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SEEKING POLICY RESILIENCE: POTENTIAL METHODS TO AVOID THE TRAGEDY OF THE ANTI-COMMONS WITH APPLICATIONS FOR INTERNATIONAL LAW

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Speech to International Law Colloquium at the University of Tokyo

1 INTRODUCTION TO ANTICOMMONS

1.1 Why I Investigate Anticommons

Greetings, I am Roy Andrew Partain, Chair and Professor of International Law and Sustainability at the University of Aberdeen and a Visiting Professor of Law at Kobe University, in the Graduate School of Law and in the Faculty of Law.

At my core, I am a researcher of Law & Economics, having formally trained as both an economic theorist and as a lawyer and legal researcher. I study how to undertake legal research using formal or mathematical structures to illuminate the inner working of legal ideas.

At different points in my career, I have been both a professor of economics and a professor of law. I have also worked professionally as a computer programmer, so I have a great interest in algorithm-based decision making, and as follows, in social choice theory and formal group decision making, such as at legislatures and by panels of judges or juries. This leads me to study

how those groups and committees, *empaneled legislators as it were*, interact to create law, especially international law, especially in strategic settings.

My research has long focused on policies in support of international law and of sustainability. It is in this regard that I hope to speak with you today, to speak of the potential risks of Tragedy of the Anticommons in international law and to speak of hopeful pathways to avoid this Charybdis of legal policy, to avoid a dangerous trap that few can escape.

1.2 Of Anticommons and Law

Twenty years ago, Professor Michael Heller, of Harvard Law, introduced the idea of an Anticommons to legal scholars and suggested how its mechanisms might lead to tragic underutilization of resources or assets.

An Anticommons can be created when multiple actors, each and individually, possess rights to exclude the use of a common resource. When each actor pursues their own individual self-interest, a great waste of underusage or abandonment of the resource will occur. And let me emphasize the word will, not might, not could, but will occur.

In legal settings, we can speak of regulatory Anticommons, wherein multiple political actors all hold powers of non-approval over a common activity. Failure to gain all the necessary approvals, (*as in the 3/4ths majority requirements of Art III (2) for Art V decisions under the International Convention for the Regulation of Whaling, such as to lift the in-place moratoriums*) or to prevent all potential vetoes (*as in the United Nations Security Council's need for Article 27 'all affirmative' votes*), means that a desired activity will not occur; the Tragedy of a Regulatory Anticommons implies that when a regulatory Anticommons exists, that a desired objective will be under-approved and thus a welfare loss will result.

Thank you very much for listening to me, and I hope we will find many new paths of research together.

1.3 The Basic Anticommons Mechanism

Heller defined the Anticommons as a group of owners, each possessing an exclusionary right to prevent other parties from using a common resource. Unless all of the holders of the exclusionary rights agree to allow use of the resource, the resource cannot be used.

At the very core of the Anticommons is a very simple idea:

A group of individuals exists, they are a club. And in that club, each person has been granted a special privilege, the right to exclude new members from the group. If a new person wants to join the group, they need to gather a card from each member, a complete set of cards means you get to join the club.

But gathering the cards is not easy. Each member of the group can set their own price, or test, for obtaining the approval card from him or her. A member can simply say no, setting her price at infinity. Each member independently decides on his or her own price. They all realize that not every potential new member will be able to afford all of the prices, or pass all of the tests, that some applicants will fail to join.

What the Tragedy of the Anticommons reveals, is that if the club members continue this process in independence from each other, fewer people will get to join the club than if the same club of members coordinated on a singular admissions price or test.

If the club is deciding who gets to use a resource, then the resource will go underused, or at the limit, not used at all. This creates a loss of social welfare.

2 TRAGEDY OF THE COMMONS – BORN IN INTERNATIONAL LAW

Let us take a quick step back, to remember the more famous Tragedy of the Commons. For its origins lay in international law, too.

It is often forgotten that the well-known Tragedy of the Commons actually began as a discourse on the need for International Law as a substitute technology, to replace the limited capabilities of scientific and engineering efforts to ‘win’ the Cold War’s nuclear competition. Hardin’s original

tragedy was not in fish nor pastures, but rather in the 'market failure' for peaceful resolution of the nuclear antipathies of that era.

Hardin writes, in the first paragraphs of the article, that he wrote "The Tragedy of the Commons" in response to an article on nuclear war and that article's conclusion that certain social problems were technologically intractable, insolvable, by rational or scientific means.

Hardin demonstrated an example of such a tragically unsolvable problem, the eponymic 'Tragedy of the Commons', originally a pastoral Commons beset with many herds of cattle, and then went on to use this new model to discuss the ecological implications of overpopulation for international environmental law and international human rights perspectives and how they met the necessary incidents of that new model, that of the Commons.

So, international law was there at the very beginning of the logical model known as the Tragedy of the Commons.

3 ANTICOMMONS IN INTERNATIONAL LAW?

The idea of the Tragedy of the Anticommons was originally described by Heller as a concern of property law. Anticommons were first identified in immovable property and in divided agricultural land holdings, and then in patent law and intellectual property management, and then onto other notions of property law.

But today I will discuss the application of the notion of Anticommons to International Law. This is a feasible approach, for the origins of the Anticommons are not actually in property law, they are in economics and game theory, which have already found many applications in international law, international relations, and diplomacy.

My interest in the Tragedy of the Anticommons, and its potential applications in international law, was piqued by the problem of addressing international law in response to the challenge of climate change.

In particular, I had worked on what is called the Green Paradox problem, wherein it is worried that international conventions for green energy policies (*such as those envisioned the 1992 United Nations "Conference on Environment and Development" (UNCED) – "Earth Summit, from which the UN Framework Convention for Climate Change and the UN Convention to Combat*

Desertification emerged) could 'tragically,' albeit in a foreseeable and mechanical manner, lead to an interim boost in harmful carbon emissions. Thus, a paradox could result. Green energy policies could worsen climate change.

This area of study was very complex, multi-disciplinary, and had left me wondering if there weren't better answers. Economists and policy makers had found ways to draft policies that could reduce carbon emissions and reduce the overall risk of climate change, yet, globally we remain on a track path of higher carbon emissions every year. We scholars, if I may speak collectively, had even found the means to identify which technologies and energy industries would be robust to overcome market and policy reluctance, so that green energy policies could become the dominant path of energy supplies in a short-enough, quick enough, time period.

Nevertheless, the hope that green energy technologies would gain more support in policy and from governments, has been met in contrast with political acts contrary to the drafting intents of the international agreements on climate change law, such as the UN Framework Convention on Climate Change, the Kyoto Protocol, and most recently, the frustrated Paris Agreements.

The efforts to control international law on climate change and related investment treaties and energy treaties … all of them were exposed to this risk of strategic political action.

One wants to research solutions to this problem too. But there were too many different models from game theory, too many models from economic research. What could international lawyers do?

That said, the more I learned of the formal models and empirical studies from the Tragedy of the Anticommons, the more I realized that this novel legal approach provided key insights into a wide array of problems in international law.

The Tragedy of the Anticommons model can be applied to any bilateral treaty, wherein compliance from both parties is required for the treaty to be functional. An example of this could be the Intermediate-Range Nuclear Forces Treaty (INF Treaty)[1] between the United States and Russia. Non-compliant behavior from one party can result in the treaty failing to achieve its objectives. If one party defects from compliance, the effect of the treaty is likely null; thus, either party has the ability to exclude the other party from enjoying the benefits of the Treaty's objectives.

[1] Formally, the Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of Their Intermediate-Range and Shorter-Range Missiles

The Tragedy of the Anticommons can also be applied in multi-party treaties (*or multilateral treaties in legal language*) or conventions, wherein the absence of a party may threaten the function of the compact; this dysfunction could be partial or complete. An example of that application is the present Joint Comprehensive Plan of Action (*JCPoA*), between Iran, the P5 + 1 (*namely China, France, Russia, the United Kingdom, and the United States; plus Germany*), and the EU; the absence of one party might so reduce the function of the objective of the JCPoA that it might fail altogether, eventually.

The tragic results can be a diminution (reduction) in the effectiveness of international law to achieve its objectives or they could include the complete frustration of international law.

ERGO, the goal of this presentation is to provide researchers in international law with:

i. a solid understanding of the underlying model and causes of the Tragedy of the Anticommons;
ii. a background in how to identify when a scenario may match the model;
iii. a review of early empirical research on the model;
iv. a review of theoretical (formal) means and hypothetical observations on how a Tragedy of the Anticommons might be avoided;
v. an understanding that the Tragedy is not always tragic, it might be strategically implemented;

and in conclusion, a review of what this all might mean for new pathways for researchers in international law.

4 What is Known of the Tragedy of the Anticommons

4.1 Are there Solutions?

While Heller is credited with discovering, or rediscovering, the Tragedy of the Anticommons, initially publishing two articles in 1998, the Tragedy of the Anticommons had actually been suggested by Frank Michelman back in 1982, who observed an argument in symmetry. The previously hidden symmetry lay in property law, that such a particular decomposition of ownership

rights could occur, given other ‘similar’ modes of fragmented property rights, that could create the opposite of a Commons.

But the actual discovery of the central mathematical mechanism did not occur twenty years earlier, but almost two hundred years ago, in 1838 by Cournot in France and in 1839 by Ellet in the United States. It lay in their models of complementary oligopolies – and those models are now routinely involved in antitrust and other areas of law. So, both lawyers and economists have some experience with the Anticommons, although they did not recognize the broader legal implications until Heller’s identification of the Anticommons paradigm.

As it turns out, the mathematical structures of the Commons and the Anticommons are duals, they are deeply similar in their abstract nature. Knowing that there are solutions to one directly reveals that the other will have solutions too.

