Research Handbook on the Economics of Property Law

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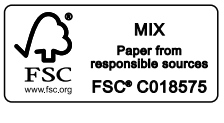

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2 Commons, anticommons, semicommons*

Lee Anne Fennell

In recent years, theorists interested in the commons have increasingly broadened their gaze to take in two new entries in the property lexicon: the anticommons[1] and the semicommons.[2] Notwithstanding some excellent work comparing and contrasting these templates and their associated tragedies,[3] the literature lacks a cohesive account of how they relate to each other and to larger questions of incentive misalignment. Although scholars sometimes frame the commons, anticommons, and semicommons as conceptually distinct forms,[4] each is best understood as a lens for apprehending a single core, challenging fact about resource systems – their need to accommodate multiple uses that are most efficiently pursued at different scales, whether simultaneously or over time.[5] This chapter offers a brief introduction to the commons, anticommons, and semicommons models and shows how the three fit together in a unified theoretical framework.

I. THE COMMONS

Although the underlying idea is much older,[6] Garrett Hardin (1968) popularized the phrase 'tragedy of the commons' and illustrated it with an example involving an open-access pasture (ibid., 1244). Reasoning that each herdsman would bear only a fraction of the costs of grazing another steer but would internalize all of the benefits of doing so, Hardin predicted that the pasture would be overgrazed (ibid.). The same problem of incentive misalignment can lead people to underinvest in collective activities (communal farms or public television, for example), take too many resource units out of a given system (as by overfishing), or put too many 'bads' into a system (such as smog, litter, or email spam).[7]

Hardin's pasture fable conjures up a distinctively compelling brand of inefficiency: a self-contained system that is transparently suboptimal for its own participants. Because the exploiters and the exploitees are one and the same – Hardin's herders harmed only themselves – the label of 'tragedy' seems especially apt and uncontroversial. It is not a matter of one group benefiting at the expense of another, much less a question of whose interests should take priority. Rather, we see a group shooting itself in its collective foot through self-defeating behavior. Parties interacting in real-world resource systems rarely deliver and realize losses in such a cleanly symmetrical manner, but the stylized commons tragedy neatly excises thorny questions of distribution from the picture to focus attention on the unambiguous costs of self-interested actions.

A. The Commons Without the Tragedy

Despite its merits as a rhetorical device, the tragedy of the commons story often fails to square with reality. The fact that a resource is held in common need not spell disaster,

as the successful management of many common-pool resources throughout history – including common grazing lands – attests (see, e.g., Dahlman 1980, 130–38; Ostrom 1990; Ostrom 2009). Refutations of Hardin's gloomy syllogism frequently begin by drawing a distinction between an open-access resource that anyone can exploit and a limited-access commons that is closed to all but its members (e.g., Ciriacy-Wantrup & Bishop 1975, 714–16; Eggertsson 2003, 75–76; Dagan & Heller 2001, 556–57) – what Carol Rose (1998b, 144) has aptly termed 'property on the outside.' The ability to exclude outsiders is an important prerequisite for a wide range of local, informal institutional solutions, even if it is not sufficient on its own to stave off tragedy (see, e.g., Ostrom 1990, 91–92; 2009, 32). Interestingly, the very features that lend power and elegance to the tragedy of the commons as a thought experiment – the closed system in which a small number of homogeneous individuals interact in reciprocal and symmetrical ways over time – may also allow real-world individuals to cooperate with each other in ways that avert tragedy (see, e.g., Ellickson 1991; Cole & Grossman 2010). Repeat play is especially important in this regard (see, e.g., Ellickson 1991, 164–65 (citing Axelrod 1984)).

There are also more fundamental reasons that tragedy may not follow from common ownership. First, misaligned incentives (that is, the existence of positive or negative externalities) can only generate inefficient results if they lead actors to choose differently than they would have under conditions of full internalization. This criterion will not always be met (see, e.g., Buchanan & Stubblebine 1962, 374–76; Dukeminier et al. 2010, 44–49; Haddock 2007). For example, people fishing from a remote pond may ignore the effects of their actions on others without triggering a tragic collapse of the fish population, if their decisions of whether and how much to fish would remain unchanged after taking into account the full social impact.[8] Similarly, people may add value by participating in a network such as a marketplace, festival, or road system without taking into account the positive spillovers their participation produces for others.[9]

Second, tragedy can only exist if it is technologically possible for the resource system to deliver different amounts of surplus as a result of individual choices.[10] Here it becomes important to clarify the sense in which struggles over finite resources can constitute commons tragedies. Consider a group of partygoers aggressively harvesting hors d'oeuvres from a buffet table's dwindling supply. Assuming no food is actually lost in the fray (and setting aside the important question of where the provisions came from in the first place), the outcome might seem to be a matter of pure distribution. Of course, the partygoers may derive varying amounts of marginal utility from the snacks, but we cannot be sure that the allocation produced by pushiness is inefficient – perhaps successfully aggressive food-harvesters are also higher valuers of food, on average.

To attribute tragedy to the spectacle, we must recognize not only the commons comprising the food itself, but also a second commons that is linked to the first, which we might call 'the party atmosphere' or, more broadly, 'the resource-gathering environment.' Actions that merely change the distribution of food harvested from the first commons may significantly degrade this second commons, whether in ways overt (injuries from tongs) or subtle (dampened conversation). Because each person may undertake individually rational but collectively costly efforts to get more of an underlying resource, a commons tragedy may cause even a fixed resource to yield up less total surplus to the group.[11]

Table 2.1 A Prisoner's Dilemma. Payoffs for (Rowena, Columbo)

	Columbo Refrains From Adding Cattle	Columbo Adds Cattle
Rowena Refrains From Adding Cattle	(0, 0)	(−7, 3)
Rowena Adds Cattle	(3, −7)	(−4, −4)

B. The Prisoner's Dilemma

The commons tragedy and its connection to problems of scale can be better understood by boiling it down to its two-player structural equivalent, the Prisoner's Dilemma.[12] Like the tragedy of the commons, the Prisoner's Dilemma derives its analytic power from the transparent manner in which the parties make self-defeating choices. Consider a miniature version of Hardin's pasture that is shared by two ranchers, Rowena and Columbo.[13]

When we meet our protagonists, each has already added cattle to the pasture up to the socially optimal point. Each must now decide whether to add yet another animal. Doing so will generate ten in benefits and fourteen in costs; hence, it is a losing proposition from a societal standpoint. But consider things from, say, Rowena's point of view. Because she will internalize the full benefit (ten) from adding a steer, but will bear only half the cost (seven) inflicted on the pasture, she will enjoy a positive payoff of three by adding a steer. Her realization that Columbo will reason the same way does not change her decision. While Columbo's decision to add an animal drops Rowena's payoff to negative four in a world where she adds a steer as well, she would do even worse (negative seven) if she refrained from adding cattle in that state of the world. The dominant strategy for each player is to defect; hence, the lower righthand corner of Table 2.1 represents the Nash equilibrium (see Baird, Gertner, & Picker 1994, 21–22; 33–34).

