the 1926 Air Commerce Act, declaring there to be a "public right of freedom of interstate and foreign air navigation" through the navigable airspace of the United States, defined as the "airspace above the minimum safe altitudes of flight prescribed by the Secretary of Commerce."[19] The Air Commerce Act did not specifically address the vertical property rights question, although clearly Congress granted permission for planes to travel through what had been considered private property.

In the 1930s, the introduction of new aircraft technology, such as the DC-3, made air travel more comfortable, and the number of passengers grew dramatically, exceeding 1.1 million in 1936. Over the next five years, the number of passenger miles traveled in the United States increased 600 percent.[20] Substantial litigation followed.[21]

In 1946, a case reached the Supreme Court brought by a chicken farmer who objected to the U.S. government flying planes over his property at such a low altitude that his panicked chickens flew into the walls of their coop.[22] In *United States v. Causby*, Justice Douglas wrote that "[t]he common law doctrine that ownership of land extends to the periphery of the universe has no

16. Thomas W. Merrill, *Trespass, Nuisance, and the Costs of Determining Property Rights*, 14 J. LEGAL STUD. 13, 36 (1985).

17. *Id.*

18. BANNER, *supra* note 15, at 98–99.

19. Air Commerce Act of 1926, Pub. L. No. 69-254, 44 Stat. 568 (1926). Minimum flight altitudes are set forth in 14 C.F.R. § 91.119 (2018).

20. Judy Rumerman, *Commercial Flight in the 1930s*, U.S. CENTENNIAL OF FLIGHT COMM'N (2003), http://www.centennialofflight.net/essay/Commercial_Aviation/passenger_xperience/Tran2.htm.

21. *See* BANNER, *supra* note 15, at 170.

22. United States v. Causby, 328 U.S. 256 (1946).

place in the modern world. The air is a public highway, as Congress has declared. Were that not true, every transcontinental flight would subject the operator to countless trespass suits."[23]

As to the vertical property rights retained by the landowner, he concluded that, "[t]he landowner owns at least as much of the space above the ground as he can occupy or use in connection with the land. The fact that he does not occupy it in a physical sense—by the erection of buildings and the like—is not material."[24] While making clear that the landowner retained some vertical property rights, the Court did not specify how much of the space below the 500-foot navigable space line belonged to the landowner. The Court intentionally avoided deciding this question, observing that there was no need to "determine at this time what those precise limits are."[25]

In *Causby*, the Supreme Court applied two different approaches to adjudicating vertical property rights. The first is the rules-based approach the Court used to set the height above which the landowner has no property rights. The Court did this by adopting the Commerce Department's rule requiring aircraft to operate above 500 feet in uncongested areas, and at least 1,000 feet above the highest obstacle over congested areas.[26] Under this rule, the landowner knows with certainty ex ante that his property rights do not extend above 500 feet or, in congested areas, more than 1,000 feet above the highest obstacle. The benefit of this type of rule is that its clarity "facilitates resolution of cases ex post and makes prediction easier ex ante."[27]

The second approach taken in *Causby* is the standards-based approach the Court used to determine the height to which

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23. *Id.* at 260–61.

24. *Id.* at 264.

25. *Id.* at 266. Merrill, *supra* note 16, at 36, argues that, common law could have solved the problem of overflights by simply tinkering with the *ad coelum* rule. Trespass (unlike nuisance) is available only to one who is a 'possessor' (as opposed to merely a nonpossessing owner) of land, and courts have held that although the holder of the surface rights 'owns' up to the heavens, he does not possess any more of the column of space than he has occupied (for example, by building a skyscraper). Thus, the surface owner would be left with an action for nuisance, which would ultimately fail because of the absence of significant harm. In other words, the Supreme Court could have continued to recognize that landowners owned the high-altitude space above them, but that the trespass exclusion remedy was unavailable because landowners did not possess that space.

26. *Causby*, 328 U.S. at 263–64.

27. Louis Kaplow, *Rules Versus Standards: An Economic Analysis,* 42 DUKE L.J. 557, 561 (1992).

property rights extend. The Court did this by holding that "[t]he landowner owns at least as much of the space above the ground as he can occupy or use in connection with the land."[28] Under this standard, it is left to the courts to decide ex post how high the landowner's property rights extend by assessing how much vertical space the owner "can occupy and use in connection with the land." This is a murky standard at best. And even if the "occupy and use" language is understood, the vertical property limit remains unclear because it is modified by "at least."

The distinction between rules and standards will come up again in our subsequent analysis of privacy issues. Standards are usually less costly to develop and allow more precise tailoring of remedies to fit specific situations, but they involve much greater administrative costs because of the likelihood that the courts will be called upon to apply the standard. In *Causby*, even if a standards-based approach made sense, the particular standard applied provides little guidance. Moreover, it is not clear why the Court did not simply decide that vertical property rights extended up to the level where navigable airspace began, since there were no drones or similar users of low-altitude airspace at the time. This would have provided the benefit of a clear rule with no apparent offsetting costs.

The cases after *Causby* did not clarify the "precise limits" of vertical property rights.[29] If anything, vertical property rights became murkier because subsequent rulings seemed to combine two different actions—trespass and nuisance. The traditional remedy for trespass is an injunction, which prohibits trespassing regardless of whether there has been any harm.[30] This is the "right to exclude" remedy that aircraft operators feared would be applied under the ad coelum doctrine.[31] The related economic theory is that where transaction costs are low, it is more efficient for the

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28. *Causby*, 328 U.S. at 264.

29. The most important subsequent case was *Griggs v. Allegheny County*, which reaffirmed that "the use of land presupposes the use of some of the airspace above it." 369 U.S. 84, 89 (1962). The County was subsequently required to compensate the landowner "because the noise, vibration, and danger resulting from airplane use of the new county airport constituted a taking of an air easement over the property." Allison Dunham, Griggs v. Allegheny County *in Perspective: Thirty Years of Supreme Court Expropriation Law*, 1962 SUP. CT. REV. 63 (1962).

30. *See, e.g.*, Merrill, *supra* note 16, at 13.

31. *See* BANNER, *supra* note 15, at 25, 94–95, 172–74 (discussing application of trespass to aerial overflights).

parties to agree ex ante on the terms of access because this ensures that the resulting exchange will fully reflect the parties' valuations.

On the other hand, the traditional remedy for nuisance is the award of damages. To recover under a nuisance theory does not require that there be a physical trespass, but instead that the activity unreasonably interfere with the use or enjoyment of the land so as to cause actual harm.[32] The related economic theory is that where transaction costs are high, it is more efficient for the courts to determine damages ex post than to expect the parties to reach a voluntary agreement.[33]

Recent aviation overflight cases have combined the two actions by requiring that landowners prove both that overflights occurred "directly above the subject property, below navigable airspace (i.e., below 500 feet), and that those flights were of such frequency that they substantially interfered with the use and enjoyment of the underlying land."[34]

In sum, *Causby* made clear (1) that high-altitude airspace had become a "public highway" available for aeronautic use by the public and (2) that surface landowners continued to have a right to exclude ground-level trespassers. However, "the low-altitude airspace between the privatized surface land and the high-altitude commons [was left with] largely undefined rules."[35]

B. The Application of Vertical Property Rights to Commercial Drones

Because drones operate below 500 feet, the advent of commercial drones has prompted a re-examination of the law pertinent to the space between the surface and 500 feet. In June 2016, after more than a decade of study,[36] the FAA issued rules limiting the altitude of small unmanned aircraft to no more than 400 feet above ground level.[37] More recently, in October 2017, the President issued an order stating that the FAA will

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32. Merrill, *supra* note 16, at 13–15.

33. See Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972), for explanation of property rules and liability rules.

34. W. Eric Pilsk, *Airport Noise Litigation in the 21st Century: A Survey of Current Issues*, 11 ISSUES IN AVIATION L. & POL'Y 371, 376 (2012).

35. Gregory S. McNeal, *Drones and the Future of Aerial Surveillance*, 84 GEO. WASH. L. REV. 354, 398 (2016).

36. In the FAA Modernization and Reform Act of 2012, Pub. L. No. 112-95, 126 Stat. 11 (2012), Congress directed the FAA to issue rules on the operation of drones.