Elinor Ostrom won the Noble Prize for Economics in large part due to her research in finding solutions to overcome the Tragedy of the Commons. It turned out that it wasn’t so tragic after all, that communities around the world had found or created their own institutional rules to manage the challenges of their local Commons, to prevent the wastage and ruin of the resources. That’s not to say that there remains no risk, no, the risk clearly remains to be addressed and each Commons will need its own bespoke solution. But we no longer need fear Hardin, that the solution is intractable, that doom awaits us all.

Similarly, the notion of the Anticommons will eventually yield to solutions. Some are already suggested, but research on Anticommons is much newer than it was for the Commons. There remains much to do, especially with regards to those Anticommons that we find in legal research, and doubly so for those Anticommons found in international law, international relations, political law, and in the affairs of diplomacy.

4.2 State of Current Anticommons Research

There are a variety of Anticommons models, each designed to test different versions of the core model. We have learned a lot from the various models, and I would like to report on these learnings to you here in summary:

1. We have learned that the Tragedy of the Anticommons fundamentally is the same result as Cournot's models of complementary oligopolies and of firms competing with complementary goods, these models originated in the early 1800s and are well understood, *at least* by economists;
2. The core problem in the Tragedy of the Anticommons is one of Pigouvian positive externalities;
    a. "The Tragedy of the Anticommons is the result of common resources remaining idle even when there could be some net social benefit. It occurs simply because the multiple holders of exclusion rights do not fully internalize the cost created by the enforcement of their right to exclude others"[2]
    b. The positive externality of coordinated production is ignored in the math of self-interest and utility/profit maximization;
    c. In contrast, the Tragedy of the Commons has a core problem of negative externalities;
3. The Tragedy of the Anticommons is systemic and rational; its underuse of resource is embedded in the mathematical structure of the game – it is not a result of psychology, of contextual framing, of behavioral economics, or of human weaknesses – it is a calculated mathematical result given the standard model;
4. Anticommons are created when multiple inputs to a process are complementary, meaning that the process cannot happen nor complete without the full set of inputs;
    a. This is equivalent to saying when a group of actors all have individual rights of exclusion to a common resource
    b. Each actor's exclusionary right(s) needs to be unconstrained when examined in social settings; similarly, the inputs must actually be complementary in nature
5. The inputs need not be perfectly complementary, but the more complementary they are, the worse the effects of the Anticommons will become;
6. Inputs can be complementary in both horizontal and vertical senses.

[2] Parisi, Schulz, & Depoorter 2004, 176.

   a. Horizontal means simultaneous, at the same time. Exclusionary rights can be simultaneous. Like coffee powder and water are needed to make coffee, both are needed at same time.
   b. Vertical means sequential, upstream and downstream. Exclusionary rights can be sequential. First you gain approval from Agency A, then you can get approval from Agency B, then you can receive permit to perform activity.
7. The more input that are required the worse the Tragedy of the Anticommons will become;
   a. Another way to say this, is the more actors that hold exclusionary rights over a process, the worse the Tragedy of the Anticommons will become
8. In modelling binary policy choices, economists rely on 'pricing competition' models of the Anticommons;
9. It is likely easier to fragment rights than to re-assemble them again – the 'Humpty Dumpty' rule:
   a. Transaction costs to dis-bundle rights to property are low in most legal systems
   b. Transaction costs to re-bundle rights to property are high in most legal systems
   c. In most cases, there will be an asymmetrical tendency to accumulate more Anticommons than 'solve' them by re-bundling the exclusionary rights; *eg, it is far more common that family farms disintegrate by inheritance into many smaller parcels than they rebuild small parcels into larger farms*;
   d. Anticommons will emerge in many systems, almost *as if* a function of time
10. Regulatory Anticommons exist and are readily modelled;
   a. Pricing models are a common model for regulatory Anticommons;
   b. Eg, agencies have overlapping areas of regulatory authority;
   c. Political science provides many logical reasons for decentralizing power across both horizontal and vertical axes of governments, so multiple vectors of Anticommons can arise
   d. Multiple reasons more difficult to cure than 'market-based' Tragedy of Anticommons events

11. Anticommons persist over the long run, they don't 'self-cure'[3]
12. Anticommons can be strategically good; sometimes they are an efficient means to protect certain resources or properties;
13. Early Empirical Studies and Results are Available
    a. Human actors find it more difficult to spot the circumstances of Anticommons than that of Commons
        i. Anticommons are waste of un-manifested events (missed chance),
        ii. Commons are waste of manifest events (ruined fish stocks),
    b. The larger the number of human actors with exclusionary rights, the worse the Tragedy of Anticommons becomes,
    c. Human actors frame the two Tragedies differently, and this cognitive bias results in worse reactions under the Tragedy of the Anticommons versus that witnessed in the Commons version
        i. No sense of loss from what never was, versus loss of previously exploitable Commons resource
        ii. "Disaster of Anticommons vs mere Tragedy of Commons?"

So there we have it, the basic toolkit for scholars of international law to identify and investigate incidents of the Tragedy of the Anticommons.

We have a working understanding of what the Anticommons really are at this point, and, we can connect that understanding to a wide array of legal ideas and concepts.

5 PREVENTING THE TRAGEDY OF THE ANTICOMMONS

There has been a Noble Prize in Economics awarded for work on solving the Tragedy of the Commons, and Elinor Ostrom's work in that endeavor opened broad new areas of research for legal scholars. It is useful to recall that the Anticommons is the dual of the Commons, so there will be solutions there too, one day. And although the research to solve and provide legal institutionals

[3] Ohkawa, Shinkai & Okamura 2012, 174 -176.

pathways to avoid or mitigate the Tragedy of the Anticommons remains in early stages, there are green shoots for us to examine.

5.1 Expropriation of Exclusionary Rights

Heller proposes that for Tragedy of the Anticommons cases of *full exclusion*, that governments or international organizations, such as the EU, could approve or coordinate the expropriation of the fragmented exclusionary rights back into a more unified bundle,[4] approaching a singular right of exclusion to reduce the amount of underuse.

Landry proposed, in the context of space law and property claims in 'outer space,' that a central international authority be established to re-bundle the allocation of exclusionary rights currently handled by a portfolio of treaties and related UN organizations;[5] he advocated that by rebundling the rights to assign property (in alignment with conventional "possession requirements")[6] that the authority could prevent future acts of fragmentation and thus preven t the creation of Anticommons in space.

5.2 Facilitation of Coordination

Parisi, Schulz, & Depoorter explain how Coase's theory of transaction costs suggest that under ideal conditions, that the actors ought to be able to re-organize and re-bundle the exclusionary rights to better align with the rights of usage to prevent the Tragedy of the Anticommons, but that those ideal conditions rarely exist and thus asymmetrical transaction costs are likely to prevent that rebundling of the exclusionary rights.[7]

In that case, a public authority or an international organization could facilitate a 'joint strategy' pathway with information, enhancing the awareness of the foreseeable welfare loss and of how various actors could improve their coordination to avoid the Tragedy of Anticommons.

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4 Heller 2013, 18.

5 Landry 2013, 566 -567.

6 Landry 2013, 567.

7 Parisi, Schulz, & Depoorter 2004, 183.

Gains from avoiding the welfare loss could be coordinated to incentivize the actors to coordinate, and that framework could be integrated into various compacts or conventions.

5.3 Resisting the Acts that Create Anticommons

International law could place importance on awareness of when Anticommons could be formed in (i) the fragmentations of exclusionary rights, (ii) the distribution of approval processes, or (iii) the creation of complementary legal processes to better enable that event to be done only when substantially warranted by the objectives of a treaty or convention.

Legal concepts such as prediality, 'touch and concern' in common law, and the *numerus clausus* principles from civil law all feature historical treatments to limit them to contractual rights versus property rights cum rights in realty.[8] Researchers of Anticommons have repeatedly emphasized the normative policy that legal policy makers, be they judges or legislators, strongly consider the development of rules that resist the fragmentation and disbundling of exclusionary rights.[9]

Beyond the historical accretion of legal rules to limit the granting of fragmentary acts of disbundling exclusionary rights, policy makers should focus on new rules that could more actively seek to time limit or reverse the process of fragmentation, especially when it occurs within a regulatory context:

> Theoretically, the Anticommons tragedy exists because it is a game theoretic coordination problem without a socially optimal dominant solution. Legally, the Anticommons tragedy continues to exist due to path dependency (Brunetti, 1991; Heller, 1998; Parisi et al., 2005). Rules involving statute of limitations, liberative prescriptions, and rules of extinction for non-use all work to reconsolidate fragmented property rights holders, but rarely have these been applied, or perhaps even could be applied, in a regulatory setting.[10] (Underscoring added.)

Thus, international law should be careful and observant at the moment that it creates the conditions of Anticommons and only so create when substantially necessary.

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8 Parisi, Schulz, & Depoorter 2004, 185.

9 Major, King, & Marian 2016, 261.; citing to Parisi 2002, without a pin-cite.

10 Krosnik 2012, 211.

Even then, safeguards to limit the longevity of those Anticommons can be included in the legal design of the convention to prevent the new Anticommons from becoming accidentally permanent or facing high transaction costs to remedy.

5.4 An Uber-Authority

Krosnik found three reforms might be of use to limit the negative efficacy of entrenched areas of regulatory Anticommons.

First, policy makers could "create a lead regulatory agency with primacy rights over" a particular regulatory concern.