C. The Problem of Scale

The payoff structure of the Prisoner's Dilemma satisfies the preconditions for tragedy laid out above: the players make different decisions than they would if they were taking into account all the implications of their actions, and the resulting combination of blinkered choices produces less overall surplus for the pair. What accounts for this payoff structure? The usual focus of blame is each rancher's ability to externalize some of the grazing costs attributable to adding an animal to the commons, which is in turn a function of common ownership of the land. But the problem is just as much a result of the rancher's ability to fully *internalize* the grazing benefits associated with adding an animal. That ability to internalize benefits flows from a property system in which the rancher holds individual (or 'private')[14] property rights in the steer, and continues to hold those rights regardless of how much communal grass it ingests.[15] It is not, then, the commonly owned land alone that produces the rancher's dilemma; it is instead the mix of individual and common ownership.[16] The same is true of any other commons problem one might care to identify, from overfishing to shirking on a communal farm – although

in some cases the private ownership in question is of one's person or one's labor rather than of a chattel or hunk of real estate (see Alchian & Demsetz 1973, 23–24).

Close analysis of the tragedy of the commons thus reveals an intriguing fact: The dilemma is driven by the presence of two (or more) activities that are being pursued at different scales and under different property arrangements.[17] The problem for Hardin's herders is only partly about the fact that grazing is pursued at a large scale and on commonly owned ground; it can be equally attributed to the fact that the raising of cattle is pursued through individual ownership of the animals. Furthermore, the mix of ownership types occurs under circumstances that permit private ownership to be used as a platform for offloading costs onto the commons, and that allow access to the commons to be used for the benefit of private property (the roving cattle). In other words, as will be developed further below, the prototypical commons tragedy grows out of an arrangement that looks a good deal like a semicommons – a system in which private and common property uses interact (Smith 2000).

If two resource uses conducted at different scales and under different ownership regimes generate payoffs like those shown in Table 2.1, we might examine the prospects for rescaling one use or the other to reduce the degree of mismatch. For example, the ranchers might conclude that grazing need not be undertaken on a large scale after all and respond with parcelization (see, e.g., Ellickson 1993, 1327–28). If individually owned cattle are grazed on individually owned plots of land, the costs of grazing fall on the same rancher who internalizes the benefits of it. But the redrawing of property lines need not move in the direction of more private ownership; commoners might instead place more elements under common ownership (Alchian & Demsetz 1973, 23). For example, the ranchers might decide that individual ownership of cattle is unnecessary and place the cattle themselves, as well as the grazing land, under common ownership.

A close analogue can be found in unitization, a prevalent approach for managing oil and gas reserves that underlie multiple parcels (see Libecap & Smith 2002, S595–96). If individual landholders are simply permitted to keep for themselves all the resource units they can extract from the common pool, an inefficiently high rate of depletion and attendant waste predictably results (see ibid., S591–93). Unitization agreements that maintain common ownership of the resource units after extraction and divide up the proceeds according to some predetermined rule alleviate this pressure toward overextraction (see ibid., S596). The goal is to create a collective body capable of making decisions in the same fully-internalized way as would a single owner, where the fugitive nature of the resource makes physical partition of the resource impracticable (see ibid, S595–96; see also Epstein 1993, 555–57).[18] Alternatively, one party could purchase oil or gas rights from all of the overlying landowners, along with any easements necessary to optimally exploit the resource (Libecap & Smith 2002, S593 & n.15 (citing Demsetz 1967, 357); see also Coase 1960, 16–17). Dean Lueck (1989) makes analogous points in the context of wildlife populations. As he explains, the fact that an animal herd (say, deer) has a territory that far exceeds the optimal land size for the land's most valuable use (say, farming) would not preclude ownership of the herd if the uses were compatible and if it were possible for all of the landowners to transact with each other or for an outsider to buy up 'deer population rights' from each of them (ibid., 301–03).

These moves involve delinking rights to the larger-scale resource from individual parcel ownership and consolidating them either in the hands of a single owner or in

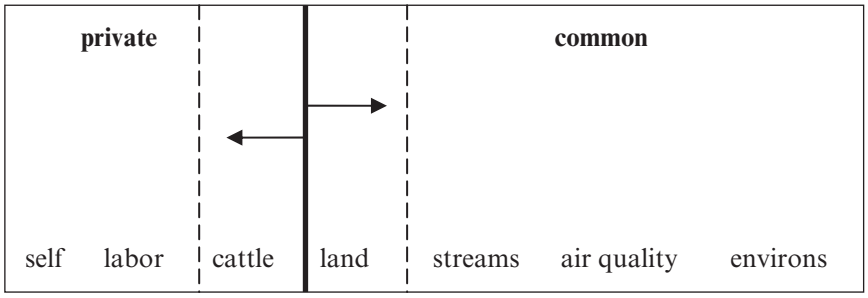

Figure 2.1 Mixed Ownership

the hands of a collectivity that will act as one. Both approaches eliminate the mismatch between ownership of the resource system and the resource units – the former by privatizing the resource system as well as the individual resource units, and the latter by collectivizing the units as well as the system. The transaction costs associated with accomplishing such shifts may be prohibitive, however. First, moving resource systems to private ownership or resource units to common ownership may be very difficult, especially if unanimous consent to the change is required.[19] This, as we will see, amounts to an anticommons problem. Second, to the extent that delinking uses from each other is costly or imperfect, a change in ownership for one use may require abandoning the most efficient scale of operation and ownership form for another use. In addition, the shift will inevitably create a new interface between privately and commonly owned elements that will carry costs of its own. Figure 2.1 illustrates this point.

The heavy vertical line in Figure 2.1 shows how a given resource system, such as a grazing pasture, might divide individually and commonly owned (or controlled) elements. A rescaling and associated ownership change can shift that line in one direction or the other, but it will not eliminate the line itself or the incentive problems that can occur when privately and commonly owned elements interact.

For example, parcelization would shift land to private ownership and thus move the line to the position of the rightmost dashed line. This removes the grazing misalignment flagged above, but the fact that resources like water and air are still experienced in common with one's neighbors may continue to distort incentives.[20] Similarly, moving to collective ownership of cattle remedies the dissonance between cattle ownership and land ownership, but creates a new abutment of private and common elements at the leftmost dashed line. As long as inputs to cattle care, including labor, remain individually owned, the temptation to shirk could replace the overgrazing tragedy with a tragedy of poor veterinary care or of other forms of neglect (see Alchian & Demsetz 1973, 23; Krier 2009, 150 n. 51). The question remains, of course, whether the new interface is less costly than the old one. Under some circumstances, shifting elements such as land into private ownership could reduce externalities and ease the bargaining burdens associated with accomplishing full internalization (Demsetz 1967, 356–57; Ellickson 1993, 1330–32), but that result depends crucially on the scale of the relevant activities and impacts (e.g., Sinden 2007, 587–94; see Ellickson 1993, 1334–35).