37. 14 C.F.R. § 107.51 (2018). The FAA Advisory Circular issued along with the rules advises drone operators to "be aware that state and local

> solicit proposals from State, local, and tribal governments to test within their jurisdictions the integration of civil and public [drone] operations into the [National Airspace System] below 200 feet above ground level, or up to 400 feet above ground level if the Secretary determines that such an adjustment would be appropriate.[38]

It is not surprising that the government is considering new rules at these particular altitude bands. Helicopters, which are not subject to the same airspace rules as planes, commonly operate at 400 feet.[39] Also, the FAA already reviews planned building construction over 200 feet to determine if the building would pose a hazard to air navigation.[40]

Under the *Causby* ruling, the altitude between the ground and 200 feet would still have "largely undefined rules" until the courts decide otherwise.[41] If the rules under consideration are adopted, they may have the effect of establishing a new public highway in the sky for drone use between 200 and 400 feet, similar to the public highway recognized in *Causby* for commercial aircraft. The balance of the Article proceeds on the assumption that the FAA should create a drone public highway between 200 and 400 feet.

If the FAA declines to assert authority below 200 feet, some states and local governments may enact laws barring drone operations below 200 feet without the consent of the landowner. See Figure 1.

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authorities may enact privacy-related laws specific to Unmanned Aircraft System (UAS) operations. The FAA encourages sUAS operators to review those laws prior to operating their UAS." FAA, ADVISORY CIRCULAR 107-2, SMALL UNMANNED AIRCRAFT SYSTEMS (sUAS) (2016), https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_107-2.pdf.

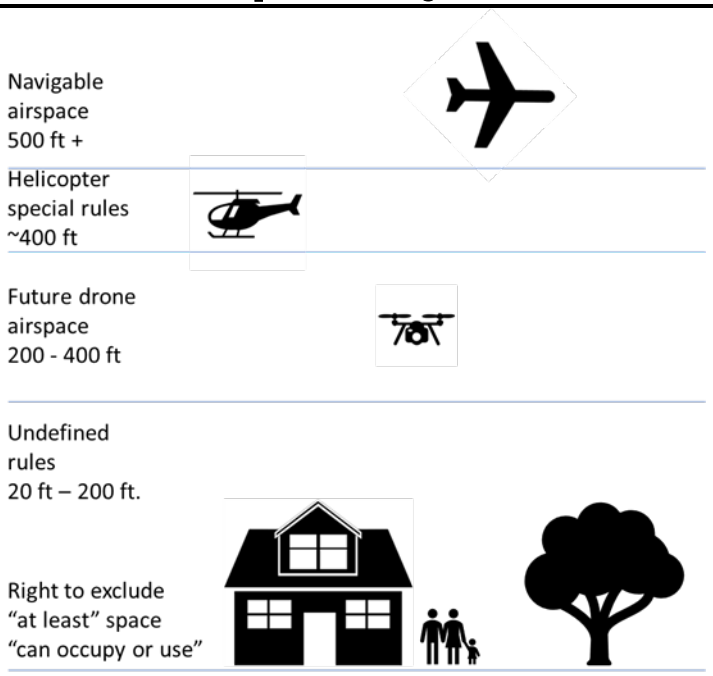
38. DONALD TRUMP, PRESIDENTIAL MEMORANDUM FOR THE SECRETARY OF TRANSPORTATION (2017), https://www.whitehouse.gov/presidential-actions/presidential-memorandum-secretary-transportation/.

39. 14 C.F.R. § 91.119(d)(1) (2018) ("A helicopter may be operated at less than the minimums prescribed [for fixed wing aircraft], provided each person operating the helicopter complies with any routes or altitudes specifically prescribed for helicopters by the FAA.").

40. 14 C.F.R. § 77.9 (2010).

41. McNeal, *supra* note 35, at 398.

Figure 1: Potential Airspace Configuration



For example, if the FAA decides not to exercise authority below 200 feet, this might allow the type of ordinance recently struck down in *Singer v. City of Newton*, a 2017 case where the City of Newton, Massachusetts attempted to ban drone flights below an altitude of 400 feet over private property without the express permission of the property owner.[42] In that case, the federal court struck down the law because it was in conflict with FAA regulations.[43]

Clarification of vertical property rights would also help avoid having landowners take matters into their own hands. In two recent cases, landowners have shot down drones. In the Kentucky case, the landowner prevailed in a suit by the drone owner when a federal court declined to consider a "garden-variety state tort claim,"[44] while in New Jersey, the county prosecutor charged the

42. Singer v. City of Newton, 284 F. Supp. 3d 125 (D. Mass. 2017).

43. The Court distinguished between field and conflict preemption and found that the Newton Ordinance was conflict preempted because it "thwarts not only the FAA's objectives, but also those of Congress for the FAA to integrate drones into the national airspace. Although Congress and the FAA may have contemplated co-regulation of drones to a certain extent [citation omitted], this hardly permits an interpretation that essentially constitutes a wholesale ban on drone use in Newton." *Id.* at 132.

44. Miriam McNabbon, *The Kentucky 'Drone Slayer' Case Dismissed,* DRONELIFE (Mar. 22, 2017), https://dronelife.com/2017/03/22/kentucky-drone-slayer-case-dismissed.

landowner with criminal mischief.[45] Unlike in the *Causby* era, when aircraft did not predominantly utilize airspace below 500 feet,[46] drones today can fly at very low altitudes and will do so over private land unless landowners have the legal right to exclude them. Therefore, conflicts between landowners and drone operators will occur until the courts decide this issue.

If new laws allow landowners to bar drones from flying overhead at altitudes of less than 200 feet, they can avoid surveillance from low-altitude vantage points above their property. But does this enable them to protect their privacy? Drones conducting surveillance from above the nearest public street can often capture the same images. Also, while there is currently a significant difference between the image details captured by most drones from 200 feet versus 30 feet, new high-end hobbyist drones are beginning to carry cameras with telephoto lenses with sophisticated stabilization technology able to capture 4K images.[47] Therefore, even if private property rights extend up to 200 feet, drones operating above that level will be able to capture detailed images of the property below or nearby. These issues will be discussed in relation to intrusion upon seclusion and trade secret appropriation in Sections III and IV. First, this Article will review the factors that cause property rights to change and how this applies to the rise of drones.

C. The Economic Basis of Property Rights: What Causes Property Rights to Change?

Harold Demsetz's seminal work on the theory of property rights relies on the concept of externalities, costs or benefits that affect parties who did not choose to incur those costs or benefits.[48]

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45. Press Release, Office of the Cape May Cty. Prosecutor, Man Indicted for Shooting Drone (Aug. 25, 2015), http://www.cmcpros.net/2015/08/25/man-indicted-for-shooting-drone.

46. See 14 C.F.R. § 1.1 (2018) (defining navigable airspace as "airspace at and above the minimum flight altitudes prescribed by or under this chapter, including airspace needed for safe takeoff and landing").

47. *See, e.g.*, Loz Blain, *Walkera's New Superzoom Camera Drone Can Spot You a Mile Away*, NEW ATLAS (July 20, 2016), https://newatlas.com/walkera-voyager-4-superzoom-camera-drone/44440/; Jason Kobler,

This Drone Zoom Lens Can Identify Your Face from 1,000 Feet Away, MOTHERBOARD (Feb. 25, 2015), https://motherboard.vice.com/en_us/article/8qxe93/this-drone-zoom-lens-can-identify-your-face-from-1000-feet-away.

48. Harold Demsetz, *Toward a Theory of Property Rights*, 57 AMER. ECON. REV. 347 (1967).

In the case of high-altitude flights over private property, the externality is the negative effect of such flights on the landowners below, who did not choose to incur those costs.