Second, they could take action "to outright eliminate some of the duplicative, fragmented regulatory rights holders which weigh down the system," to declutter the number of actors to a much smaller set of actors.[11]

Finally, she recommends regulatory action to better facilitate cutting the Gordian Knot of Anticommons:

> The theoretical solution to any Anticommons tragedy is to coordinate the perspectives of disparate rights holders, either through force (the lead agency concept), diminution of the number of rights holders (organizational reform), or simply better communication, organization, and alignment of expectations of existing rights holders.[12]

Thus, Krosnik recommends a notion of super-ministry, a reduction in the number of agencies with overlapping regulatory zones, and efforts to facilitate coordination of the agency-actors.

5.5 Teamwork – the Lesson from Football Coaches

On a happier note, "Be a team player" might be the final anthem against all Anticommons ever, suggesting both a goal of a team win and the need for individual sacrifice, even if in a limited sense.

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11 Krosnik 2012, 212; see also the discussion, supra, at sec. 3.8.1, wherein Krosnik establishes that the welfare loss increases as the number of agencies increases.

12 Krosnik 2012, 212.

Many sports teams face the Anticommons Tragedy in every single game played in competition. As noted by Major, King, and Marian, a football team is composed of many excellent players who need to coordinate with each other's talents and skill sets to win as a team yet simultaneously need to maximize their own metrics and game-time data events, such as points scored by the player.[13] Each player knows that unless the team works together, and that each player yields on their personal optimal metrics, that there is a high risk that the team may lose and all players lose on fame and income. .[14]

Yet, every player knows that each player, especially professional players where income is all critical, is watching and maximizing their personal metrics and individual displays of greatness to best increase their career earnings, including from non-team income such as personal sponsorships and advertising.[15] Football teams face the Tragedy of the Anticommons in every professional game they play.

The challenge of coaches and team owners is to find a way to optimize both each player's own personal performance and to best ensure that the team actually wins the game. While I have yet to find a formal model of teamplay that can universally be applied to legal issues, it can be reassuring to legal researchers that many people have spent careers looking for ways to overcome hidden Anticommons problems; indeed, some have found the human condition enjoys coordinating to yield a bit in order to win as a team.

Almost as if Michelman were telegraphing hope to the reader, he provided a critique of Hardin's notion of tragedy, that it was its unavoidableness, based on humanity's incapacity to cooperate; Michelman counters that any notion of private property requires the existence of trust and of cooperation:

> In other words: no trust, no property. In the very survival of proprietary institutions we have empirical evidence of the possibility of trust; as we have in the electorate's behavior each election day.
>
> Short of absurdity, then, the metaphor of the Commons cannot speak to us more powerfully of the rational necessity of social cooperation than of its rational possibility. In this dialectic of necessity and possibility, private property emerges

13 Major, King, & Marian 2016, 251.

14 Major, King, & Marian 2016, 251.

15 Major, King, & Marian 2016, 251.

> as a possible device or instrumentality for social cooperation -- available, as such, only to agents *who have, in the first place, a capacity for cooperative action.* The initial premise has to be that of cooperative capacity; it cannot be the contradictory of that.[16] (Underscoring added.)

Perhaps the Behavioral Economists will have more to add as research evolves on how to best address the incentive packages, the mechanism design approach, to achieve more general solutions to the Tragedy of the Anticommons. But if there is anything to be true about international law, its very core, truly its *Coeur et Raison d'Etre*, is to facilitate that "rational necessity of social cooperation."

6 COMEDY OF ANTICOMMONS

Despite the discussion of Anticommons Tragedies, all is not lost, strategic underuse might be wise policy in some cases.

First, it is clear that the Anticommons is not always a tragic result, sometimes you want to protect resources or policies, and an Anticommons can act as a safeguard to resist action on those fronts without wholly preventing action.

Rose referred to the Comedy of the Commons,[17] that a Commons can sometimes be used in a socially productive manner, that it is not always a tragedy. Heller extended this idea, calling it a Comedy of the Anticommons, that overlapping areas of regulatory oversight might be an excellent way to securely protect a resource to which society does not want to make easily accessible. Quoting from Bertacchini, de Mot, and Depoorter;

> A number of scholars have suggested that an Anticommons regime is a desirable allocation of property rights when non-use of the resource is the preferred

16 Michelman 1982, 687 – 688.

17 *See* Rose 1986, 723.

> equilibrium; such as in the context of conservation management or environmental preservation of resources[18] (Underscoring added.)

And in the transition from socialistic governance to private governance, as occurred in Russia, has happened to some extent in China, and as we watch in Myanmar and North Korea, there is always a transition from abundant yet abused Commons towards private goods, it may be a conservative norm to consider how to leverage an Anticommons approach until the market is more vibrant and the government more resilient in effective governance of certain precious resources or policies.

As Parisi, Schulz and Depoorter noted, in alignment with Heller's historical settings of the Anticommons emergent in Russia, "[t]he transition from Commons to privatization, while beneficial in terms of the creation of private incentives for research, generates a gradual proliferation of exclusion rights with resulting Anticommons problems."[19]

Thus, one must be careful in becoming a Cassandra of the Anticommons, cursed by the God Apollo to see only doom in the future, as not all Anticommons are fully characterized as tragic, as they may well indicate a beneficial but incomplete capture of a useful resource space. The Anticommons can protect those resources that a community wishes to shield from over-usage or risk of depletion – it can be the beneficial reverse of the Tragedy of the Commons.

Even law itself can be handled in this manner, and as such, this is a lesson for the drafting of major international conventions and frameworks.

An example can be given from American constitutional law.[20] To add a new federal statute, most bills must pass votes in both the House of Representatives and in the Senate, then they must be signed by the President, and finally, not be overturned by the Supreme Court for any reason. This amounts to four actors, each with exclusionary rights to prevent passage of the statute.

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18 Bertacchini, de Mot, & Depoorter 2009, 171

19 Parisi, Schulz, & Depoorter 2004, 184

20 The account here follows from the process as described by the National Archives, who administers the process; available at https://www.archives.gov/federal-register/constitution . See also Article V of the US Constitution: "The Congress, whenever two thirds of both houses shall deem it necessary, shall propose amendments to this Constitution, … , when ratified by the legislatures of three fourths of the several states, … ."

On the other hand, amending the Constitution itself requires a super-majority passage in both the House of Representative and in the Senate (2/3^{rds} in both Houses), followed by a large group of States (3/4th, currently 38 of 50 states) to approve the new amendment (each state being its own internal Tragedy of Anticommons of multiple actors all needing to not exercise rights of exclusion), and finally, not be overturned by the Supreme Court. While not in perfect complementarity, as unanimity of the States is not required, this process would still require far more actors than those required to simply add new federal statutes.

The Comedy of the Anticommons can be seen herein as protecting the core legal institutions from rapid change. Change to the Constitution are 'guarded' by a larger number of exclusionary right holders than are efforts to change federal statutes. Similarly, this approach could be used to design flexible yet robust international legal conventions, providing rigorously for resiliency.

Thus, the Anticommons can be an asset to protect and steward key assets, assets that the public would prefer to have preserved and not used, in the default case of events. And these assets may very well be the legal institutions built and served by international law.

7 International Law and the Tragedy of the Anticommons

I understand that this speech has covered a lot of new ground and that much of it combined law and economics together, sometimes in ways new and complex. But it is my sincere hope that the audience today has learned more about an exciting area of research, the Anticommons.

The existence of an Anticommons can be useful or frustrating, depending on whether we are seeking the benefits of efficient resource usage or seeking to protect that resource by underuse.

International law clearly plays a role in both encouraging the use of certain resources, such as the Deep Seabed (also known as the Area) under the rules of UNCLOS, or protecting that resources from discouraging its use, such as the rules on protecting the atmosphere from harmful emissions, as seen in the UN Framework Convention for Climate Change and the Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer.

Where scholars of international law can focus, at least in the near term, is to try and identify where Anticommons phenomena are to be found. When considering how an international treaty works or operates, does it contain the necessary ingredients of an Anticommons?

i. **Multiple Inputs**: Are there multiple inputs, actors, or agencies involved in a process?
ii. **Anticommons mechanism**:
    a. Do the various actors have some type of exclusionary rights, can they block or prevent actions or decisions, or, do they have 'rights of necessary approval'?
    OR
    b. Are there procedures that need to happen together making something result, either simultaneously or sequentially?
iii. **Contrast of Singularity**: Can you see how things could be done better if all the actors (or inputs) coordinated as-if they were a singular entity (occurred altogether)?

If a legal researcher finds that questions (i) and (ii) can both be answered yes, then that researcher likely has an Anticommons on their plate. But the answer to question (iii) reveals what is lost by the presence of the Anticommons.

And these types of patterns are commonly found in international law.

i. Where one finds a committee that holds votes wherein one veto can derail a process, you have an Anticommons.
ii. Where you find a peace process that requires all parties to submit to a process, say allowing inspectors to examine something, and if breach by any party could breach and risk the loss of the accords, then you have an Anticommons.
iii. If you have an environmental treaty that attempts to gain controls over the emissions of a pollutant to a river, signed by parties upstream and downstream, but if it only takes only polluter to ruin the water, then you have an Anticommons.
iv. If you have an international process that requirements a process and approval (could be recognized as merely "completing" a process) from multiple authorities or NGOs, then you have an Anticommons.

And there are many more ways that the simple idea of an Anticommons can crop up in international law. Legal researchers should remain vigilant to spot them before the Anticommons become problematic.

Because the emergence of an Anticommons means the reduced use or the loss of use of a resource, or a reduction or elimination of the objective of a project in international law, it is very important for scholars in international law to begin to recognize them. Equally, when international lawyers are assigning rights in the design of a new instrument of international law, they must take care to avoid creating the elemental pieces of an Anticommons. And if those acts of disbundling are necessary and required to achieve the objective of that international instrument, perhaps to achieve peace, then the drafters should consider placing safety devices into those legal instruments, to limit the impact and longevity of those newly created Anticommons, much as Krosnik advised.