A shift in ownership represents just one of several ways of ameliorating a tragedy-prone payoff structure and the underlying problem of scale. Alternative approaches

would allow uses to continue at different scales under existing ownership forms, but would adopt other measures designed to generate outcomes that look more like those that full internalization would produce.

D. Addressing the Tragedy

The problem of incentive misalignment captured in Table 2.1 can be approached in two basic ways: coercively overriding each player's power to defect, or changing the relative payoffs of defection and cooperation.[21] The first possibility corresponds most closely to Hardin's (1968, 1247) idea of 'mutual coercion, mutually agreed upon,' and typically implies the state-wielded threat of force.[22] The second approach involves explicitly or implicitly repricing the alternatives so that the choice between them more closely reflects the full internalization of costs and benefits.

Repricing can take a variety of forms. First, the state (or other collective body) can tax defection or subsidize cooperation.[23] Setting penalties or rewards at levels that capture the previously externalized costs or benefits leaves each actor free to engage in cost-benefit comparisons incorporating the revised figures (see, e.g., Krier 1994, 452–53). Such an approach can accommodate heterogeneity among actors, such as unusually high costs of cooperation, in a way that directly coercive approaches cannot (see ibid.). But getting the prices right can be tricky (see, e.g., ibid.). Insufficient penalties (or rewards for restraint) may fail to avert tragedy, while excessive repricing may lead actors to engage in too little of a productive activity like ranching.

Price adjustments might also be nonpecuniary in nature. For example, a norm-based sanction and reward system may operate upon commoners in a manner closely akin to taxes and subsidies by inflicting the pain of social shaming or bestowing the pleasure of social inclusion and camaraderie (see, e.g., Sunstein 1996, 912–13; McAdams 1997, 355–75). Alternatively, norms might be inculcated in a manner that alters the players' internal calculus, so that cooperating brings a glow of satisfaction and defecting produces pangs of remorse and shame (McAdams 1997, 380–81; cf. Ullmann-Margalit 1977, 36–37). In this way, norms may become self-enforcing, diminishing or eliminating the need for monitoring and enforcement by the group (see McAdams 1997, 380–81).

Redrawing property lines represents an indirect way to accomplish repricing.[24] The potential to change the mix of private and common property, and thereby to alter the universe of costs and benefits that parties internalize and externalize, has already been noted. The redrawing of property boundaries can occur in other ways as well. Incentives to overdraw resources from the commons can be blunted by limits on the alienability of harvested resources (see, e.g., Rose-Ackerman 1985, 942–43; Epstein 1985, 978–88; Lueck 1989, 318–19; Hsu 2003, 870; Fennell 2009, 1429–33), by limits on use (e.g., Levmore 2002, S436), or even by limits on the owner's right to exclude others from the extracted resources (see Heller 1998, 675 & n. 246). All of these alternatives reduce the payoff associated with the noncooperative action and hence change ex ante incentives through a brand of repricing – although not without some attendant ex post costs.

Notwithstanding this array of solutions, the tragedy of the commons continues to present a foundational puzzle, one that James Krier (1992) termed 'The Tragedy of the Commons, Part Two': how could people locked in the tragedy's noncooperative

equilibrium perform the impressive acts of coordination necessary to escape it? (ibid., 337). If private property rights were necessary to avert tragically misaligned incentives, for example, we need some account of how people overcame their incentive problems to create those property rights.[25] Rudimentary property rights might be explained by conventions in which one party's possession triggers deference by others (see, e.g., Krier 2009, 154–55 (discussing Sugden 2004)). But possession-based conventions would only sharpen the mismatch between private incentives and the social optimum when units are drawn out of a resource system that is too large to be reduced to individual control. Responding to these incentive misalignments requires coordination, whether it takes the form of assembling consent to a new system of property rights or employing a political apparatus to coerce cooperation (see, e.g., Krier 1992, 337–38). The anticommons model sheds light not only on the problems that may follow such changes, but also on difficulties in accomplishing these realignments in the first place.

II. ADDING THE ANTICOMMONS

Frank Michelman (1982) posited an imaginary regime that was the opposite of the commons, one in which no person could make use of a resource without obtaining permission from every other person (see ibid., 6, 9). This 'anticommons'[26] turned out to possess structural properties of more than mere theoretical interest. Although scholars had long realized that multiple vetoes over resource use could produce inefficiency (see, e.g., Arrow 1979, 25–26; Buchanan 1973, 73–74; Demsetz 1967, 354–55; Krier 1992, 335–36), Michael Heller (1998; 2008) made this structural dilemma salient and memorable through a series of vivid examples that developed, adapted, and applied Michelman's concept. For instance, Heller suggested that the puzzle of busy kiosks near empty storefronts in post-socialist Moscow could be explained by the fact that opening a store (but not a kiosk) required obtaining permits from multiple actors (Heller 1998, 633–40; 2008, xiv–xv, 143–56). James Buchanan and Yong Yoon (2000) followed up with a formal model of the dilemma, using the example of a parking lot that could only be accessed by patrons who obtained a parking pass from each of two independently operating ticket booths (ibid., 4–10).

The term 'anticommons' has since become shorthand for a broad class of problems requiring the assembly of permissions or entitlements, from land development to patent rights.[27] In each case, the worry is the same: that a value-enhancing assembly – one that could leave every party better off than the status quo – will fail to occur as a result of strategic holdout behavior and other transaction costs. Like the tragedy of the commons, the tragedy of the anticommons makes inefficiency transparent by creating a self-contained system in which participants make themselves worse off. But just as commonly owned property does not inevitably lead to a commons tragedy, the dispersal of veto rights does not automatically create an anticommons tragedy (Michelman 1985, 14–15; Heller 1998, 673–75; Heller 2008, 46).

A. When Is an Anticommons Tragic?

The problem of the anticommons is fundamentally a problem of assembly – whether of permissions, land, biotech patents, or something else.[28] Putting individually controlled

fragments together to make a larger whole requires either obtaining the consent of the fragment-holders or overriding their refusal to consent, and dividing up the surplus (if any) that the resulting assembly will produce. If the individual pieces are protected by a property rule, these two operations are linked – consent of each entitlement-holder is required, and the price of the fragment may be set at whatever level the entitlement-holder chooses (Calabresi & Melamed 1972, 1092). Routine transaction costs and strategic behavior can make such reconfigurations prohibitively difficult, however, and the assembly may not occur (see, e.g., ibid., 1106–07). This is not necessarily tragic. Not all assemblies should occur, from an efficiency perspective. Fragments may be more valuable when kept in separate hands than when assembled into a whole (see, e.g., Heller 1998, 674–75); if so, there is no assembly surplus to be had.