In Demsetz's words, "[w]hat converts a harmful or beneficial effect into an externality is that the cost of bringing the effect to bear on the decisions of one or more of the interacting persons is too high to make it worthwhile . . . ."[49] As noted, property rights in the pre-aviation era were defined to include the right to exclude overhead flights, including those at high altitude. With the growth of aviation, the combination of: (1) low costs imposed by high-altitude flights on landowners; (2) the large number of contractual parties required; and (3) the high cost of identifying which flights had flown over particular properties meant that the transaction costs involved in trying to make aircraft operators pay landowners for using their high-altitude property would exceed the payments received.[50] As such, pre-aviation vertical property rights were poorly attuned to the growth of commercial aviation, which required a narrower definition of vertical property rights. For that reason, Congress and the courts ultimately carved out high-altitude space as an exception that is not part of a landowner's vertical property rights.

Most of the externalities literature focuses on new property rights being created to address contemporary problems. Two examples are the creation of property rights in portions of the radio freedom spectrum and in airport takeoff and landing rights. In both cases, historical "first in time" allocation methods resulted in limited resources being used by grandfathered lower-value users, with many other users waiting in line for access to these resources.[51] The economic benefits of creating new property rights far exceeded the costs, and by creating new property rights, the government was able to use market forces to distribute the new ownership interests.

Another factor contributing to the creation of these new property rights is that the modern world is better equipped to capture externalities because transaction costs, such as the costs of monitoring, contracting, and making payments, are generally much lower than in the past. But occasionally, as with the reduction of

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49. *Id.* at 348.

50. If transaction costs were zero, the result would be different. In that event, an economically efficient solution would be achieved even with *ad coelum* vertical property rights, in accordance with the Coase theorem.

51. *See, e.g.*, Kristilyn Corbett, Note, *The Rise of Private Property Rights in the Broadcast Spectrum*, 46 DUKE L.J. 611, 616–17 (1996).

vertical property rights, new technical or commercial innovations mean that an existing property right becomes of value, but not enough value to exceed the transaction costs entailed in enforcement.

What causes a change in the factors that contribute to the capture of externalities? Demsetz answered this question succinctly as well: "changes in economic values, changes which stem from the development of new technology and the opening of new markets, changes to which old property rights are poorly attuned."[52]

D. How Does the Rise of Drones Fit Within the Economic Framework Underlying Vertical Property Rights?

A comparison of commercial aviation and the drone industry shows how the rise of drones fits within the economic framework underlying vertical property rights. In the case of commercial aviation, pre-existing vertical property rights posed a major barrier to the development of the industry. Without some modification of property rights, the industry would have struggled to develop route networks of significant scale. As noted, the industry could have appealed to individual state or local governments to use eminent domain to condemn the airspace over massive numbers of individual properties, but at the time, this was considered impractical.[53] Moreover, the reduction of vertical property rights resulting from the *Causby* decision caused almost no harm to anyone. Most of the time, landowners hardly notice planes flying at cruise altitudes. For the chicken farmer dealing with noisy planes flying only 100 feet or so above his property, the Court provided a remedy.[54] In sum, the reduction of vertical property rights to aid commercial aviation had a net social economic benefit.

In the case of commercial drones, there are efficiency gains from permitting drones to fly more directly to their destination by flying above private property.[55] These include (1) the reduction in operating costs from more direct flight paths; (2) the avoidance of contracting costs with property owners; and (3) the avoidance of

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52. Demsetz, *supra* note 48, at 350.

53. BANNER, *supra* note 15, at 98–99.

54. *See* Griggs v. Allegheny Cty., 369 U.S. 84, 89–91(1962). For a listing of airport noise cases, see *Airport Noise Law Cases*, AIRPORT NOISE LAW, http://airportnoiselaw.org/cases.html (last visited Mar. 29, 2018).

55. For a short debate about this issue, see Michael Froomkin & Ryan Calo, *Should You Be Allowed to Prevent Drones from Flying Over Your Property?*, WALL ST. J. (May 22, 2016), https://www.wsj.com/articles/should-you-be-allowed-to-prevent-drones-from-flying-over-your-property-1463968981.

other costs associated with operating narrowly prescribed routes, such as the greater likelihood of collisions. However, there are alternatives to flying over private property so long as local governments permit drone flights above public streets and other public land. Compared with aircraft, drones are much less affected by overflight restrictions because they are typically used for short-range operations. Unlike aircraft, drones can limit their flight paths so that they fly only above public streets.[56] For drone deliveries, the recipient can provide blanket permission to the drone operator—Amazon, UPS, and so on—for the drone to land. And for photography, the drone operator can either get permission from the private property owner or photograph from a public location. Finally, drone operators can negotiate agreements to fly over private property when it is in their interest to do so, and the associated administrative costs have dropped dramatically since *Causby* as a result of the Internet, form contracts, and new mapping technology.

The wireless telephone industry, for example, which relies on cell phone towers for signal transmission, has entered into approximately 190,000 cell phone tower leases in the United States,[57] generally divided into rooftop leases and ground leases.[58] In the early days of cell phones, coverage was spotty, but it has continually expanded over time, as would be the case with drone "fly routes." Keep in mind that wireless is a network business where the value of the service is dependent on the number of users. Thus, broad cell phone coverage is required for wireless to be successful. This is not the case with drones. The inability to make a drone delivery to a customer or group of customers does very little to degrade the value of drone deliveries to other customers. In sum, even if drone flights over private property are

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56. For discussion of drone flight path navigation precision, see James Morra, *Autonomous Drone Flies with Centimeter-Level Accuracy*, ELECTRONICDESIGN (Oct. 14, 2015), http://www.electronicdesign.com/systems/autonomous-drone-flies-centimeter-level-accuracy;

ANDY PUTCH, DRONEDEPLOY, LINEAR MEASUREMENT ACCURACY OF DJI DRONE PLATFORMS AND PHOTOGRAMMETRY (2017), https://www.polkdrones.com/uploads/7/3/6/3/73631665/linear_measurement_accuracy_of_dji_drone_platforms_and_cloud-based_photogrammetry-v11.pdf.

57. Tim Omarzu, *Cell Tower Boom: Are Private Land Owners Being Paid Enough to Host Them?*, TIMES FREE PRESS (June 14, 2004), http://www.timesfreepress.com/news/local/story/2014/jun/04/cell-towers-booming-are-private-land-owners-being-/142154/.

58. *See* Ken Schmidt, *Types of Cellular Leases,* STEEL IN THE AIR (June 22, 2013), http://www.steelintheair.com/different-types-of-cell-tower-leases-explained/.

prohibited without the landowner's consent, common drone uses, such as for photography, inspections, and future package deliveries will continue either with the private property owner's consent or from public locations.

On the other hand, although a further reduction of vertical property rights to accommodate drones may offer fewer benefits to the drone industry than was the case for commercial aviation, the costs imposed by reducing the landowner's property rights to 200 feet above the surface are negligible. As with planes flying at high altitude, most landowners are unlikely to notice overhead drones operating at an altitude of at least 200 feet, the equivalent of 20 stories overhead. Battery-operated drones are much quieter than a jet or piston engine, and newer models are being developed to minimize the buzz.[59] Thus, nuisance concerns will be largely abated.[60]

Apart from privacy costs, which are the subject of Section III, the costs imposed by drones flying above 200 feet are negligible. The efficiency benefits for the drone industry of reducing vertical property rights to create a 200- to 400-foot high public highway for drones, along the lines the FAA has proposed, exceed the negligible costs incurred by landowners. However, the consideration of privacy costs in this analysis alters the cost calculus. As will be discussed in Section III, low-flying drones impose privacy costs by interfering with seclusion. The questions then become: (1) how great are those costs? and (2) do those costs vary depending on the altitude at which drones are permitted to operate?

III. PRIVACY LAW: INTRUSION UPON SECLUSION

This Part discusses the application of intrusion upon seclusion law to drone operations. Section A briefly recounts the origin of modern privacy law. Section B summarizes the reasonable expectation of privacy standard that underlies the intrusion upon seclusion tort. Section C discusses the economic basis of privacy rights. Section D discusses how the rise of drones fits within this economic framework. Section E deals with the effects of height

59. For a description of the new technology being employed to make drones quieter, see Steven Robertson, *Do Drones Make Noise?*, QUADCOPTER CLOUD (May 12, 2016), http://www.quadcoptercloud.com/drones-make-noise.