And it's important to recall that not Anticommons are 'tragic', as some can be used in wonderful ways to protect assets and institutions that our cultures and communities seek to safe-guard. We can truly speak of potential Comedies of the Anticommons.

In closing, I hope I have brought awareness of this interesting model of human interaction and of how it can connect to research questions in international law.

For me, it has been an honor to discuss these ideas with you here today at the University of Tokyo. I hope if you have any questions, that you will feel to reach me by email or by other modern technologies, so that I can assist you in finding and addressing Anticommons in international law, so that we can find solutions before they become Tragedies of the Anticommons.

I hope you will agree that the idea of the Anticommons is a useful research paradigm and tool for research in international law, but also, that sometimes ancient ideas should be revisited for their modern applications.

And who knows, maybe someone in this room will one day earn the Noble Prize, much as Elinor Ostrom did, for finding effective methods to contain and manage the concerns raised by the model of the Anticommons. Thank you very much!

Roy Andrew Partain
2019-06-22, Saturday.
Tokyo, Japan.

SEEKING POLICY RESILIENCE: POTENTIAL METHODS TO AVOID THE TRAGEDY OF THE ANTI-COMMONS WITH APPLICATIONS FOR INTERNATIONAL LAW

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1 INTRODUCTION

Twenty years ago, Professor Michael Heller introduced the idea of an Anticommons to legal scholars and suggested how its mechanisms might lead to tragic underutilization of resources or assets.

An Anticommons can be created when multiple actors, each and individually, possess rights to exclude the use of a common resource. When each actor pursues their own individual self-interest, a great waste of underusage or abandonment of the resource will occur.

But the idea of the Tragedy of the Anticommons was essentially described by Heller as a concern of property law. Anticommons were first identified in immovable property and in divided

agricultural land holdings, in patent law and intellectual property management, and in other areas of property law.

Since those seminal articles from 1998, the idea of Anticommons has been explored and explained in a wide array of economic models. Even the archaeology of the models have been explored, with roots found back to Cournot and Ellet in the early 1800's. The positive and formal models have been tested with experimental and empirical studies, which have validated the initial concerns raised by the formal models. The experimental studies found that when behavioral economics and other psychological framing issues were added to the basic 'mechanism of tragedy', the losses expected from Anticommons scenarios were exacerbated. The Tragedy of the Anticommons is real, both in a formal and empirical sense of the concept. The welfare loss can be put on a metric and measured. Yet, the concept remains underdeveloped in many areas of legal research.

In legal settings, we can speak of regulatory Anticommons,[21] wherein multiple political actors all hold powers of non-approval over a common activity. Failure to gain all the necessary approvals, or to prevent all potential vetoes, means that a desired activity will not occur; the Tragedy of a Regulatory Anticommons implies that when a regulatory Anticommons exists, that a desired objective will be under-approved and thus a welfare loss will result. Thus, the Anticommons has passed from a property law concept into a more broadly defined construct that can be applied to law and its institutions.

This article will discuss the application of the notion of Anticommons to International Law. This is a feasible approach, for the origins of the Anticommons are not actually in property law, they are in economics and game theory, which have already found many applications in international law, international relations, and diplomacy. The Anticommons too, can find their place among these other models of strategic behavior in the development of international law and in the furtherance of international institutions.

[21] Krosnik 2012, 211.

2 `DEFINING AND FINDING THE ANTICOMMONS TRAGEDY

Despite frequent coverage and the growing body of references to the concept of the Tragedy of the Anticommons,[22] it would appear that the basic formal models of the Anticommons continue to frustrate many scholars, who may have focused on only certain aspects of its totality:

> the concept of Anticommons has become a popular theme in law-and-society journals. Unfortunately, the concept is often applied imprecisely and without full understanding of the underlying strategic model.[23]

Many scholars have thought that the model, despite formal models to the contrary, were demonstrations of purely behavioral economics and of contextual framing. Those elements can certainly worsen the effects of the model, as will be covered later, but the formal models do explicitly provide for, and need no additional sourcing, for the grim mechanism at the heart of the Anticommons Tragedy:

> The Anticommons model, however, when rigorously applied, does not depend on private information, predatory threats, or negotiating skill. Rather, systematic suboptimality emerges from rational Nash calculations by separated actors all seeking to maximise their individual return. The critical point is that there is no

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22 Note on style, in this document the words Commons and Anticommons are handled as proper nouns and thus capitalized when appropriate. When recognized as proper nouns, they carry the specific and unique meanings as formally described in the economics literature, as in "ecologists are concerned about Commons and patent lawyers about Anticommons;" distinct from a more routine commons without the economic consequences, as in "the sheep are resting in the commons."

23 Major, King, & Marian 2016, 260.

> need to posit unfair strategic manipulation in order to generate multiple-player results at variance from the Pareto efficiency. [24]
>
> Anticommons is a unique form of inherent bundling suboptimality, with sufficient real-world applications that it safely can be distinguished from other occurrences of bargaining failure.[25]

A goal of this paper is to provide both an introduction and a functional survey of key learnings across the emerging Anticommons literature, to provide scholars with more accessible points of entry and better command of the documented features of the Anticommons models.

It is important for scholars to understand that there is a solidly demonstrated mathematical model that results in the economic notion of welfare loss, a model directly based on complementary oligopoly models from the early 1800's, wherein the simplest of assumptions of independent behaviour under strategies of rational self-interest results in an obvious sub-optimal level of usage of a resource. It is equally important for scholars to realize that human characteristics can worsen the results of that already tragic outcome. But key for scholars, is to understand that the basic phenomena of AntiCommons scenarios is as mechanically pre-determined and not, at its core, driven by anything but individually expressed rational self-interest.

2.1 Hardin: Background of Tragedy and of Commons

In this discussion on the Tragedy of the Anticommons, there are two terms to be considered, (i) 'Tragedy' and (ii) 'Anticommons.'

The first, 'tragedy,' is directly sourced to Hardin's well-cited and yet controversial paper, "Tragedy of the Commons," first printed in Science in 1968.[26] Although many researchers might

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[24] Major, King, & Marian 2016, 261..

[25] Major, King, & Marian 2016, 261..

[26] Economic models did already exist as did the notion of an exploited Commons. The idea of an exploited Commons can be sourced to Aristotle, as Heller cites from The Politics and the Constitution of Athens for an early example of how "shared ownership can lead to overuse" of the underlying property or asset. Heller 2013, 7. Further, it is now well recognized that Gordon had already presented an economic model on the depletion of a fishing Commons in 1954, with Scott's response following in 1955. Nevertheless, it is unavoidable fact of history that Hardin's article is

see Hardin's model as an economic model, he was in fact a professor of biology, and the subtitle of his paper was "The population problem has no technical solution; it requires a fundamental extension in morality," establishing a clear topic of *moral philosophy*. Hardin claimed that his paper was an investigation into the existence of a "class of human problems which can be called 'no technical solution problems.'"[27]

Hardin defined his concept of a 'technical solution':

> A technical solution may be defined as one that requires a change only in the techniques of the natural sciences, demanding little or nothing in the way of change in human values or ideas of morality.[28]

Hardin quickly moved to categorize the problem space as within Game Theory, drawing on models from Tic-Tac-Toe to Von Neumann and Morgenstern's text of *Theory of Games And Economic Behavior*,[29] and on to underlining a major thesis from Adam Smith's *The Wealth of Nations*,[30] which again, began as a moral inquiry.

Hardin cites Smith, without specifically attributing the notion to him, for the commonly held idea that.

> "he [Smith] contributed to a dominant tendency of thought that has ever since interfered with positive action based on rational analysis, namely, the tendency to assume that decisions reached individually will, in fact, be the best decisions for an entire society. If this assumption is correct, it justifies the continuance of our present policy of laisez faire… If the assumption is not correct, we need to

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the one that caught public attention and enabled the pastoral term 'commons' to become the preferred choice, versus Gordon's more technically useful 'common-property resource.'

27 Hardin 1968, 1243. This inquiry was in response to an earlier paper by Wiesner and York on the intractability of solving the Cold War's nuclear crisis via the development of ever more advanced technology, wherein they had claimed "Both sides in the arms race are … confronted by the dilemma of steadily increasing military power and steadily decreasing national security. It is our considered professional judgment that this dilemma has no technical solution. If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation." Id, with reference to Wiesner & York 1964, 27. (Underscoring added.)

28 Hardin 1968, 1243.

29 Hardin 1968, 1243.

30 Hardin 1968, 1244.

> reexamine our individual freedoms to see which ones are defensible." (Underscoring added.)

Hardin then went on to cite Whitehead's definition of dramatic tragedy: "(t)he essence of dramatic tragedy is not unhappiness. It resides in the solemnity of the remorseless working of things."[31] Thus, tragedy is defined as mechanical, a clockwork, a logical result of postulates and their iterations.

Thus, Hardin's concept of tragedy "resides in the solemnity of the remorseless working of things," particularly in the outcomes of "decisions reached individually," and implicitly those decisions calculated via Smith's notions of rational 'economic' self-interest and Von Neumann and Morgenstern's notions of expected utility maximization. Hardin saw a society of individual and independent decision makers, each according to their own algorithms of optimization, working as towards a public calculation of how to act at large – that public behavior is naught but a sum of many individuals and not that of an integrated public agency. Tragedy, in the sense of Hardin's Tragedy of the Commons and later in Heller's conceptualization, is a Greek fate, an unavoidable doom that arises from our freedoms to decide as we will. Hardin summarizes: "[r]uin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the Commons."