Thus, diagnosing an anticommons tragedy requires more than pointing out fragments that could be put together and noting that they have not been so assembled. Those unassembled pieces could bespeak a tragically blocked aggregation, but they might instead represent an assembly that was just not worth doing, once everyone's interests were taken into account. A focus on the structural features conducive to tragedy can offer some, albeit incomplete, guidance. In the absence of monopoly power or 'thin markets' (see Merrill 1986, 75–77), a would-be holdout has no leverage and hence no incentive to strategically overstate her price. If she tries to do so, the assembler will simply obtain a substitute fragment from someone else who is willing to sell more cheaply, or create an assembly that leaves out the contested fragment (see, e.g., Cohen 1991, 358–59). Thus, anticommons tragedies are plausible only in settings where good substitutes are absent.

While it is not always easy to assess the availability of substitutes and hence the degree of monopoly power that a particular holdout might possess, examining the production function for assembly surplus may be helpful. Particularly conducive to holdout dynamics are lumpy or 'step' goods that do not deliver surplus in smoothly increasing increments as additional inputs are added, but rather provide a large shot of surplus all at once, when the assembly is complete (see, e.g., Taylor & Ward 1982, 353). If all of the components are necessary in order for any of the surplus to be enjoyed, the last holdout can command a high price – and, perceiving this, each fragment-holder will strive to be in that enviable position (see, e.g., Posner 2007, 62–63). In such a case it is possible (although by no means certain) that an assembly failure is attributable not to efficient fragmentation but to strategic behavior. In contrast, a fragment that will only add a relatively minor portion of the surplus that an assembly will produce or that is fungible with other readily available components can be much more readily jettisoned from the project. Such possibilities cabin strategic holdout behavior.

B. The Anticommons and the Commons

Both the commons and the anticommons tragedies feature self-interested choices that are collectively suboptimal. What, then, distinguishes the two dilemmas? Most writers on the anticommons tragedy, including Heller, strongly associate it with the underuse of resources (see, e.g., Heller 2008, 32–37; Buchanan & Yoon 2000, 1–2; Hsu 2003, 814). Although doing so offers an intuitive contrast with the example of resource overuse featured in Hardin's tragedy of the commons, the underuse/overuse dichotomy masks the structural nature of both tragedies. The anticommons tragedy is an assembly problem,

nothing more and nothing less.[29] There is nothing in the nature of assembly – whether we are speaking of land, permission, intangibles, or anything else – that necessarily pushes us in the direction of intensified use.

To be sure, people often want to assemble fragments in order to engage in more intensive uses (for example, combine land parcels to develop a shopping center) but sometimes they want to do the opposite (such as buy up land parcels to construct a large, contiguous nature preserve). Similarly, the dispersed veto rights that characterize the anticommons can block actors not only from doing a particular thing (such as fishing from a pond) but also from creating a world in which actors are *not* doing that thing. Difficulty assembling consent to oil or gas unitization offers a case in point: the anticommons problem in that case, if unresolved, will result not in underuse of the resource, but continued overdrawing of it (see Heller 2008, 44). Heller's application of the anticommons model to efforts to coordinate conservation efforts further illustrates this point (ibid., 183–84). We can also find converse examples involving excessive draws against a common resource like space, which represent commons tragedies yielding too little use of a resource (see, e.g., Fennell 2004, 935; Heller 2011, n.44).

Another unstable distinction is that between too many 'use privileges' (associated with the tragedy of the commons) and too many 'exclusion rights' (associated with the tragedy of the anticommons) (see Heller 1998, 677). As the examples above suggest, sometimes parties keep valuable assemblies from occurring not by tacking 'keep out' signs on their property, but rather by engaging in uses (like polluting or drawing on a common pool) that keep people from being able to enjoy a desired resource (like an environment free of pollution or a common pool that remains viable over time). For similar reasons, identifying the anticommons with 'too much private property' (e.g., Heller 2001, 86) is incomplete. While individual holdings can certainly give rise to anticommons dynamics, assembly problems can also arise in contexts featuring too little private property.[30]

Returning to the patterns of strategic behavior that lie at the heart of the commons and anticommons dilemmas, respectively, offers a more promising distinction. Whereas the commons tragedy follows the strategic pattern of the Prisoner's Dilemma, the anticommons often resembles the strategic game of Chicken.[31]

C. A Game of Chicken

Chicken gets its name from a potentially deadly (and, one would hope, largely fictional) game in which two drivers speed toward each other, each hoping the other will swerve first (see, e.g., Schelling 1966, 81–87; Baird, Gertner & Picker 1994, 43–45). There is one way to win the game (induce the other party to swerve first), and three ways to lose, in decreasing order of desirability: (1) swerve at the same time as the other party; (2) swerve first; and (3) crash into the other party. This same basic strategic interaction can be found in less dramatic contexts, such as negotiations between two parties (see, e.g, Baird, Gertner & Picker 1994, 43–45; Posner 2007, 62). A deal that will produce surplus is worth doing regardless of exactly how that surplus gets divided up, but each party would prefer to receive a larger share. Here, 'driving straight ahead' means getting more than one's share of the available surplus, 'swerving first' means taking less than one's share in order to facilitate the bargain, and 'crashing' means that the deal falls apart altogether.

In bargaining, as in roadway Chicken, one's best move depends on what the other

Table 2.2 Chicken Game. Payoffs for (Rowena, Columbo)

	Columbo Swerves	Columbo Drives Ahead
Rowena Swerves	(4, 4)	(1, 7)
Rowena Drives Ahead	(7, 1)	(0, 0)

party is going to do. Thus, unlike the Prisoner's Dilemma, Chicken does not feature dominant strategies that combine to produce a single Nash equilibrium; instead, there are multiple equilibria (see Baird, Gertner & Picker 1994, 44). A crash is by no means inevitable and indeed should be avoidable, but two players who misread each other or miscalculate about the total amount of surplus available may stick to positions that, in combination, preclude the successful completion of an efficient deal. We need not worry about the crash outcome in competitive markets; a party who insisted on a supernormal share of surplus would only hurt herself, metaphorically crashing into a wall, while the other party would go on to trade with a less problematic partner. But holdout problems similar to those discussed above can appear in situations of bilateral monopoly, where neither party has access to alternative trading partners (see, e.g., Posner 2007, 62).

Returning to the earlier interaction between Rowena and Columbo illustrates not only how the game of Chicken works, but also how the tragedy of the anticommons connects to the tragedy of the commons. When we last saw them, our protagonists were locked in a Prisoner's Dilemma, each tempted to add more cattle than would be efficient. If they could agree among themselves to refrain from adding the extra ungulates, the tragedy of the commons could be averted, and a surplus of eight – the difference between the payoffs in Table 2.1's upper left ('both refrain') and lower right ('both add') cells – could be enjoyed between them. Each would be better off with even a little of this surplus but each would prefer to get more of it rather than less. Their attempts to assemble the acts of forbearance that will produce the surplus, and their struggle over how that surplus will be divided, makes up the Chicken game depicted in Table 2.2.[32]

Each player must choose whether to 'swerve' by ceding surplus to the other, or 'drive ahead' by insisting on the bulk of the surplus. The outcome in the lower-right corner is the 'no deal' or 'crash' outcome in which all of the available surplus is lost, dispreferred by both parties. However, each party will try to play the strategy of 'drive ahead' if she thinks the other party can be bullied into swerving. The concern here is not that one party or the other will get an 'unfair' share of the surplus; that may be a problem for independent normative reasons, but it is a question of distribution rather than efficiency (see, e.g., Cohen 1991, 352–53). Rather, the worry is that each will push too far, miscalculate, and contribute to a crash. The crash in question involves nothing other than failure in contracting – long recognized as the true root of inefficiency in resource use (see Coase 1960, 15–17; Cheung 1970). What the anticommons analysis illustrates, however, is that externalities in common-pool contexts can flow not only from the absence of a right to contract or flaws in the contract stipulations themselves (see Cheung 1970, 50–52), but also from parties strategically standing on their rights and refusing to engage in beneficial bargains.