60. Living next to a large and noisy drone base would be covered by the same principles that apply to living next to a large airport, train station, or highway.

and proximity on the offensiveness of the intrusion. This Part concludes that the original economic rationale for intrusion law, which is that it is economically beneficial to protect seclusion, applies equally well in the drone era. The complicating factor is determining when individuals have a reasonable expectation of privacy, given the advances in drone photography and monitoring capabilities that enable drones to conduct surveillance from high altitudes. The conclusion reached here is that individuals have a reasonable expectation of privacy in their fenced-in backyards regardless of advances in drone surveillance technology. Not only should drone surveillance of this area be prohibited under intrusion law but also, because of the large number of drones, new simple rules that establish a presumption of intrusion should be issued.

A. Advances in Mass Communication and the Development of Privacy Law

The origin of modern privacy law lies with the 1890 article, *The Right to Privacy,* by Samuel Warren and Louis Brandeis.[61] The article was reportedly prompted by the publication of gossipy newspaper stories about Warren and his wife that the couple considered an invasion of their "social privacy."[62] Warren and Brandeis argued that the press was overstepping "the obvious bounds of propriety and of decency" and that gossip was "no longer the resource of the idle and of the vicious, but ha[d] become a trade . . . pursued with industry as well as effrontery."[63] At the time, defamation law provided legal protection against false information, but not against the publication of truthful private information.[64] Warren and Brandeis argued that a separate "right to be let alone" existed as a matter of common law and should be explicitly recognized.[65]

While the publication of gossipy stories may have prompted Warren and Brandeis's article, advances in mass communications technology amplified the impact of those stories. Between 1850 and 1890, daily newspaper circulation increased by a factor of ten, from

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61. Irwin R. Kramer, *The Birth of Privacy Law: A Century Since Warren and Brandeis*, 39 CATH. U. L. REV. 703, 704 (1990).

62. *See* BANNER, *supra* note 15, at 138.

63. Samuel D. Warren & Louis D. Brandeis, *The Right to Privacy*, 4 HARV. L. REV. 193, 196 (1890).

64. Kramer, *supra* note 61, at 707.

65. Warren & Brandeis, *supra* note 63, at 205.

758,454 to 8,387,188.[66] Rapid advances in print photography were also taking place, which made it possible for newspapers to print photographs directly instead of from engravings.[67] These advances in the late 1800s focused attention on privacy rights, just as the rapid growth of air transportation in the late 1930s and 1940s focused attention on vertical property rights. Warren and Brandeis summarized the impact of new technology on privacy as follows: "Instantaneous photographs and newspaper enterprise have invaded the sacred precincts of private and domestic life; and numerous mechanical devices threaten to make good the prediction that 'what is whispered in the closet shall be proclaimed from the house-tops.'"[68] Largely in response to the article, state courts recognized a right to privacy under common law, and state legislatures passed similar legislation.[69]

B. The Reasonable Expectation of Privacy Standard Inherent in the Intrusion Upon Seclusion Tort

In 1960, William Prosser wrote a well-known law review article, organizing the privacy torts cases by subdividing them into four categories, including intrusion upon seclusion.[70] The *Restatement of Torts*, which incorporates Prosser's categorization, defines intrusion upon seclusion as "[o]ne who intentionally intrudes, physically or otherwise, upon the solitude or seclusion of another or his private affairs or concerns, is subject to liability to the other for invasion of his privacy, if the intrusion would be highly offensive to a reasonable person."[71] The Restatement of the Law explains that:

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66. William A. Dill, Growth of Newspapers in the United States 35 (Mar. 15, 1928) (Unpublished Masters dissertation, University of Kansas), https://kuscholarworks.ku.edu/bitstream/handle/1808/21361/dill_1928_3425151.pdf?sequence=1.

67. Vernon Valentine Palmer, *Three Milestones in the History of Privacy in the United States*, 26 TUL. EUR. & CIV. L.F. 67, 72 n.20 (2011).

68. Warren & Brandeis, *supra* note 63, at 195.

69. See Dorothy J. Glancy, *The Invention of the Right to Privacy*, 21 ARIZ. L. REV. 1 (1979), for additional history and context of the Warren and Brandeis' article.

70. William L. Prosser, *Privacy*, 48 CAL. L. REV. 383, 389 (1960). The other three categories are: (1) public disclosure of embarrassing private facts about the plaintiff; (2) publicity which places the plaintiff in a false light in the public eye; and (3) appropriation, for the defendant's advantage, of the plaintiff's name or likeness. *Id.*

71. RESTATEMENT (SECOND) OF TORTS § 652B (AM. LAW INST. 1977).

> The invasion may be . . . by the use of the defendant's senses, with or without mechanical aids, to oversee or overhear the plaintiff's private affairs, as by looking into his upstairs windows with binoculars or tapping his telephone wires. . . . The intrusion itself makes the defendant subject to liability, even though there is no publication or other use of any kind of the photograph or information . . . .[72]

The tort of intrusion upon seclusion remains in force today in many states.[73] To prevail, the plaintiff must have "an objectively reasonable expectation of seclusion or solitude in the place."[74] For example, the courts have found that the tort does not provide protection in places accessible to the public, such as a city sidewalk, a public school classroom, or a health club.[75] The law currently provides little protection from "intrusive videotaping, photography, or surveillance, so long as the activity occurs in a public place."[76]

An important factor in determining whether the expectation of privacy is reasonable is the vantage point of the observation, recalling the discussion of vertical property rights in Section II. "Many intrusion claims are dismissed because the plaintiff's activities were visible from a public vantage point—that is, the activities were observable (without the use of technological enhancement aids) from vantage points at which any observer has the right to be."[77] To date, the cases involving intrusion upon seclusion have not involved sightings from aircraft or drones, except for some "Peeping Tom" cases involving drones hovering outside bathroom and bedroom windows, which are generally covered by criminal laws against voyeurism.[78]

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72. *Id.*

73. *See* Eli A. Meltz, *No Harm, No Foul? "Attempted" Invasion of Privacy and the Tort of Intrusion Upon Seclusion*, 83 FORDHAM L. REV. 3431, 3440–43 (2015); *see also* Jeremy Friedman, Note, *Prying Eyes in the Sky: Visual Aerial Surveillance of Private Residences as a Tort*, 4 COLUM. SCI. & TECH. L. REV. 3, 21 n.60 (2003) (listing intrusion upon seclusion court cases). Intrusion upon seclusion and other privacy torts are governed by state law. DANIEL J. SOLOVE & PAUL M. SCHWARTZ, IAPP PUBLICATIONS, PRIVACY LAW FUNDAMENTALS 36 (2017).

74. Taus v. Loftus, 151 P.3d 1185, 1212 (Cal. 2007).

75. Andrew J. McClurg, *Bringing Privacy Law Out of the Closet: A Tort Theory of Liability for Intrusions in Public Places*, 73 N.C. L. REV. 989, 992–93 nn.7–12 (1995).

76. *Id.* at 991–92 (citing cases).

77. Friedman, *supra* note 73, at 29–30.

78. *Id.* at 26.

C. The Economic Basis of Privacy Rights

Economists have generally been skeptical of privacy because it "hides information and in so doing compromises market optimization."[79] "In grossly oversimplified terms, the consensus of the law and economics literature is that more information is better, and restrictions on the flow of information in the name of privacy are generally not social wealth maximizing, because they inhibit decision making, increase transaction costs, and encourage fraud."[80] However, the economic case for providing privacy protection for seclusion or solitude, as opposed to secrecy, is quite different. Privacy as seclusion creates social and economic benefits and therefore should be protected.