Hardin compared the behaviors underlying the Tragedy of the Commons to the acts leading to pollution. He listed several acts that presented models of costs of clean-up versus costs of emitting, that pollution resulted from private decisions to prefer the lower costs of emissions to higher costs of clean-up. He founds solutions to pollution in charging Pigouvian taxes to the polluter to effect decisions to prefer clean-up to the now costlier act of emission and in coercive

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[31] Hardin 1968, 1244. The original quote on "tragedy" from Whitehead: "Let me here remind you that the essence of dramatic tragedy is not unhappiness. It resides in the solemnity of the remorseless working of things. This inevitableness of destiny can only be illustrated in terms of human life by incidents which in fact involve unhappiness. For it is by them that the futility of escape can be made evident in the drama. This remorseless inevitableness is what pervades scientific thought. The laws of physics are the decrees of fate." (Underscoring added.) Alfred North Whitehead, "Science and the Modern World," in: Alfred North Whitehead: An Anthology (Cambridge University Press, Cambridge, UK, 1953), 372.

legislation with similar mechanisms.[32] In his earlier description of the herdsmen on the common pasture, he wrote of each herdsman recognizing that his own benefit of free pastoral lands came at cost to other, that his costs of pasture exhaustion were externalized to other herdsmen. [33] Thus, Hardin twice recognized the role of externalities, particularly negative externalities, in the creation of the Tragedy and in the act of creating pollution.

Hardin did list certain options as potential solutions to the 'inevitable' Tragedy:

(i) education to "counteract the natural tendency,"[34]
(ii) sell the Commons into private property, [35]
(iii) to retain the Commons but publicly govern the access to them, and,
(iv) in extremis, to legislate to prohibit access to the Commons, an imposition of prohibition. [36]

In somewhat counterpoint to the labyrinthian roots of Hardin's sense of tragedy, the root of the term Anticommons is there in Hardin's article but with less grandeur. He chose the word 'commons' as part of his intellectual narrative, in relying on an exemplar tale of a shepherd minding his flock on a pasture.[37]

"Picture," Hardin wrote, "a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the Commons."[38] The contours of the tragedy are sketched onto this pasture held in common by the local community. [39]

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32 Hardin 1968, 1245. It is of note that Hardin did not explicitly recognize the economic model fo Pigou in his article, but the notion was well established and is identical to Hardin's concept as used.

33 Hardin 1968, 1244.

34 Hardin 1968, 1245.

35 Hardin 1968, 1245.

36 Hardin 1968, 1245 – 1246.

37 Hardin refers to cattle, but in a bit a Jungian synchronicity, the actual term tragedy itself is derived from Greek, *trágos* + *ōidḗ* (τράγος + ᾠδή, 'male goat song'), which is a reference to the goat satyrs present within ancient tradegies and dramas. Thus, the word 'tragedy' itself harkens back to a pastoral Commons.

38 Hardin 1968, 1244.

39 Hardin 1968, 1244.

Thus, Hardin's Tragedy of the Commons began with a concern of how to identify if there are classes or categories of social problems that are cognitively or computationally intractable, thus the sense of tragedy. He began with a discussion on how to address the challenges of nuclear warfare, passed through a discussion on collective abuse of a commonly held pasture, and discussed global population dynamics and the risks they posed. The tragedy of the Commons that he focused on were issues of international law, even if we have ever since seen it primarily as a matter of environmental law.

2.2 Cournot's Models and Duality

Heller cites Antonin-August Cournot as one of the first economists to capture similar phenomena to the Tragedy of the Anticommons, in his models on complementary goods and services, dating back to 1838; Heller also evidences Ellet's independent discovery of the same issues in 1839.[40]

Cournot discusses a model of duopoly wherein "two firms selling identical products engage in quantity competition and each firm takes the other's output level as given in setting its own output level."[41] The products in question were copper and zinc, to sell to a bronze smelter. For Cournot, and others at the time, this discovery was seen as a theoretic first, in that a monopoly, previously viewed as the worst case in economic analysis for public welfare, was formally found to present less deadweight loss than this newer model of 'complementary oligopoly.'[42] As Krosnik tells the story:

> It was the first case in the literature where consolidation of market power was suggested as a welfare improving outcome. Cournot showed that aggregate welfare in this instance of a "complementary oligopoly" was actually improved if the complementary inputs were supplied by a single monopolist, rather than by competing and independent firms, as the monopolist would internalize any

40 Heller 2013, 20, with reference to Cournot 1838 and to Ellet 1839.

41 Sun & Liu 2017, 30.

42 Krosnik 2012, 206.

> negative cross-price effects from the inputs and arrive at a lower combined price.[43]

Thus, Cournot's model of two competing firms, but firms competing with complementary goods, was originally noted for its worse deadweight loss than the model of a monopoly. The model was notorious from its very beginnings; but it would take a while to become re-modelled as a multi-player models (beyond 2 parties), to be recognized as a type of game theory model, and for it to find a place with legal research. That would take the better part of a century.

Two chapters later in the same text, Cournot introduces a model of complementary monopolies, wherein two monopolies each produce a unique product that requires the other product; in Cournot's example, he has a copper producer and a zinc producer whose products are both needed to create bronze, so the buyers of metals from the two monopolies would need to pay for both products if they intended to make bronze. [44] As Sun and Liu note, Cournot demonstrates that "in equilibrium the sum of the two prices will generally exceed the monopoly price that would be set by a single owner of both goods." [45]

These models are similar, albeit one competing in goods and the other in prices. Back in 1968, Sonnenschein had highlighted that these two models were functionally equivalent,[46] as each model can be re-derived from the other model. Sonnenschein not only proved that the two models are dual in nature, but he also noted that Edgeworth, of Edgeworth Box fame, had found a critique of the duopoly model that could also, as a dual, be applied to the monopoly model,[47] that the model suggested the evidence of lost welfare – the very kernel of the Tragedy of the Commons, and by Sonnenschein's duality and as explicated noted by him, the same problem exist for the

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43 Krosnik 2012, 206.

44 Sun & Liu 2017, 30.

45 Sun & Liu 2017, 30.

46 Sonnenschein 1968, 316. The title of that article is so self-evident to its core research result, that one hardly needs to cite more than the title, "The Dual of Duopoly is Complementary Monopoly: or, Two of Cournot's Theories are One."

47 Sonnenschein 1968, 317. Edgeworth's of the duopoly model critique is summarized by Sonnenschein as, "[a]t a positive profit equilibrium, each duopolist can obtain a greater revenue by reducing his price a little and selling the quantity that clears the market (provided, of course, the other duopolist does not change his price." Id.

complementary monopolists and thus Sonnenschein might have been the first to present the basic mechanism underlying the model of the Tragedy of the Anticommons.[48]

Buchanan and Yoon demonstrated that Cournot's duopoly model reflects a tragedy of the Commons wherein two producers are allowed to extract from a common resource and Cournot's complementary monopoly model reflects a Tragedy of the Anticommons, reflecting a common 'underusage.'[49]

It is ever more clear from Cournot's models, and from the intellectual history of those economic models, that the intellectual structure of Hardin's Tragedy of the Commons and that of Heller's Tragedy of the Anticommons are ultimately two incarnations of the same core model.

2.3 Michelman

Parisi, Schulz, and Depoorter report that Michelman was the first to define those incidents now described as a Tragedy of the Anticommons. Michelman develops a sophisticated framework of property types, including private property (PP), a broadly defined Commons cum state of nature (SON), and the proto-type of an Anticommons, the regulatory regime (REG). The REG requires the authorization of all parties before a resource can be used, or read the other way around, each owner hold a veto or exclusionary right against all of the other owners.

> We need some reasonably clear conceptions of regimes that are decidedly not PP, with which PP regimes can be compared for presumptive efficiency. It will be convenient to have three of these before us:
>
> 1. *State of nature* (SON). In a state-of-nature (SON) regime there are never any exclusionary rights. All is privilege. People are legally free to do as they wish,

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48 Sonnenschein 1968, 317- 318; the observation was made on the first page with the proof presented on the second. Sonnenschein's article was published in March/April of 1968, eight months prior to Hardin's note and some thirty years prior to Heller's 1998 publication, ergo, Sonnenschein would not have been aware of the future value of his discoveries. For the record, he also did not comment on Gordon's and Scott's earlier papers, 1954 and 1955, respectively, on fishing Commons.

49 Sun & Liu 2017, 30.

> and are able to do, with whatever objects (conceivably including persons) are in the SON.'
>
> 2. *Regulatory regime* (REG). The converse of SON is a regulatory regime (REG), in which everyone always has rights respecting the objects in the regime, and no one, consequently, is ever privileged to use any of them except as particularly authorized by the others. (Rules for determining when such authorization exists may vary along several axes. At one extreme, authorization would require near-simultaneous unanimous consent; tending toward the other extreme would be a rule defining authorization as expressions of consent from any two persons occurring within the same twelve-month time span. The latter rule constitutes an REG: under it, each person always has a right that each of the others shall leave the covered objects alone except insofar as authorization is obtained.) [50] (Emphasis is in the source material, underscoring has been added.)

Heller's definition and Michelman's are not quite identical, as spotted by Parisi, Schulz, and Depoorter, in that Michelman's definition is universal in character, what they label "*full-exclusion* Anticommons" whereas Heller's definition is group-sized, labeled a "*limited-exclusion* Anticommons."[51]

2.4 Heller's Conceptualization of the Tragedy of the Anticommons

The literature on the Tragedy of the Anti-Commons is commonly held to have begun with Heller's seminal research on market behaviors in post-Soviet Russia.[52] He provided the first definition of an anti-commons in 1998:

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50 Michelman 1982, 665.