Although these two-player games are helpful for examining strategic interactions, the

prototypical anticommons problem, like the prototypical commons tragedy, is a multiplayer game. This is not a coincidence. While two-party bargains can sometimes lead to impasse, the risk of the 'crash' outcome is greatly magnified when many different parties hold independent vetoes on an assembly of entitlements. Misreadings and miscalculations become more likely in the many-player case, and mundane transaction costs associated with identifying and communicating with the other parties rise as well (see, e.g., Ellickson 1993, 1330–31; Demsetz 1967, 354–57; Posner 2007, 62–63). Seen in this light, a potential anticommons problem lies between every garden-variety commons problem and its solution. Put differently, the anticommons problem and its underlying Chicken Game structure shed light on an important aspect of the contracting problems that can perpetuate commons tragedies.

D. Linked Tragedies and Solutions

The example above shows one connection between the anticommons and the commons, but the relationship between these models requires further exploration. Recall again the slate of solutions to the tragedy of the commons: mandating cooperation, or repricing the choice between cooperation and defection. One mechanism for repricing involves redrawing property lines so that actors better internalize the costs and benefits of their choices. Implementing this alternative may involve granting various actors ownership or control of individual fragments or parcels – a rightward shift of the vertical line in Figure 2.1. The anticommons literature has stressed the potential difficulty in later reassembling those resulting fragments into a unified whole.[33] This line of reasoning emphasizes the link between commons and anticommons tragedies that has received the greatest amount of scholarly attention: a 'propertized' solution to the tragedy of the commons may create a tragedy of the anticommons (see, e.g., Heller 2008, 18).

This is an important point, but the analysis underlying it is incomplete in at least two respects. First, the inefficiency produced, if any, is not unique to the propertized solution, but could stem from any response to a tragedy of the commons that is premised on errors or faulty assumptions about the most efficient use of the resource over time. A commons from which all commoners have been coercively banished by the government is just as 'tragic' (assuming some use of the commons would be optimal) as one that no commoner can assemble sufficient permission to enter. What propertization adds to the story, at least potentially, is a heightened level of stickiness. Unlike fines or bans that can be politically undone on less than unanimous consent, property fragments are often thought to be particularly difficult to reassemble. But other institutional responses to commons dilemmas can also prove problematically resistant to change (see Daniels 2007), and political overrides can also apply to property interests, as through eminent domain.[34] Moreover, easy access to political overrides is not an unmixed blessing; good as well as bad interventions into commons tragedies can be undone. In some cases, the stickiness in arrangements that stems from propertization can actually enhance efficiency over time (see Bell & Parchomovsky 2003).

A second, more fundamental inadequacy in the usual connection drawn between the commons and the anticommons can be seen by returning to Figure 2.1's vertical line dividing the realms of individually and commonly owned property. The anticommons tragedy is usually thought to stymie only leftward moves of that dividing line – that is,

moves that would increase the domain of the commons relative to the domain of individual ownership. But rightward moves that take elements out of the commons and place them under individual ownership can also be blocked by interested stakeholders (see, e.g., Dahlman 1980, 187; Rose 1998a, 97). Solving the tragedy of the commons in any manner, whether through redrawing property lines or otherwise, requires actors to give up something – their current untrammeled access to the resource in question (Krier 1992, 335–36). To the extent that such access represents something like a property interest, an effort to aggregate consent to a plan of forbearance may itself present an anticommons dynamic (see, e.g., Heller 2008, 183–84).

We might, therefore, expect holdout problems analogous to those anticipated in moving from private to common property to beset attempted moves in the other direction.[35] In other words, it is not only propertized *interventions* into a commons tragedy that can produce an anticommons tragedy; an anticommons dynamic can also interpose itself between a commons tragedy and its solution. This is precisely the point that was illustrated above when the original Prisoner's Dilemma (commons dilemma) between Rowena and Columbo in Table 2.1 morphed into Table 2.2's game of Chicken (anticommons dilemma) once they began to negotiate a solution.

The anticommons theorist might respond that it is politically and legally easier to forcibly aggregate the forbearance necessary to solve a commons dilemma than it is to aggregate other kinds of entitlement fragments (see Heller 1999, 1195–96). Framed more broadly, perhaps the political capacity to move from common to private property is greater than the capacity to move from private property to the commons. Yet we have seen moves in both directions, and a variety of accounts exist for how and why such moves occur (see, e.g., Demsetz 1967; Field 1989; Levmore 2002; Wyman 2005; Bell & Parchomovsky 2009). Without more information about the underlying efficiency stories, it is difficult to know whether too few shifts of one type or another have occurred, much less whether anticommons dynamics are to blame.

One more take on the problem also deserves attention: conferring property rights may be essential to aggregating (or gathering the political will to impose) forbearance. Consider here the prevalence of 'grandfathering' provisions within legislation designed to curtail draws against common pool resources (see, e.g., Rose 1998a, 97; see also Nash & Revesz 2007, 1730; Levmore 1999, 1665–66). If it is impossible to move from one inefficiently fragmented entitlement pattern without introducing a newly fragmented ownership pattern, we should not lament the fact that the new arrangement 'propertizes' – in fact, it may be replacing a less efficient form of de facto propertization. On this account, property – and the veto power it confers – does not only feature in anticommons tragedies, but may also be essential to overcoming them.

III. SCALE AND THE SEMICOMMONS

Resource systems, as we experience them on the ground, are never solely composed of individually owned or commonly owned elements. Instead, we constantly encounter interacting mixtures of private and common property.[36] In developing the notion of the 'semicommons,' Henry Smith (2000) focused attention on a subset of these interacting elements – those in which 'both common and private uses are important and impact

significantly on each other' (ibid., 132). In the remaining space, I will examine how this subset, as well as the larger category of mixed property regimes, relates to the commons, the anticommons, and the unifying problem of scale.