Regarding photographic surveillance of the interior of a home, Richard Posner writes, "Privacy enables a person to dress and otherwise disport himself in his home without regard to the effect on third parties. This informality, which is resource-conserving, would be lost were the interior of the home in the public domain."[81] Similarly, in the absence of privacy protection, "[c]onversation will be more costly because of the external effects, and the increased costs will result in less, and less effective, communication."[82] The main effect will be to increase the formality of conversation and not to increase useful information.[83]

Still another reason to protect privacy is that it "may encourage people to participate in beneficial activities that they would not engage in otherwise."[84] Thus, Posner observes that there is an economic case for protecting secrets that are a "byproduct of socially productive activity" if disclosing them would reduce the incentives to engage in the activity.[85]

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79. Ryan Calo, *Privacy and Markets: A Love Story*, 91 NOTRE DAME L. REV. 649, 652 (2016).

80. Richard S. Murphy, *Property Rights in Personal Information: An Economic Defense of Privacy*, 84 GEO. L.J. 2381, 2382 (1996).

81. Richard A. Posner, *The Right of Privacy*, 12 GA. L. REV. 393, 403 (1978).

82. *Id.* at 401.

83. *See* Lior Strahilevitz, *A Social Networks Theory of Privacy*, 72 U. CHI. L. REV. 919, 929 (2005) ("The more ordinary love letters wind up in the New York Times, the more guarded private figures composing such letters will become in writing and sending them.").

84. Steven Penney, *Reasonable Expectations of Privacy and Novel Search Technologies: An Economic Approach*, 97 J. CRIM. L. & CRIMINOLOGY 477, 493 (2007).

85. Posner, *supra* note 81; *see also* Charles J. Hartmann & Stephen M. Renas, *Anglo-American Privacy Law: An Economic Analysis*, 5 INT'L. REV. L. &

Privacy as seclusion is a superior economic good in that the demand for it usually increases as wealth increases. Wealthy people spend more on privacy-enhancing property and equipment, such as fences, walls, hedges, security systems, and larger tracts of land that provide increased separation from neighbors and the public. Greater demand for privacy may also be evidenced by the devotion of additional resources to efforts to obtain strong laws to protect privacy.

Finally, in evaluating privacy harms, Ryan Calo divides privacy harm into subjective and objective components. Subjective privacy harm is "the perception of unwanted observation."[86] Objective privacy harms are "those harms that are external to the victim and involve the forced or unanticipated use of personal information."[87] Seeing a drone outside one's bathroom window is likely to entail subjective privacy harm. Distribution of the photographs taken by the drone is likely to result in objective privacy harm.

D. How Does the Rise of Drones Fit Within Economic Framework Underlying Privacy Rights?

Since the critical factor in determining whether there has been an intrusion is whether the intrusion is unwanted, it should make little difference that a new technology is being used. Although the law is not settled,[88] drone surveillance of people in their fenced-in backyards will likely be considered an intrusion.

This result is consistent with the economic rationale for protecting seclusion. Permitting an uninvited drone to gather information about the informal activities of the landowner is likely

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ECON. 133, 145 (1985) (following Posner's reasoning closely in stating that "[t]he economic position . . . is that public disclosure of private facts (other than commercially useful information) is desirable as long as the information is not obtained . . . in such a fashion as to inhibit private discourse").

86. Ryan Calo, *The Boundaries of Privacy Harm*, 86 IND. L.J. 1131, 1131 (2011).

87. *Id.* at 1148.

88. For instance, California has responded to the lack of clarity by enacting legislation which prohibits "attempts to capture, in a manner that is offensive to a reasonable person, any type of visual image . . . of the plaintiff engaging in a private, personal, or familial activity, through the use of any device, regardless of whether there is a physical trespass, if this image . . . could not have been achieved without a trespass unless the device was used." CAL. CIV. CODE § 1708.8(b) (West 2016). The law seems designed to make photographs taken from a drone illegal if they could not have been taken from a public street or a neighbor's window. Other states are expected to follow with similar legislation.

to have a net economic cost, regardless of the vantage point. In Posner's words, the "informality, which is resource-conserving, would be lost."[89] Under the framework urged by Lior Strahilevitz for analyzing privacy harms involving intrusion or publication, the conduct "engenders social harms that exceed the associated social benefits."[90]

When used for photography, the privacy costs imposed by drones are nearly the same whether the drone flights operate at 200 to 400 feet overhead, at lower altitudes overhead, over the public street, or over other nearby property. In each case, the drone can take photographs of the same private property. A small plane flying in public airspace with professional equipment may be able to take the same photographs.[91] However, drones have the potential to impose greater privacy costs than small planes because they will be used far more often; there are far more drones than small planes, and drones have much lower operating costs.

At lower altitudes, drones impose additional costs because the sounds of a drone are reported to be annoying.[92] Also at sufficiently low altitudes, drones impose privacy costs based solely on the proximity of the drone. Imagine encountering a drone at short range, say 20 or 30 feet away, while relaxing in a fenced-in backyard. At such a range, the presence of the drone is likely to be unnerving regardless of whether the drone is taking photographs.

The net effect of permitting drones to fly at lower altitudes is to reduce social welfare because at these altitudes drones impose much higher privacy costs while offering minimal additional economic benefits. The minimum 200-foot operating level being considered by the FAA may be a good estimate of the dividing

89. Posner, *supra* note 81, at 403.

90. Lior J. Strahilevitz, *Reunifying Privacy Law*, 98 CAL. L. REV. 2007, 2011 (2010).

91. With regard to commercial flights, the privacy costs imposed on landowners are *de minimis*. "[T]he actual risk to privacy from commercial or pleasure aircraft is virtually nonexistent. Travelers on commercial flights, as well as private planes used for business or personal reason, normally obtain at most a fleeting, anonymous, and nondiscriminating glimpse of the landscape and buildings over which they pass. The risk that a passenger on such a plane might observe private activities, and might connect those activities with particular people, is simply too trivial to protect against." California v. Ciraolo, 476 U.S. 207, 223–24 (1986) (Powell, J., dissenting).

92. Jon Fingas, *Drone Noise is Driving People Crazy*, ENGADGET (July 18, 2017), https://www.engadget.com/2017/07/18/study-says-drone-noise-more-annyoing-than-any-car/.

line and seems to be the direction regulation is headed.[93] Below this level, drone operations generally should not be permitted.[94] For the same reason, as discussed in Section II, vertical property rights should emerge or, in this case, re-emerge below 200 feet. At this altitude, drone operations should be considered a trespass and property owners should be permitted to exclude them.[95]

The effects of privacy intrusion on social welfare can be illustrated using a simple example. Assume that a landowner highly values his or her ability to relax in the fenced-in backyard in ragged shorts and a torn shirt without fear of being photographed. Assume further that an intruder intentionally commands a drone to hover nearby with an attached camera and that the intrusion would be highly offensive to a reasonable person. In the absence of intrusion law, a rational landowner in this example will invest in preserving seclusion up to the value he or she places on it.

Let us re-examine this situation taking into account the existence of intrusion law. As seclusion is defined here, the intruder whose drone is carrying a camera and startles the person in the backyard commits an intrusion even when the drone takes no photographs. In this case, the seclusion that is highly valued by the landowner has no value to others. Because the intrusion itself brings no economic benefit to the intruder and is unlikely to bring any non-economic benefit since the drone takes no photos, this type of intrusion is likely to be accidental or easily deterred by the threat of a small penalty. The intrusion law therefore has a social benefit in this situation by deterring this type of intrusion and enabling the property owner to avoid investing in privacy protection measures.

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93. Further analysis may support the conclusion that a slightly lower or higher altitude is a better reflection of the dividing line.

94. Of course, there should be exceptions for operations that are well within the confines of one's own property or in public spaces where the privacy expectations are clearly understood and accepted.

95. Gregory McNeal recommended in 2014 that landowners have the right to exclude drones from the surface of their land up to 350 feet above ground level, concluding that "[s]uch an approach may solve most public and private harms associated with drones." GREGORY S. MCNEAL, DRONES AND AERIAL SURVEILLANCE: CONSIDERATIONS FOR LEGISLATURES 4 (2014), https://www.brookings.edu/wp-content/uploads/2016/07/Drones_Aerial_Surveillance_McNeal_FINAL.pdf. In contrast, Troy Rule argued in 2015 that a "rule defining exclusion rights as covering only 100 feet or 200 feet would arguably be insufficient because it would allow small drones to cheaply hover above land, potentially violating landowners' privacy or threatening their safety from those altitudes." Troy A. Rule, *Airspace in an Age of Drones*, 95 B.U. L. REV. 155, 187–88 (2015).