51 Parisi, Schulz, and Depoorter 2000, 5.

52 Heller 1998, 622-623. At a speech delivered at Google, Heller said that Igor Gaidar had approached Heller to ask him why so many Russian store fronts remained underused while the sidewalks in front of those same empty stores were filled with itinerant vendors. If so, perhaps some of the accolades for the identification of the existence of Anti-Commons could be shared with Gaidar for "spotting the issue" if not also the answer. Video available at https://www.youtube.com/watch?v=9n89Ec3DFtk .
See also , available at
https://changethis.com/manifesto/49.02.GridlockEconomy/pdf/49.02.GridlockEconomy.pdf

> More generally, one can understand Anticommons property as the mirror image of Commons property. In a Commons, by definition, multiple owners are each endowed with the privilege to use a given resource, and no one has the right to exclude another. When too many owners have such privileges of use, the resource is prone to overuse - a *tragedy of the Commons*. Canonical examples include depleted fisheries, overgrazed fields, and polluted air.
>
> In an Anticommons, by my definition, multiple owners are each endowed with the right to exclude others from a scarce resource, and no one has an effective privilege of use. When there are too many owners holding rights of exclusion, the resource is prone to underuse - a *Tragedy of the Anticommons.* [53] (*underscoring added.*)

With this definition, and a study of underused storefront in Moscow, began the modern metaphor for asymmetric structures of ownership and control.[54] In the same year, he and Eisenberg expanded the application of the model to intellectual property law and patent law policy in Science:

> Anticommons property can best be understood as the mirror image of Commons property. A resource is prone to overuse in a tragedy of the Commons when too many owners each have a privilege to use a given resource and no one has a right to exclude another.
>
> By contrast, a resource is prone to underuse in a "Tragedy of the Anticommons" when multiple owners each have a right to exclude others from a scarce resource and no one has an effective privilege of use. In theory, in a world of costless transactions, people could always avoid Commons or Anticommons tragedies by trading their rights.
>
> In practice, however, avoiding tragedy requires overcoming transaction costs, strategic behaviors, and cognitive biases of participants, with success more likely within close-knit communities than among hostile strangers. Once an

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53 Heller 1998, 623-624.

54 Heller takes credit for coining the term "Tragedy of the Anticommons;" "I coined the term *Tragedy of the Anticommons* to help make visible the dilemma of too fragmented ownership beyond private property. Just as the idea of underuse transforms the continuum of resource use, 'Anticommons' transforms the continuum of ownership." Heller 2013, 17. (Italics in the original.)

> Anticommons emerges, collecting rights into usable private property is often brutal and slow[55] (*underscoring added.*)

This definition expanded upon the earlier one by including reference to Coase's transaction costs theory of conflicting property rights.[56]

But the core to both definitions of the Tragedy of the Anticommons is a situation wherein rights of exclusion, or exclusionary rights, are held by many against the rights of ownership of a much smaller number of people, wherein Heller's earlier 'ownership' focus appears to be centered upon some sort of usufruct or "effective privilege of use."[57]

Heller has provided several refinements to his definition of 'commons.'

First, he separates the concepts of open access from group access.[58] Open access is a situation wherein no one is excluded from access to the resource, or no one has sufficient control to exclude anyone at all, and that includes the high seas under UNCLOS or of the air and atmosphere under the UNFCCC and the Montreal Convention.

Group access is a situation wherein not everyone, but a define group of actors, have sufficient control of a shared resource to exclude all other actors from that resource but that they cannot exclude members of the group from accessing it. Heller provides as example a small pond surrounded by a small group of landowners, who all have access to the pond, but each of whom might have sufficient fencing to exclude all outsiders from reaching and accessing the pond.[59]

Second, he reminds that while public property might sound like something held in common for the people, it often in fact has but a small number of decision makers, often just one, who decide how the property is to be used and how the exclusionary rights are to be operated.[60] Thus, public property is often functionally similar to private property but with the social public as its rightful, albeit limitedly, occupant or enjoyer. [61]

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55 Heller & Eisenberg 1998b, 698

56 Add citation to both original radio waves article and later article of Coase.

57 *See* Heller 1998, 623-624; *see also* Heller & Eisenberg 1998b, 698

58 Heller 2013, 14.

59 Heller 2013, 14. He also suggests the shared mews of Notting Hill, in London, and of New York City's Grammercy Park. Id.

60 Heller 2013, 15.

61 Heller 2013, 15.

So this approach results in private property, group access property, public property, and open access property, all with distinguishable stakeholders and different approaches to how exclusionary rights operate over the property.

Heller provides the Anticommons parallels for the above observations on the modalities of Commons. *Open Access* is paralleled by *Full Exclusion*; wherein an unlimited number of people each have the right to block each other.[62] A key problem, however, is that spotting or identifying underuse of a full exclusion resource can be much more difficult than spotting the wastage of an open access resource [63] in part because likely that underuse has long been in place and thus ambient to our expectations of usage.

Group Access is paralleled by *Group Exclusion*; wherein a limited number of actors can exclude each other from a resource. Examples of this include "corporations, partnerships, trusts, condominiums, even marriages."[64]

Given these terms, Heller presents a prism of five levels of property, each with varying levels of access and exclusion, with only the middle three availing themselves to cooperative and market-based solutions to avoiding the dual tragedies of Commons and Anticommons.

Table 1: The full spectrum of accessible and excludable property

	Zone of Cooperative and Market-Based Solutions			
Open Access	Group Access	Private Property	Group Exclusion	Full Exclusion

2.4.1 Caution on Overinclusion of Commons and Anticommons

Fennell warned that many scenarios that at first glance might appear to have an ownership structure that could result in Tragedy of the Commons or Tragedy of the Anticommons might not actually

62 Heller 2013, 18.

63 Heller 2013, 18.

64 Heller 2013, 18.

the necessary elements to result in either form of tragedy.[65] She posits that the economic concepts of 'rivalrous/nonrivalrous' goods and services and 'excludable/nonexcludable' may change the play of the mechanisms so that no tragedy in fact results.[66]

It is perhaps tautological to argue that nonexcludable goods would be difficult to place within an Anticommons setting, as one wonders how an actor could obtain exclusionary rights to a good or service that is inherently nonexcludable. So, excludable goods can be found in Anticommons but not their cousins the nonexcludable goods.

It is more complex how the condition of being rivalrous, nonrivalrous, or even antirivalrous would have to do with Anticommons. A rivalrous good is one that is difficult for two parties to enjoy simultaneously; its consumption is in some sense an exercise of an exclusionary right to other potential consumers. Yet, a rivalrous good remains in that state permanently, that is not an exercise of a right, not per se. On the other hand, five people might jointly own a rivalrous good, each with the ability to exclude any of the others from enjoying that rivalrous good. In such a case, an Anticommons would result.

A nonrivalrous good is simply a good that one, two, or more folks can enjoy without necessarily preventing the use of others. But nothing in that definition would necessarily prevent a group from again holding it as an asset in common, with each other having a right to exclude any person from accessing the commonly owned nonrivalrous good. An Anticommons again forms.

So, perhaps Fennell's real warning is focused on nonexcludable goods.

2.5 Varieties of Definition, Legal and Economic

Since Heller introduced the concept of the Anticommons, other scholars have proceeded to find useful ways to characterize the phenomena to facilitate its recognition in a variety of circumstances.

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65 Fennell 2004, 918-919. Fennell's examples are drawn from intellectual property, such as knowledge of a musical score, and from public television broadcasts, reflecting that consumption of both prevents no one else from also fully consuming their full without any loss of the basic resource from the public at large. Id.

66 Fennell 2004, 918-919.

Perhaps the cleanest alternative definition comes from Major, King, and Marian, focusing on the strategic thoughts of the actor:

> The core prerequisites are merely that each actor knows that there are several necessary complementary inputs, that she controls at least one of them, and that successful bundling of all inputs will generate positive benefits available for allocation, giving rise to a non-cooperative strategic game.[67]

The focus drawn here is (i) the existence of multiple necessary but also complementary inputs, (ii) that she controls the exclusions or withholding rights over at least one of those inputs, and (iii) a reality that full inclusion of all of the inputs will result in the maximum amount of 'benefits,' which could be (but might not be) re-allocated back to each actor. Individualistic, selfish pursuit of this game will then result in output levels lower than if all possible inputs were included in the process. But focusing on the key issues are (i) exclusionary control (ii) over complementary inputs (iii) for a potentially collective or multi-input process. [68]

2.5.1 Focus on Mismatched Topology of Rights

In explaining their empirical studies of the Tragedy of the Anticommons, Van Hiel, Vanneste, and De Cremer implemented a Venn-diagram approach to define the Tragedy of Anticommons while simultaneously reflecting its symmetry with the Tragedy of the Commons.

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67 Major, King, & Marian 2016, 151.