A. Seeing the Semicommons

As Smith (2000, 132) explains, medieval farming and grazing arrangements constituted a semicommons: pieces of farmland were individually owned but the land as a whole was shared for grazing purposes. In the open field arrangement, grazing alternated with farming in a seasonal cycle (ibid.), but this sequential feature is not essential to the notion of a semicommons. What is important is that the ownership arrangements reflected the different scales at which two activities – farming and grazing – were best undertaken (see ibid.; Dahlman 1980, 132). Rather than hold farmland in contiguous blocks or parcels, the commoners who shared the grazing land each held a number of physically dispersed strips (see Ellickson 1993, 1388–90 & fig. 3). While a variety of reasons for this arrangement have appeared in the literature, including the diversification of risk (e.g., McCloskey 1989), Smith (2000, 146–54) has emphasized its role in controlling strategic behavior. Interspersing farmland holdings dampens the incentives that commoners might otherwise have to use their private holdings or their access to the common grazing land strategically to burden or benefit particular parcels; the physical layout binds together the fates of many different owners (ibid.).

The farming and grazing semicommons contained a built-in solution to the problems presented by mixtures of private and common property. However, the notion of the semicommons extends to interacting mixtures of common and private property whether or not they are managed in this manner.[37] Nonetheless, it has been viewed as a relatively narrow category of mixed property. In what Smith (2000, 161) has termed 'true semicommons property,' the commonly and privately owned elements 'cover the same physical resource,' such as land. The incentive structure also differs from that of the prototypical commons in which each rancher must bear 1/n of the costs of an added animal (ibid., 139; Bertacchini, De Mot & Depoorter 2009, 165–66). In a semicommons, privately owned elements (such as sheep) may be used to impose costs not indiscriminately on the commons as a whole but selectively on other people's privately owned elements (such as farming lands); similarly, commoners might use their access to the commons to benefit their own private property at the expense of other parties' property (for example, by attempting to direct trampling sheep elsewhere) (see Smith 2000, 132; Bertacchini, De Mot & Depoorter 2009, 165–71).

Thus cabined, a semicommons is indeed distinguishable from the stylized commons in which defecting means proportionately harming every member of the group, oneself included. But the prototypical commons with its homogeneous players and perfectly symmetrical payoffs operates more as a simplified model than as an approximation of reality. Because producers of externalities rarely bear a perfectly proportionate share of the costs they impose, real-world situations classified as commons dilemmas often hew much closer to the semicommons model. More broadly, the challenges brought to light by the semicommons – operations at multiple scales and the resulting interaction of different ownership regimes – encompass the tragedies of both the commons and the anticommons, whether considered in prototypical or contextualized form.

On this account, the semicommons is less a distinctive property type than a manner of seeing – a lens or frame through which to view existing or proposed arrangements that involve activities at different scales, whether simultaneously or over time. I have already suggested that tragedies of the commons are driven by the incentive misalignments produced by differently scaled activities under different ownership regimes. These mixed regimes are usefully illuminated by the semicommons analysis. We can now examine how the anticommons fits in.

B. The Commons, the Anticommons and the Semicommons

Recall that what pulls incentives out of alignment in a tragedy of the commons is not common ownership alone, but rather the interface between private and common ownership. As discussed above, that interface can be altered either by parcelizing more of what is commonly owned or bringing under common ownership more of what is privately owned. Neither move eliminates the potential for strategic interaction between privately and commonly owned elements. As long as spillovers exist, parcelization is incomplete. Similarly, any system of common ownership incorporates private elements to the extent that it leaves individuals with some control over their own bodies and labor (see Alchian & Demsetz 1973, 23–24). Nonetheless, changing the mix of common and private property may produce a new mixed regime that aligns better with the scale of events affecting the actors' returns (see Ellickson 1993, 1325–35).

Accomplishing the reconfiguration of property rights, however, requires either obtaining or overriding the consent of the parties affected, and somehow distributing the resulting surplus. This is where the anticommons comes in. If the parties are given a veto over the reconfiguration, an anticommons dynamic may keep it from happening. As discussed above, this may not be a bad thing; it depends on whether the present configuration is more or less efficient than the proposed revision, which in turn depends (at least in part) on questions of efficient scale. Similarly, once a reconfiguration of ownership occurs, an anticommons dynamic may lock it in place. Again, this could be benign (if the reconfiguration is, and remains, efficient) or tragic (if the reconfiguration was undertaken in error or becomes inefficient over time). To maintain greater flexibility, we might attempt to draw (or redraw) property lines in a way that simultaneously accommodates multiple scales, builds in future reversibility, or both.

A focus on reversibility suggests an interesting direction in which the logic of the semicommons might be extended. Thus far, the semicommons literature has focused on the simultaneous or 'temporally interleaved' use of resources (Smith 2002, S481). Such a mixed ownership regime might accommodate multiple activities that can be most efficiently pursued concurrently at different scales. But there is an analogous problem of accommodating differently scaled uses of resources *over time* – what we might characterize as a temporal semicommons.[38] For example, individual pieces of land might be most efficiently held as individual homesteads at Time 1, but might be more valuable when combined to form some larger development or preserve at Time 2. Just as the judicious drawing of property boundaries can allow activities to be pursued simultaneously at different scales under different ownership rubrics – that is, without private ownership wrecking things for the commons, or vice versa – so too might property be crafted in a manner that allows a resource to be used in different configurations at different times.[39]

Thus, the semicommons idea, writ large, speaks to the fact that it is efficient to have property configured in different ways under different circumstances, whether those circumstances occur at the same time or at different times. Allowing those different property arrangements to coexist (whether in space or over time) requires defeating or precluding strategic behavior. The mechanisms employed in the traditional semicommons bear a striking resemblance to some of the strategies that have been developed to deal with reconfiguration challenges over time, as the next section explains.[40]

C. Toward Strategy-Proof Solutions

The existence of historic semicommons demonstrates that it may be efficient, at least for a time, to maintain operations on multiple scales and take other measures to align incentives. As Smith (2000, 132) explains, '[a] semicommons need not be tragic where the benefits from operating on multiple scales outweigh the costs of strategic behavior and its prevention.' Thus, awareness of the semicommons prompts us to consider various forms of strategy-proofing as alternatives to altering the mix of privately owned and commonly owned elements within a resource system, where different efficient scales of operation exist for different uses.

The scattered pattern of farmland ownership within common grazing fields shows how mechanism design can harness self-interest and defeat strategic behavior. As Smith observes, the system works in part by making boundaries more obscure and rendering it more difficult to tell whether a particular act will be to one's benefit or detriment (Smith 2002, S480–81). This idea of veiling decisionmakers from crucial information about the personal implications of their decisions also underlies a broad range of strategies for eliciting unbiased information and advancing distributive goals, from the 'veil of ignorance' thought experiment in Rawlsian analysis, to the 'one divides, the other chooses' strategy for dividing up cakes (and other things) (see Smith 2000, 165; see also Rawls 1971, 85, 136–42; Brams & Taylor 1996, 8–12). While the physical interspersal that blurs boundaries in medieval grazing fields is not feasible in many settings, the idea of generating useful uncertainty can be transplanted to solve otherwise intractable problems.