If, however, the intruder takes photographs and threatens to offer them for sale, the intrusion brings a potential benefit to the intruder and a cost to the victim.[96] Assuming that the photographs have no value other than to the person in the backyard, the intruder has no economic incentive to threaten to release them, other than for blackmail. The blackmail itself has negative effects on social welfare. If the victim pays the blackmailer, the victim has still suffered subjective harm, and the blackmailer has wasted resources committing the blackmail even if the money paid is considered only a transfer. If the victim does not pay the blackmailer and the photographs are released, the blackmailer has wasted resources committing the blackmail, and the victim suffers both subjective and objective privacy harm. Thus, the intrusion law along with the criminal law of blackmail helps reduce inefficient use of drones while allowing efficient uses.[97]

Continuing with this example, suppose that the intruder uses a drone to take photographs that have significant market value, such as photographs of a celebrity. This case will be covered by the same torts of intrusion and public disclosure (and possibly other torts), but the economic calculus is different.[98] In this case, the drone photographer may cause the victim subjective harm through the intrusion and disclosure, and objective harm through economic injury to the victim's reputation. In addition, because the photographs have market value, the drone photographer is essentially committing theft. As with other intentional torts, the penalty for such activities should include not only compensatory damages but also punitive damages to reflect the fact that not all

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96. In this case, the intruder's actions are governed by the intrusion tort and by the tort of public disclosure of private facts, both of which are subcategories of invasion of privacy. "One who gives publicity to a matter concerning the private life of another is subject to liability to the other for invasion of privacy, if the matter publicized is of a kind that (a) would be highly offensive to a reasonable person; and (b) is not of legitimate concern to the public." RESTATEMENT (SECOND) OF TORTS § 652D (AM. LAW INST. 1977).

97. Blackmail laws generally prohibit threats to reveal private information about a person that is likely to cause them embarrassment or financial harm unless the victim pays money. For an introduction to blackmail and extortion, see *Blackmail*, JUSTIA, https://www.justia.com/criminal/offenses/white-collar-crimes/blackmail/ (last visited Mar. 13, 2018). Links to individual state blackmail laws may be found at *State Extortion Laws,* FINDLAW, http://statelaws.findlaw.com/criminal-laws/extortion.html (last visited Mar. 13, 2018).

98. Some states, such as California, also have specific anti-paparazzi statutes. *See* CAL. CIV. CODE § 1708.8(f) (West 2015).

incidents will be detected and therefore to eliminate any expected economic gain for the tortfeasor.[99]

E. The Effects of Height and Proximity on Offensiveness

One remaining question for drone operations that do not involve photography or other information collection is at what height do those operations become offensive to a reasonable person and therefore intrusive? If drones are permitted to operate freely between 200 and 400 feet, the courts will rule that routine operations at that height that do not involve photography or other types of personal information collection are not intrusive. Even at that height, however, the courts may find that extended hovering over a particular property or repeated visits to a location are intrusive. What about operations below 200 feet? If the FAA limits all drone operations to the 200- to 400-foot band, then any drones operating below that level over private property without the landowner's consent will be doing so illegally. But if the FAA or the courts permit drones to operate below 200 feet when they are above public streets or other public right of ways, that will leave open the question of defining the circumstances which constitute an intrusion that is "highly offensive to a reasonable person" for drone operations that do not involve photography or other information collection.

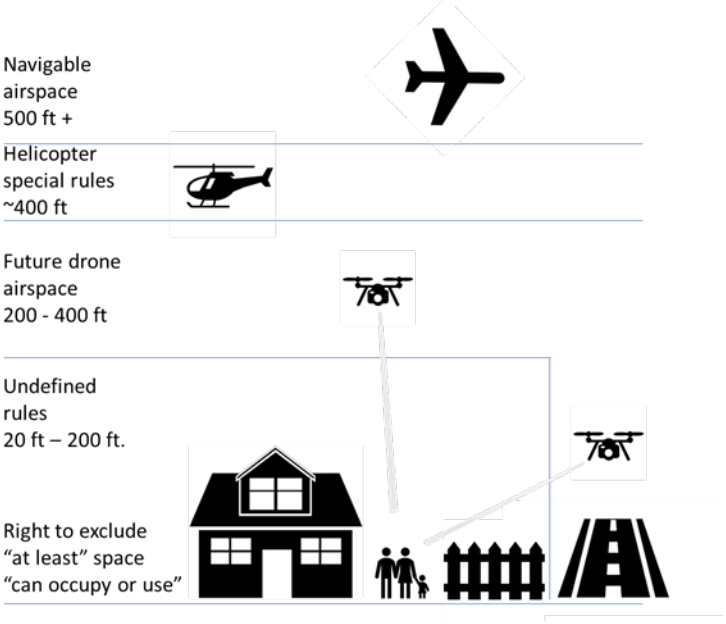
The same question remains open with regard to drones operating with the owner's consent above private property but near the property line. For example, a drone hovering at a height of twelve feet above an individual's property but close to the property line may well be intruding upon the seclusion of the neighbor in their backyard.

Given the large number of drones, it would likely reduce litigation costs if the courts adopted simple rules that establish a presumption of intrusion, for example, when drones are operated below a certain height when within a certain distance of the property line. A simple rule would make it easy for drone operators to predict when their activities would be presumed to be intrusive. As noted, rules generally are costlier to develop than standards and cannot be precisely tailored, but in this case are

99. Note that, on average, there is a higher likelihood of detecting the unauthorized photographs than of detecting a typical stolen trade secret. The value of the photographs lies in their publication, while the value of a stolen trade secret, such as a formula or process, may be captured entirely without public disclosure.

likely to be preferable to the alternative of relying on the general standard of the *Restatement of Torts* that the intrusion is prohibited when it would be highly offensive to reasonable person. Common-law nuisance may also cover this situation, but the nuisance standard will be no more specific than the intrusion standard.

Figure 2: If Drones Are Permitted to Operate Below 200 Feet When They Are Above Public Streets or Other Public Right of Ways



In summary, the rise of drones should not change the economic rationale or legal standards for determining when an intrusion has occurred. Regardless of the law, the dramatic increase in drone operations means that intrusions are also likely to increase. Because at present, few practical measures can be taken to shield individuals in their yards from overhead view, the real-world results will be both heavier reliance on legal enforcement to punish and deter intrusions, and a chilling effect on some types of backyard activity. The next section explores how drones may affect the protection of corporate privacy.

IV. CORPORATE PRIVACY: TRADE SECRET LAW

This Part discusses the application of trade secret law to drone operations. Section A explains how the elements of trade secret law differ from those of intrusion upon seclusion. Section B discusses the economic basis of trade secret protection. And

Section C discusses how the rise of drones fits within this economic framework. This Part concludes that the original economic rationale for trade secret law applies equally well to the drone era, but that firms may need to take additional precautions to benefit from trade secret protection both as a legal matter and for practical reasons.

A. The Difference Between Trade Secret Law and Intrusion Upon Seclusion

Trade secret protection is the corporate equivalent of intrusion protection for individuals. Trade secrets have been protected under common law in the United States since at least the middle of the nineteenth century.[100] To be considered a trade secret, the information must be "sufficiently valuable and secret to afford an actual or potential economic advantage over others."[101] Information about a competitor's inventory, construction activities, customers, or employees may constitute trade secrets provided that the information is treated as secret and provides a competitive advantage.