68 Major, King, & Marian 2016, 151.

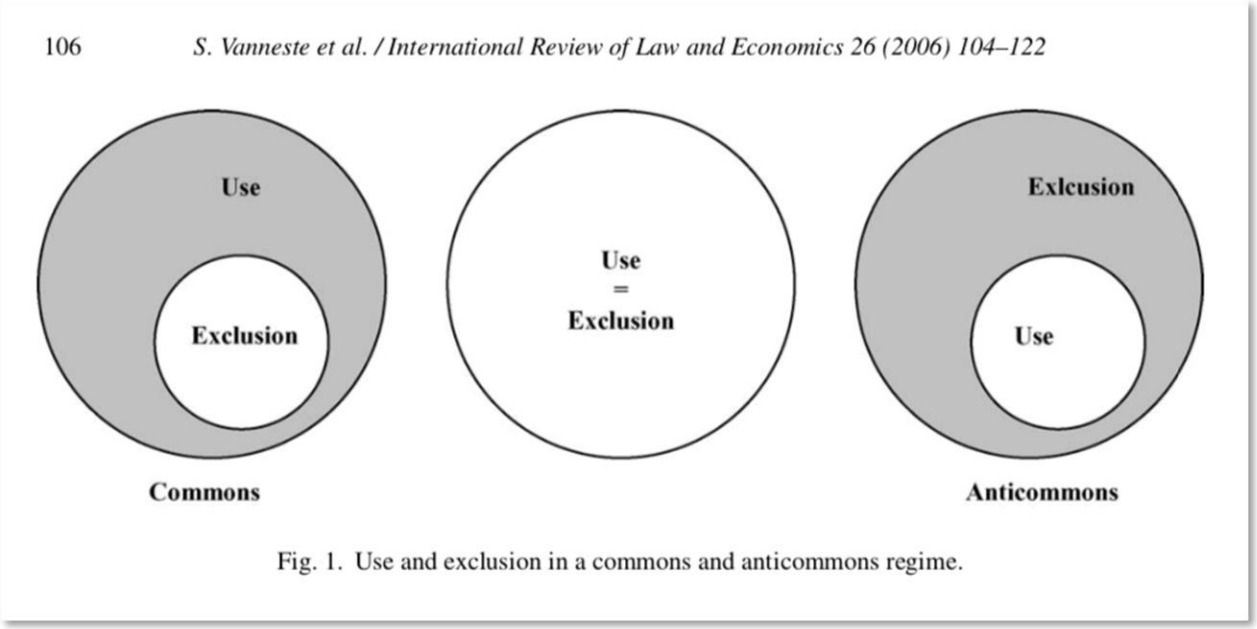

Fig. 1. Use and exclusion in a commons and anticommons regime.

Herein, they label the two cases the "dilemmas." At the core of their definition is the interplay of the breadth of rights to use and of rights to exclude:

> According to the traditional conception of property, owners enjoy a complementary bundle of rights over their property, including, among other things, the right to use the property and the right to exclude others from it. Commons and Anticommons dilemmas can be conceived as symmetric deviations from the standard bundle of rights (see Buchanan & Yoon, 2000; Heller, 1998; Heller & Eisenberg, 1998; Parisi, Schulz, & Depoorter, 2005). In Commons dilemmas, the right to use stretches beyond the effective right (or power) to exclude others. Conversely, in an Anticommons property regime, the co-owners' right of use is crowded out by an overshadowing right of exclusion held by other co-owners[69] (Undersoring added.)

There is a problem with this definition, that while it is correct in spirit, its non-technical aspects could confuse lawyers.

The key issue here is the definition of 'owners', 'co-owners', and 'others' are not as clear as they later are in their paper. When a single 'owner' contains fully matching rights of use and exclusion, that is the tradition notion of private property; however, that owner could be multiple

[69] Van Hiel, Vanneste, & De Cremer 2008, 175.

parties so long as they speak and act as a single actor. When that group of owners begins to act with more than one voice is when these dilemmas of Commons and Anticommons can emerge.

In many ways, it the mismatch of the set of voices on use versus the set of voices on exclusion that enables the tragic mechanism behind both dilemmas.

2.5.2 Anticommons and Unlimitedness of Exclusionary Rights

While it is well recognized orally and descriptively that each actor in the Anticommons possesses individual rights of exclusion, rights that exceed their individual rights of use, it is really only in the economic literature that the formal models reveal that the rights of exclusion are unlimited or unconditional. Major, King and Marian, in anticipation of their formal model, describe the requirement:

> In Anticommons, each of the co-owners thus has the unconstrained ability to block or restrict supply of their joint property, whether directly through prohibitions and conditions upon the quantity made available or indirectly through the price charged for use or sale. [70] (underscoring added.)

2.6 Simultaneous and Sequential Anticommons

In the earlier draft version of their paper,[71] Parisi, Schulz, and Depoorter found a way to describe the social arrangements of Anticommons Tragedies:

> In a horizontal Anticommons case, various right holders exercise exclusion rights simultaneously and independently. This may involve two agents in a

[70] Major, King and Marian 2016, 250.

[71] This paper went through several released versions and eventually was published in a substantially version from the earlier drafts. E.g., compare Parisi, Schulz, & Depoorter 2000 and Parisi, Schulz, & Depoorter 2005.

> horizontal relationship, such as multiple co-owners with cross-veto powers on the use of a common resource. [72] (Underscoring added.)

> In a vertical Anticommons situation, exclusion right holders are in a vertical relationship with one another, with choices made sequentially by the various right holders.[73] (Underscoring added.)

Parisi, Schulz, and Depoorter detail that there exist two classes of externalities that can enable the mechanism of the Tragedy.

The first class includes simultaneous or same-time-period externalities, such as a complementary set of goods or a complementary set of monopolies.[74] "In the simultaneous case, various right holders exercise exclusion rights at the same time, independently."[75]

The second class is a non-simultaneous or sequential set of externalities, wherein an occurrence in an earlier time period have exclusionary impact on an occurrence in a later time period, that the "the underuse of productive inputs today bears consequences into the future," as they remind is standardly assumed in the theory of economic growth.[76] The heart of the sequential model of Anticommons is that the acts of exclusion occur in successive stages; the actors to this sequence of events might be internally hierarchal in nature or might be temporally sequenced without hierarchy:

> In the sequential case, the exclusion rights are exercised in consecutive stages, at different levels of the value chain. The various right holders exercise exclusion

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72 Parisi, Schulz, & Depoorter 2000, 6.

73 Parisi, Schulz, & Depoorter 2000, 6.

74 Parisi, Schulz, & Depoorter 2004, 176.

75 Parisi, Schulz, & Depoorter 2004, 177.

76 Parisi, Schulz, & Depoorter 2004, 176. In making this comment on theories of economic growth, on observes that they have implicitly suggested an opportunity to re-study economic growth as a space of Anticommons Tragedies solved in sequence over time to reduce the wastage implicit from earlier conditions. Furthermore, a reader can observe that this approach might also substantiate a claim for the role of law in economic growth and development, particularly its ability to provide lego-cultural institutions to prevent or avoid Tragedies of the Anticommons.

> rights in succession. This may involve multiple parties in a hierarchy, each of whom can exercise exclusion or veto power over a given proposition.[77]

They go on to state that the classes need not be exclusive of each, instead, a scenario might have both simultaneous and sequential classes of Anticommons in the same set of circumstances. For example, land usage might require solving an Anticommons over what to plant in the field in any given year, but also require solving a multi-year use problem to balance yields and recovery periods; these types of circumstances might even have different actors across the years of the problem set, to further complicate the conditions of the Tragedy in play.[78]

> The sequential Anticommons problem thus reveals the cost of sequential fragmentation of use and exclusion rights, as manifested in the deadweight loss resulting from the uncoordinated action of the two sequential right holders.[79]

In this manner, the Tragedy can be played out over time across a sequence of steps and stages.

Major, King, and Marian provide illustrations of several types of non-simultaneous Anticommons.[80] They demonstrate a formal model of a 'price leader' in an Anticommons wherein one actor sets her price before the other actors can set their prices. [81] In a price-leader model, the price requested will be higher, ergo worse for the Tragedy, than that seen in simultaneously priced Anticommons models. [82]

They also demonstrate a model of upstream to downstream complementary production, wherein the overall welfare loss is worse than if they had merged into a singular monopoly. [83]

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77 Parisi, Schulz, & Depoorter 2004, 177.

78 *See* Dagan & Heller 2000, on land use and its nexus with the Tragedy of the Anticommons across multi-generational family holdings. See also

79 Parisi, Schulz, & Depoorter 2004, 182.

80 Major, King, & Marian 2016, 254.

81 Major, King, & Marian 2016, 253-254.

82 Major, King, & Marian 2016, 253-254.

83 Major, King, & Marian 2016, 254.

2.7 Public Governance and the Anticommons

Gao and Wang cite Sobel and Leesom as the first theorists to have discussed the Tragedy of the Anticommons as a matter of public governance context instead of in a market-based context, that the public service version might ought to be referred to as the "Tragedy of the Political Commons[sic]."[84]

Gao and Wang state that the "meaning of ownership in public management is different from that in economics and law."[85] While in ordinary property rights, the rights of exclusion are vested directly with the individual(s) in possession of the item, good, or receipt of service, in the case of public governance, it is the agencies of the State, who "as agents of the people, public organs enjoy the right to exercise such power" to exercise those exclusionary rights.[86] As such, the focus turns to how and when agents of State power claim exclusionary rights over the provision of public services, public goods, and related welfare issues.

They list three ways for such a Public Anticommons to emerge:

i. When multiple agencies can issue policy guidance on the same singular issue, without necessarily being required to coordinate;[87] this represents an unbundling of the regulatory rights of exclusion on approvals for the regulated behavior;
ii. When multiple agencies can claim jurisdictional oversight on the same singular policy concern;[88] this represents an unbundling of the jurisdictional authority which enable regulatory rights of exclusion on approvals for the regulated behavior;
iii. Uncoordinated approval systems can lead to overlapping rights to exclusion and thus to Anticommons tragedies; [89] this can occur when a proposed project requires multiple approvals for its own singular existence even though the approvals

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84 Gao & Wang 2008, 1755. There is in Gao & Wang a non-specific reference to Parisi's model from Parisi 2004.

85 Gao & Wang 2008, 1755.

86 Gao & Wang 2008, 1755.

87 Gao & Wang 2008, 1756.

88 Gao & Wang 2008, 1757.

89 Gao & Wang 2008, 1757.

> themselves are from clearly delineated lines of jurisdiction and/or of policy guidance – in essence this is Heller's original Russian storefront problem.