For example, liability rules can sidestep holdout problems that preclude efficient entitlement rearrangements over time, but their efficacy depends upon reliable valuations of the entitlements in question (Calabresi & Melamed 1972, 1107–08). Getting entitlement holders to accurately report their own valuations is obviously difficult when a party knows in advance whether a higher or a lower number will be to her benefit (see, e.g., Ayres & Talley 1995, 1030). Consciously constructing situations in which that information is veiled or blurred – as where a stated valuation is made not only a basis for receiving compensation but also a basis for paying a tax – can help to alleviate the problem of strategic misstatements (see, e.g., ibid.; Tideman 1969, 51–69; Levmore 1982; Fennell 2005).[41] While such a tactic may seem to take us far afield from the semicommons, the genius of the semicommons solution similarly resides in its capacity to render the implications of stratagems unclear, and hence deter them.

CONCLUSION

Our tour of the commons, anticommons, and semicommons has revealed a number of connections among these models, but the overarching theme of scale deserves special emphasis. Property forms attempt to match the scale of the relevant activity, but resources are often used in multiple ways, spillovers are ubiquitous, and privately and commonly owned elements are always interacting. The commons literature highlights one facet of this interaction: the mismatch between private and collective returns to a given act.

The anticommons shows us how difficult it can be to solve a commons problem through a rearrangement of property rights, as well as how difficult it can be to undo any solution that we manage to cobble together. While these are interesting points in their own right, we must ask why all this assembly – whether of consent to a consolidation of property interests, or of forbearance with respect to a common pool resource – is necessary in the first place. The answer involves changes over time in the efficient scale of activities. Regardless of whether a contemplated move will involve more individually owned property or more commonly owned property, getting those who hold a stake in the resource to agree to the shift can implicate the anticommons holdout dynamic.

Our understanding of both the commons and anticommons can be enriched by the semicommons analysis, which highlights both the problems associated with using resources on multiple scales and the potential efficiency of this arrangement when undertaken in conjunction with strategy-proofing measures. Incentive-compatible mechanisms not unlike those used in the spatial semicommons can help to build reversibility into property arrangements so that activities can be pursued at different scales not only concurrently but also consecutively.

NOTES

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1. The anticommons was first conceptualized by Frank Michelman (1982, 6, 9; 1985, 6–7) and later adapted and applied by Michael Heller (1998; 2008).
2. The term 'semicommons,' as used in this chapter, was coined by Henry Smith (2000) to refer to interacting private and common property uses. A different usage appears in Levmore 2002, S422 (referring to a system of 'open access and restricted use').
3. A recent paper modeling the relationships among these three templates is Bertacchini, De Mot & Depoorter 2009. Scholarship addressing the relationship between the commons and the anticommons includes, for example, Michelman 1985; Buchanan & Yoon 2000; Hsu 2003; Fennell 2004; Munzer 2005; Vanneste et al. 2006; and Heller 2011.
4. For example, Heller (2001) characterizes the anticommons as a fourth 'ideal type,' that can take its place alongside private property, common property, and state property, while recognizing that real-world property systems often combine elements of these types. See also Heller 2011, figs 3.2 & 3.9 (presenting the commons and anticommons as different ends of a spectrum that has private property at its center).
5. The issue of multiple scales has been closely associated with the semicommons (see, e.g., Smith 2000; Bertacchini, De Mot & Depoorter 2009), and scale also receives extensive attention in Ellickson 1993. Other discussions of scale as it relates to the ownership and use of property include, for example, Lueck 1989, 300–303; Heller 1999, 1221–22; and Sinden 2007, 556–61, 585–93.
6. Antecedents to Hardin's analysis, including the work of Aristotle, are noted in Ostrom 1990, 2–3.

Important economic treatments of common pool resources include Warming 1911 [1983]; Gordon 1954; Demsetz 1967; and Cheung 1970.

7. The literature on resource dilemmas is vast. For some examples see Ostrom, Gardner & Walker 1994, 8–15 (discussing 'appropriation' and 'provision' problems); Libecap & Smith 2002 (overextraction of oil); Thompson 2000, 250 ('overdrafting' of water); Ellickson 1993, 1326 (overharvesting and shirking in communal farming); Eggertsson 2003, 76–78 (discussing 'supply side' and 'demand side' effects of open access regimes). The distinction between 'resource units,' such as fish, and 'resource systems,' such as fisheries, is emphasized in Hess & Ostrom 2003, 121; see also Lueck 2003, 202 (distinguishing between resource 'stocks' and 'flows').
8. See, e.g., De Alessi 2003, 91 (observing that '[o]pen access does not present a problem as long as the supply of a resource is so great relative to the demand that there is no (net) gain from conserving or improving it'); Rose 1986, 717–18 (discussing 'plenteous' goods); see also Epstein 1994, 28 (observing that when water is abundant, diversion may 'produce private gains that exceed the losses to the commons').
9. Carol Rose (1986, 767–70) refers to the potential for such interaction and associated spillovers as 'the comedy of the commons.' She notes, however, that a risk of underinvestment exists that might be countered by legal doctrines that help to encourage rather than discourage such participation. See ibid. at 768–71.
10. See, e.g., Ostrom, Gardner, and Walker 1994, 15–16 (characterizing 'suboptimal outcomes' and the capacity to improve matters through 'institutionally feasible alternatives' as preconditions of a common-pool resource dilemma); Michelman 1985, 5–6 (observing that 'degradability' is required for a 'supposedly tragic common').
11. Tragedies of the resource-gathering commons are not limited to 'fixed pot' resources, although they may receive special attention in that context. See, e.g., Posner 2007, 36 (discussing wasteful competition to recover treasure from a shipwreck); see also Anderson & McChesney 2003, 5 (discussing wasteful competition for open-access resources).
12. The Prisoner's Dilemma captures the choice faced by each of two prisoners who are questioned separately about their joint crime and must decide whether to stay silent (cooperate) or testify (defect). Under the payoff structure presented, each player does better by defecting, regardless of what the other prisoner does, even though the pair would do better jointly if both cooperated. See, e.g., Baird, Gertner, & Picker 1994, 33–34; Goetz 1984, 8–17. The structural equivalence between the Prisoner's Dilemma and the tragedy of the commons has been frequently noted. See, e.g., Ostrom 1990, 3–5; Baird, Gertner, & Picker 1994, 34; Michelman 1985, 9. Even though institutional arrangements can change the game and forestall tragedy (see Cole and Grossman 2010), it remains useful to frame the baseline incentive structure that prompts such arrangements as a Prisoner's Dilemma.
13. For similar applications of the Prisoner's Dilemma to the overgrazing problem, see Baird, Gertner, & Picker 1994, 34; Ostrom 1990, 3–5.
14. Consistently with much of the commons literature, I use 'private' here to designate individual ownership, even though commonly owned resources can also be 'privately' held by the commoners. See Krier 2009, 144–45.
15. See Lueck 2003, 202 (discussing appropriation of resource units from commonly owned stock).
16. See Alchian & Demsetz 1973, 22–23 (describing the problematic 'incongruity' between ownership forms that exists whenever a resource can be converted to private ownership by removing it from a communal resource system). The significance of the juxtaposition of private and common ownership to resource dilemmas has also been noted in, for example, Krier 2008, 11 & n. 29; Lueck 2003, 202; Heller 1998, 675 n. 246 (with attribution to William Miller); and Gordon 1954, 135.
17. See supra note 5 (collecting citations relating to scale).
18. In order to get all owners to agree to unitization, however, a form of partitioning – dividing the resource into different physical areas or temporal phases – may be used, despite its potential to pull incentives out of alignment. Libecap & Smith 2002, S590–91; S597–S606.
19. In the oil and gas context, many jurisdictions have addressed these difficulties through compulsory unitization laws that permit a specified majority to impose unitization on dissenters – a solution that carries its own risks. See Libecap & Smith 2002, S596, S606–07; see also Mohan & Goorha 2008 (analyzing the potential for ex post bargaining and hold-up problems in incomplete unitization contracts).
20. See Demsetz 1967, 356 (making this point in the context of a dam that affects a neighbor's water levels), cited and discussed in Krier 2009, 141; Rose 1998a, 95 (noting land's adjacency 'to other resources, notably air, water, and wildlife stocks,' that 'are considerably more difficult to divide into individual properties'); Sinden 2007, 556–61, 586–93 (emphasizing the problems that larger-scale phenomena, such as ecosystems, present for private property solutions).
21. These strategies can be carried out through a variety of institutional arrangements. See, e.g., Ostrom 1990, 8–21 (critiquing the dichotomy between governmental and private property solutions and suggesting that