While trade secret law and privacy rights have been linked, the two areas of law are governed by different principles.[102] In the privacy area, courts generally do not consider the costs of security measures that could have avoided the intrusion. Trade secret protection, however, is available only to those firms that take reasonable precautions. Under the *Uniform Trade Secrets Act* adopted by nearly all states,[103] a trade secret must be "the subject of efforts that are reasonable under the circumstances to maintain its secrecy."[104] As summarized in the *Restatement of Unfair*

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100. Edmund W. Kitch, *The Law and Economics of Rights in Valuable Information*, 9 J. LEGAL STUD. 683, 689 (1980). Originally treated as a form of property rights, trade secrets are now protected under principles of unfair competition. Michael Risch, *Why Do We Have Trade Secrets?*, 11 MARQ. INTELL. PROP. L. REV. 1, 14–15 (2007).

101. RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 39 (Am. Law Inst. 1995).

102. Richard A. Posner, *Trade Secret Misappropriation: A Cost-Benefit Response to the Fourth Amendment Analogy*, 106 HARV. L. REV. 461, 462 (1992).

103. *See* Trade Secrets Law and the UTSA – A 50 State and Federal Law Survey Chart (updated for Texas), Fair Competition Law (Aug. 13, 2017), www.faircompetitionlaw.com/2017/08/13/trade-secrets-laws-and-the-utsa-a-50-state-and-federal-law-survey-chart-updated-for-texas/ ("Every state but Massachusetts and New York has adopted the Uniform Trade Secrets Act (the UTSA) in one form or another.").

104. UNIF. TRADE SECRETS ACT § 1(4)(ii) (amended 1985).

Competition, "[p]recautions taken to maintain the secrecy of information are relevant in determining whether the information qualifies for protection as a trade secret."[105]

The case of *E.I du Pont deNemours & Co. v. Christopher* is especially relevant to the issue of how commercial drone operations may affect trade secret protection.[106] In that case, the defendants took photographs of a DuPont plant under construction from a plane flying in public airspace and thereby obtained information about the secret process used to manufacture methanol.[107] DuPont had erected fences around the plant to hide the details of its construction, but had not shielded the construction from overhead viewing.[108] The defendants argued that they had done no wrong in photographing the plant because "they conducted all of their activities in public airspace, violated no government aviation standard, did not breach any confidential relation, and did not engage in any fraudulent or illegal conduct."[109]

The Court disagreed, finding that DuPont had taken reasonable precautions to maintain secrecy. "Our tolerance of the espionage game must cease when the protections required to prevent another's spying cost so much that the spirit of inventiveness is dampened. Commercial privacy must be protected from espionage which could not have been reasonably anticipated or prevented."[110] "Perhaps ordinary fences and roofs must be built to shut out incursive eyes, but we need not require the discoverer of a trade secret to guard against the unanticipated, the undetectable, or the unpreventable methods of espionage now available."[111]

The Court concluded that once completed, the plant would have concealed much of the secret process, and that requiring DuPont to put a roof over the unfinished plant "would impose an enormous expense to prevent nothing more than a school boy's trick."[112] It continued: "Reasonable precautions against predatory eyes we may require, but an impenetrable fortress is an

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105. RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 39 cmt. g (Am. Law Inst. 1995).

106. E. I. du Pont deNemours & Co. v. Christopher, 431 F.2d 1012, 1013 (5th Cir. 1970).

107. *Id.* at 1013.

108. *Id.*

109. *Id.* at 1014.

110. *Id.* at 1016.

111. *Id.*

112. *Id.* at 1016.

unreasonable requirement, and we are not disposed to burden industrial inventors with such a duty in order to protect the fruits of their efforts."[113] "Regardless of whether the flight was legal or illegal . . . the espionage was an improper means of discovering DuPont's trade secret."[114] The *DuPont* opinion makes clear that trade secret holders must take reasonable precautions to obtain the benefits of trade secret law protection. And when trade secret holders have taken reasonable precautions then courts will evaluate whether defendants utilized improper means in appropriating trade secrets.

B. The Economic Basis of Trade Secret Rights

Trade secret law encourages efficiency by forbidding socially unproductive methods of discovering someone else's commercially sensitive information.[115] The primary economic benefit of the law is "the decrease in both the amount spent on protecting secrets and the amount spent by those who seek to learn them."[116] Both activities are wasteful, and by protecting trade secrets, the law seeks to avoid a costly arms race between protectors and thieves. Friedman, Landes, and Posner argue that the additional benefit of trade secret law is that, without it, inventors would have less incentive to invent.[117] However, this additional benefit is offset to some extent because "breaking the trade-secret owner's information monopoly" would itself provide an economic benefit.[118]

As noted, to obtain trade secret protection, the holder must take "reasonable precautions" to maintain secrecy.[119] What

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113. *Id.* at 1017.

114. *Id.*

115. The RESTATEMENT (THIRD) OF UNFAIR COMPETITION § 39 cmt. a (Am. Law Inst. 1995) notes that trade secret protection against "improper physical intrusions furthers the interest in personal privacy." Also, the rules protecting trade secrets "promote the efficient exploitation of knowledge by . . . facilitating disclosure [of useful information] to employees, agents, licensees, and others who can assist in its productive use." *Id.*

116. Risch, *supra* note 100, at 26.

117. For a discussion of the advantages and disadvantages of trade secrets and patents, see David D. Friedman et al., *Some Economics of Trade Secret Law*, 5 J. ECON. PERSP. 61, 61–72 (1991).

118. *Id.* at 69–70.

119. *See generally* Robert G. Bone, *Trade Secrecy, Innovation, and the Requirement of Reasonable Secrecy Precautions*, *in* THE LAW AND THEORY OF TRADE SECRECY: A HANDBOOK OF CONTEMPORARY RESEARCH 46 (Rochelle C. Dreyfuss & Katherine J. Strandburg eds., 2010) (providing a brief history and overview of the reasonable precautions requirement in trade secrecy law).

constitutes a reasonable precaution will vary with the value of the secret.[120] A trade secret of high value, such as the formula for Coca Cola, should be, and is, closely guarded.[121] A trade secret of low value, such as the client list for a small accounting firm, warrants only minimal protection. Similarly, those who seek to appropriate a trade secret will invest an amount based on their expected likelihood of success and the value of the trade secret.

The effects of trade secret theft on social welfare, with and without trade secret law, can be illustrated using a simple example. Assume that trade secret protection does not exist, and that the owner of a secret process to manufacture plywood values it at $1,000. Assume that the thief values the secret at $900. The owner values the trade secret more highly because otherwise the owner should sell the secret as opposed to continuing to use it. These numbers could be multiplied by 100 or 1,000 to make them more realistic, but the principles would not change. Both the owner and the thief estimate that the likelihood of successful theft is 60% in the absence of precautionary measures. In this sample example, there are no information, transaction, or legal system costs.

Assuming that the owner will lose the entire value of the trade secret if it is lost, the owner is willing to invest up to $600 (60% of $1,000) in the above scenario to protect against the loss of the trade secret. To invest more would be unwise since the precaution cost would exceed the expected loss. The thief is willing to invest up to $540 (60% of $900) to uncover the secret. The protection and discovery expenses are wasteful, as is the $100 loss of value if the secret is transferred to the thief.

Assume now that trade secret law exists and has the effect of reducing the likelihood that the thief will succeed to 30%. The thief still has a 60% chance of actually uncovering the secret but will be caught 50% of the time and prevented from using the secret. In this scenario, the owner is willing to invest up to $300 (30% of $1,000) to protect against the loss of the trade secret. The thief is willing to invest up to $270 (30% of $900). Thus, trade secret law reduces the likelihood that the secret will be stolen and therefore reduces the amount of wasteful precautionary spending.

It still makes economic sense for the thief to invest up to $270 to steal the secret. This incentive can be eliminated by imposing

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120. Posner argues that to maximize social welfare trade secret holders should be required "to invest in such [precautionary] measures until the judicial remedy, with all of its concomitant social costs, becomes the cheaper means of protection." Posner, *supra* note 102, at 474.

121. *See* WILLIAM POUNDSTONE, BIG SECRETS 30–34 (1983).

punitive damages, which, as Friedman explains, are "designed to deter strategic torts."[122] In our example, the thief will succeed 30% of the time. Therefore, requiring the thief to pay three and one-third times the actual damages would mean that a risk-neutral thief would have no economic incentive to attempt to steal the trade secret. It turns out that only about one-third of trade secret awards include punitive damages.[123] A risk averse owner who believes there is a low probability of apprehending and collecting from the thief will still make a substantial investment in precaution.

C. How Does the Rise of Drones Fit Within the Economic Framework of Trade Secret Law?

From the facts of the *DuPont* case, it is easy to see how the increasing prevalence of drones may substantially increase the chance that thieves will uncover trade secrets. This is not because drones have more advanced capabilities to sense and collect information. High-resolution satellites, low-flying planes, and electronic surveillance equipment located in nearby vehicles can capture information as well as drones.[124] However, because drones are far less expensive to acquire and operate, thieves can afford to launch many more surveillance flights and therefore are more likely to uncover secrets that are visible or detectable by drones.

A trade secret that was not worth stealing using a plane may well be worth stealing using a drone. In turn, the amount the owner must spend to avoid such thefts will likely increase. At some point, inexpensive "anti-drone" technology will become available to meet demand, but in the short term, the more likely scenario is that widespread use of relatively inexpensive drones will lead to greater surveillance. One way to deal with the expected increase in drone surveillance is to apply punitive damages much more frequently than the current 30%. Another is to establish simple rules regarding the types of drone operations that will be presumed to be intrusive. Sightings of drones that violate those rules could be reported to the FAA to trigger a notice of possible violation.

V. INADVERTENT INTRUSIONS

122. DAVID D. FRIEDMAN, LAW'S ORDER 210 (2000).

123. John E. Elmore, *A Quantitative Analysis of Damages in Trade Secrets Litigation*, INSIGHTS, 79, 90 (2016).

124. MCNEAL, *supra* note 95, at 2 (pointing out the incongruity between recent state legislation prohibiting governmental surveillance using drones "while largely allowing the government to conduct identical surveillance when not using this technology").

How will inadvertent intrusions be treated? Regardless of the law, there will be inadvertent trespasses and intrusions by drones, just as there are inadvertent trespasses and intrusions by people, bicycles, cars, and trucks at ground level today. Assuming that a drone public highway is established, probably at the 200- to 400-foot level, there will be airspace that belongs to the landowner somewhere below that. Drones will occasionally trespass in that airspace. For example, drones making package deliveries may slice into a nonconsenting landowner's airspace as they descend from the drone public highway. There is no reason to treat these incidents differently from other inadvertent trespasses, such as the trespass of children retrieving their errant soccer ball from a neighbor's lawn. Someday, the exact flight paths of all commercial drones will be easily tracked, but currently, the same evidentiary problems exist for drone trespassers as for ground-level trespassers. At least in the short term, most drone trespasses will be undetected unless they cause visible damage.

With regard to privacy intrusion, the standard is that the intrusion must be intentional and highly offensive to a reasonable person.[125] Thus, occasional inadvertent intrusions are unlikely to trigger liability. John Villasenor notes that "[a] passerby on the street at night who happens to glance up and notice that the light in a nearby home has just been turned off is certainly not violating privacy rights. Likewise, courts will be very unlikely to consider a fleeting, accidental capture of imagery of a home's curtilage or (through a window) interior acquired by a passing [drone] to be an invasion of privacy."[126]

Frequent drone incursions, however, may raise concerns about whether they are truly inadvertent or part of a monitoring pattern.[127] In *United States v. Jones*, a Fourth Amendment case, Supreme Court Justice Alito observed that "[i]n the precomputer age, the greatest protections of privacy were neither constitutional nor statutory, but practical."[128] However, "[r]ecent years have seen the emergence of many new devices that permit the monitoring of

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125. RESTATEMENT (SECOND) OF TORTS § 652B (AM. LAW INST. 1977).

126. John Villasenor, *Observations from Above: Unmanned Aircraft Systems and Privacy*, 36 HARV. J.L. & PUB. POL'Y 457, 502–03 (2013). Frequent drone trespasses may also constitute a nuisance if they interfere with the quiet use and enjoyment of a person's land. RESTATEMENT (SECOND) OF TORTS § 822 (AM. LAW INST. 1979).

127. *See* Orin S. Kerr, *The Mosaic Theory of the Fourth Amendment*, 111 MICH. L. REV. 311, 313 (2012).

128. United States v Jones, 565 U.S. 400, 429 (2012) (Alito, J., concurring).

a person's movements."[129] He concluded that "relatively short-term monitoring of a person's movements on public streets accords with expectations of privacy that our society has recognized as reasonable. [citation omitted] But the use of longer term GPS monitoring in investigations of most offenses impinges on expectations of privacy."[130] The same reasoning may apply to drone operations. A drone that repeatedly hovers above or near a particular property may impinge on expectations of privacy regardless of the height at which the drone is operating.

VI. CONCLUSION

In the near future, the FAA should specify that drones have their own "public highway," located between 200 and 400 feet above the ground. The FAA's specification of drone operating rights will not clarify the status of property rights below that level, which have been unclear since the *Causby* decision in 1946. However, by creating a new drone public highway, the FAA will remove an impediment to the growth of the drone industry without imposing significant costs on property owners, just as the Supreme Court did for commercial aviation in the *Causby* case.

By creating a drone highway, new questions will emerge in relation to property rights associated with the proposed highway. In *Causby*, the Court avoided specifying the "precise limits" of property rights below 500 feet—the altitude which then formed the lower limit of national airspace—on the basis that there was no need to decide the issue. Aircraft then did not, and still do not, use airspace below 500 feet, except to take off and land. Drones, however, fly at these low altitudes and will fly over private land unless landowners have the legal right to bar them. Therefore, conflicts between landowners and drone operators will occur until the courts decide this issue.

In crafting a rule to govern drone operations, courts will have to balance privacy rights of property owners against the interests of drone operators. The benefits of reducing vertical property rights to create a 200- to 400-foot high public highway for drones are likely to far exceed the costs. However, permitting drones to fly at significantly less than 200 feet offers only minimal additional economic benefit to the drone industry while significantly increasing potential privacy costs for individuals. When drones become sufficiently close to people on the ground, their presence

129. *Id.* at 428.
130. *Id.* at 430.

alone is highly offensive and imposes significant privacy costs even when they are not taking photographs or recording sound. And when the marginal cost of lower altitude drone operations exceeds the marginal benefit, property rights should emerge or, in this case, re-emerge. The minimum 200-foot operating level may be a reasonable approximation of the altitude where the marginal privacy cost equals the marginal drone commerce benefit. Below this altitude, drone operations without the consent of the landowner should be considered a trespass, and property owners should be permitted to exclude them as they would any other trespasser.

Operations above 200 feet present a different set of challenges because of the technical surveillance capabilities of drones. Many drones operating at that height are, or soon will be, able to capture detailed images of the property below, and therefore individuals will still need to rely on intrusion law to protect their privacy. The rise of drones should not change the legal standards of the intrusion upon seclusion tort. So long as the intrusion is unwanted, it should make little difference that a new technology is being used to intrude.

Regardless of the law governing drone operations, the total number of intrusions will likely increase because of the rapidly increasing number of drones and drone operations. At present, few practical measures can be taken to shield individuals in their yards from overhead view, creating a chilling effect on some types of backyard activity. The real-world results of the absence of privacy shields will be heavier reliance on legal enforcement to punish and deter intrusions. Accordingly, the courts should adopt simple rules regarding those operations which, if violated, would establish a presumption of intrusion.

Trade secret law protects corporate privacy only for firms that take reasonable precautions. Because drones are far less expensive to acquire and operate than planes, thieves can afford to launch many more surveillance flights. A trade secret that is not worth stealing using a plane may well be worth stealing using a drone. In turn, the amount the trade secret owner must spend to avoid such thefts will likely increase. At some point, inexpensive "anti-drone" technology will become available, but in the short term, the more likely scenario is that widespread use of relatively inexpensive drones will lead to greater surveillance of commercial activity. Accordingly, greater penalties should be assessed for trade secret violations using drones and punitive damages should be awarded more frequently.