local institutional arrangements offer an alternative); Heller 2008, 24 ('There are three distinct approaches [to commons tragedies]: privatization and markets, cooperative engagement, and political advocacy and regulation.').

22. See Ostrom 1990, 8–9 (discussing potential role of 'Leviathan' in resolving commons tragedies).
23. This basic approach equates to Pigouvian taxation, which endeavors to bring the net private and social impacts of a given action into alignment through state-imposed taxes or subsidies. Pigou 1932, 172–203. Because taxes are coercively imposed, they too might be classed within Hardin's 'mutual coercion' prescription. See, e.g., Krier 1992, 334–35.
24. See Smith 2000, 162–63 (discussing how boundaries may operate not only as prices but also as 'sanctions' that produce a large discontinuity in payoffs).
25. As Krier (1992) notes, this puzzle has long been recognized in the literature. See ibid., 338–39 n. 44 (collecting citations). For more recent discussions see, e.g., Krier 2009; Rose 1998a.
26. See Michelman 1985, 6–7 (defining and discussing the 'anti-common'); Ellickson 1993, 1322 n. 22 (referencing the 'anticommons' and attributing the idea to Michelman 1982).
27. See, e.g., Heller 1998; Heller & Eisenberg 1998; Heller 2008. Some scholars have questioned the fit between the theoretical anticommons problem and various real-world phenomena, especially with respect to patents. See, e.g., Epstein & Kuhlik 2004; Mann 2005, 999–1009; Walsh et al. 2005; but see Heller 2008, 66–69 (discussing and critiquing conclusions drawn from Walsh et al. 2005).
28. Heller (2008) suggests that anticommons or 'gridlock' problems have become more prevalent because '[t]oday, the leading edge of wealth creation requires assembly.' Ibid., xiv.
29. For a contrary view and a narrower reading of the term 'anticommons' see Katz 2010: 104–11. The point in the text is a functional one based on the typical structure of the problems that have been associated with the anticommons tragedy. See Fennell 2004, 933–64 (advocating and developing a functional taxonomy that eschews some of the distinctions that have been drawn between commons and anticommons tragedies).
30. It is an empirical question whether anticommons dynamics are more likely to block moves from private property to common property than moves in the opposite direction. For discussion, see infra note 35 and accompanying text.
31. Goetz (1984, 35–36) explicitly associated Chicken with land assembly problems, which have in turn been identified as an important category of anticommons tragedies (see, e.g., Heller 2008, 107–21).
32. This insight (without the Chicken label) was captured in Demsetz 1967, 354–55 (explaining that an effort to solve a commons problem by mutual agreement may be blocked by a 'hold-out' who, in the meantime, retains 'the right to work the land as fast as he pleases'). See also Krier 1992, 335–36 (discussing Demsetz's work and presenting an example involving excessive tree-chopping, in which '[e]ach chopper is effectively a monopolist whose agreement is essential to saving any trees'). But see Wyman (2005, 132) (suggesting that solutions to resource dilemmas are less vulnerable to holdouts than Demsetzian accounts assume because '[i]n practice . . . the collective-choice rules for altering property rights rarely require unanimity among the affected parties').
33. This argument rests on the 'Humpty Dumpty' claim that assembling fragments is more difficult than breaking apart unified entitlements. See, e.g., Heller 1999, 1169; Parisi 2002.
34. Entitlements can also be made more easily reversible by design, as through the use of liability rules that effectively extend a call option to nonowners. See, e.g., Morris 1993, 852; Calabresi & Melamed 1972, 1092, 1107.
35. Whether there is an asymmetry in the ease with which these two kinds of moves can be accomplished is an interesting question. Experimental work by Vanneste et al. (2006) found that people playing board games in three-person groups behaved less cooperatively in wielding the right to hold out than in accessing a common pool resource. These results might suggest that the form of ownership or problem frame is psychologically significant. Ibid. 117; cf. Andreoni 1995; Nash 2009. That fact might bear in turn on people's relative willingness to agree to moves from common to private property and vice versa. However, the very attempt to assemble agreement might itself cause interests in a commons to be recast psychologically as private property rights.
36. See, e.g., Michelman 1985, 13 ('[A]ny practicable, real-world so-called private property regime must contain large doses of both common and anti-common.').
37. In later work, Smith (2005; 2008) has suggested that other, differently managed resources – telecommunications and water – share the semicommons structure. Other authors have employed the semicommons in other contexts. See, e.g., Heverly 2003, 1164–83 (information); Loren 2007, 274–79 (creative works); Fennell 2008, 1102–03 (neighborhoods and metropolitan areas).
38. The text refers to multiple efficient scales that abut each other in time rather than space. A different facet of the relationship between time and the semicommons involves the use of rotation systems and similar mechanisms to avoid strategic behavior, providing a temporal analogue to the scattered farming strips. See Smith 2000, 165–66.

39. For a discussion of the adaptation of systems over time to changing conditions, such as the transportation advances that made the medieval open-field arrangement unnecessary, see Janssen, Anderies, & Ostrom 2007.
40. Doctrines that limit the degree of fragmentation that can occur in the first place can also serve to address reconfiguration challenges over time (see Heller 1999, 1176–82; see also Ellickson 1993, 1374; Michelman 1982, 15–16).
41. This family of approaches has inspired a large literature and presents numerous complications. For example, obtaining truthful valuations will only be possible if certain design parameters are satisfied (Plassmann & Tideman 2009).

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