Gao and Wang provide their own model of such a Political Anticommons Tragedy, wherein two agencies can both withhold approval for a public service that requires approvals from both agencies.[90] Approvals from agency A create positive externalities for Agency B, and vice versa. [91] They develop a formal model that examines the outcomes when they cooperate to maximize joint value and when each agency maximizes its own self-interest. [92] Indeed, Gao and Wang's model find that when the two agencies each maximize their own self-interest, a significant Tragedy of the Anticommons results. [93]

They also provide a model of what appears to be a public services payoff matrix version of Cournot's original complementary monopoly model, with the public represented as the 'consumer' of the joint service provided by two agencies.[94]

2.8 The Importance of Exclusionary Rights in Property Law

A note is necessary on the phrases 'rights of exclusion' and 'exclusionary rights.'

The US Supreme Court once held that "the right to exclude others" to be "one of the most essential sticks in the bundle of rights that are commonly characterized as property."[95] Merrill has raised substantial arguments that, at least in common law jurisdictions, that the concept of exclusionary rights is the most central test is determining if a party can make a claim to possessing a right in a 'property':

> in demarcating the line between "property" and "nonproperty"- or "unowned things" (like the air in the upper atmosphere or the resources of the ocean beyond

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90 Gao & Wang 2008, 1756.

91 Gao & Wang 2008, 1756.

92 Gao & Wang 2008, 1756.

93 Gao & Wang 2008, 1756. Gao and Wang report that the difference is "far less." Id.

94 Gao & Wang 2008, 1757.

95 Merrill 1998, 730, with reference to Kaiser Aetna v. United States, 444 U.S. 164, 176 (1979).

> a certain distance from shore) - the right to exclude others is a necessary and sufficient condition of identifying the existence of property.[96]

Merrill's claim on exclusionary rights is supported by several arguments.[97]

First, he posits an argument of 'single-variable essentialism,' which he finds seminally in Blackstone; "the right of property; or that sole and despotic do- minion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe."[98] He lists Jeremy Bentham and Felix Cohen as examples of other authorities who writings evidence this argument.[99]

Second, he posits that a 'multiple-variable essentialism' argument for defining property allows for property to be fuzzily defined by a multiple of incidents, with Blackstone providing a listing of three incidents and Tony Honore providing a longer listings of eleven.[100] While not providing a specific example of how exclusionary rights are located within the two listings, Merrill claims that exclusionary rights are necessary, if not also sufficient, given the incidents in the listings. In a subsequent analysis, Merrill revisits this 'multiple-variable essentialism' definition and finds it richly supports the concept of 'necessary and sufficient,' indeed he finds the right to exclude logically primal under this framework.[101]

Next, a historical argument is presented. Merrill deconstructs the notion of usufruct to be tantamount to a temporally delimited version of exclusionary rights, that only the holder of the usufruct has the rights to the use of the property and thus possesses an right to exclude all others to its use or occupancy.[102] He cites to the authority of legal historians Ellickson and Cronon, who separately found similarly that usufructs were the earliest of identified notions of property, and

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96 Merrill 1998, 731.

97 It appears that King, Major, & Gabriel 2016a, 67 - 68, provide a survey of this same set of arguments in less detail, albeit without citation to Merrill 1998, so it might be independently redeveloped.

98 Merrill 1998, 734.

99 Merrill 1998, 734 – 735.

100 Merrill 1998, 735 – 736.

101 Merrill 1998, 740 – 745.

102 Merrill 1998, 746.

thus, that rights of exclusion are of the most ancient of property rights and thus other rights are likely derivative of exclusionary rights.[103]

Third, he posits that exclusionary rights exist and function across a range of private, public, and intellectual property notions while many, if not most, of the other 11 incidents of Honore's bundled definition of property do not map across those varieties of property.[104] He lists riparian river rights, patent rights, gatekeeper rights at national parks, and 'choses in action' as broad examples of exclusionary rights.[105]

In a contemporaneous echo of Heller and a focus on Commons and what presents tragedy and its cure, Merrill explains that agreed-to exogenous authority can prevent tragedy of the Commons:

> Common or community property is not truly unowned, because there is a designated entity - the community - that exercises the right to exclude outsiders with respect to these resources. The existence of this right to exclude is the one significant linkage between private property and common or community property.[106]

In a nutshell, Merrill's arguments provide rigorous support for a claim that 'exclusionary rights' are the central, if not the "*sine qua non*,"[107] foundational incident of rights in property. As such, Heller's use of exclusionary rights, and of their shared possession as the core of the Tragedy of the Anticommons model, and the many manners in which property rights and their stewardship can be shared, strongly imply that the Tragedy of the Anticommons may be extremely common in the exercise of property rights and may well be a major yet unrecognized factor in the underutilization of many assets that display any form of jointly held 'exclusionary rights.'

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103 Merrill 1998, 746.

104 Merrill 1998, 748 – 750.

105 Merrill 1998, 748 – 751.

106 Merrill 1998, 750.

107 Merrill 1998, 730.

3 IDENTIFIABLE CHARACTERISTICS OF ANTICOMMONS TRAGEDY

Perhaps obvious to the reader, the Tragedy of the Anticommons builds on similar modelling assumptions as the Tragedy of the Commons, that each actor is fully rational, that each one acts in autonomous economic self-interest, that each has a decision-making process that includes information internal to it but that information external to it, and that each actor is limited to their ex ante assets.

Yet, despite this clustering of rationality, the model deterministically does not necessarily yield optimal outcomes. As described by Michelman:

> "And although there is no reason to confide absolutely in either the beneficence or the omniscience of the state as regulator of property composition, there is also none for trusting more to accidental regulation by individual dealings. If the state does not always act in view of the economic interest of society as a whole, neither do individuals."[108]

The existence of a crowd of rationally behaving actors does not necessarily result in rational behavior by the crowd with regards to the whole of the crowd.

3.1 Duality of the Commons and Anticommons Tragedies

3.1.1 Buchanan and Yoon's Models

Buchanan and Yoon, in responding to a footnote in Heller's work that noted that the concept of the Tragedy had not yet been captured formally in a model,[109] developed the first explicit and formal models of the Anticommons,[110] building on their earlier efforts on an array of property models, including on Tragedy of the Commons.[111]

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108 Michelman 1982, 677.

109 Buchanan & Yoon 2000, 1.

110 Buchanan & Yoon 2000, 5.

111 Buchanan & Yoon 2000, 3, with reference to Buchanan & Yoon 2001, with multiples models presented throughout, beginning at 396.

In so doing, they both formally, and perhaps more importantly, popularly established the parallels between the two models of the Tragedy of the Commons and of the Anticommons.

> In the limiting case, in which all persons in a large group are assigned rights of exclusion such that each proposed user must secure the permission of all persons, the resource may not be used at all, despite its potential value. This potential will be wasted in idleness in a way comparable with full dissipation wastage under open-access Commons usage at the other limit.[112] (Underscoring added.)

Building on the previously discussion of the duality in the Cournot models,[113] Buchanan and Yoon both present explicit models for the Tragedy established that there is a formal symmetry, reflected in a resource's over-usage due to numerous rights of access and in a resource's underusage due to numerous rights of exclusion.

Parisi, Schulz, and Depoorter saw a symmetrical structure in the both the duality aspects and in the modes of competition:[114]

Mode of Competition	**Substitute Items** **Negative Externalities**	**Complementary Items** **Positive Externalities**
Use // Activity	Hardin Type Commons	Michelman - Heller Type Anticommons
Exclusion // Price	Bertrand Type Commons	Buchanan & Yoon Type Anticommons

112 Buchanan & Yoon 2000, at 4.

113 Supra, at sec. 2.2; Buchanan and Yoon do not refer to Sonnenschein in Buchanan & Yoon 2000 and in Buchanan & Yoon 2001, although it is foreseeable that they may not have been aware of the article. They do refer to their model as being "analogous to Cournot-Nash duopoly," Buchanan & Yoon 2000, at 9, and that "the equilibrium in either the multiple- users model or the multiple-excluders model is structurally analogous to that familiar in Cournot-Nash duopoly-oligopoly settings of interfirm competition." Id at 10. *See also* Buchanan & Yoon 2001, 404, Appendix B for a model entitled "Many Majority Coalitions are Analogous to Cournot Duopoly."

114 Parisi, Schulz, and Depoorter 2000, 12; Parisi, Schulz, and Depoorter 2005, 584. I have re-integrated the terms from both charts, as the two drafts implemented and focused on slightly different concerns.

They explain:

> The problem of the Commons is related to a negative externality of use rights. The proverbial number of cows grazing on a parcel of land are a measure of the extent of the right of use. The problem of the Anticommons is related to a negative externality of exclusion rights (a positive externality of granting use rights). In both cases the negative externality implies underuse. But the essential difference lies in the fact that this externality refers to rights of use in the case of the Commons problem and it refers to the right to exclude in the Anticommons case. Conceptually these problems are absolutely similar. This leads us to call these problems dual to each other.[115]

In less technical terminology, Fennell explained the duality from a transaction costs and bundled perspective:

> Instead of everyone having too much freedom to allocate resources between themselves and the collectivity, as was the case in the tragedy of the Commons, participants in an Anticommons dilemma lack the ability to put together entitlements into bundles that would make them usable. This powerlessness can be better understood as a dispersal of power-the power of individual fragment holders to refuse a transfer at a price acceptable to the would-be assembler.[116]

Fennell also warns that many problems facing real-world Commons are re-configurable into Anticommons scenarios;[117] she illustrates with both open park usage and swimming pool usage examples where both exclusionary rights and use privileges can be used to model the same phenomena.[118]

Thus, one can observe that some problems are invertible, being of both Tragedies, yet a review of the literature has yet to find a model that demonstrates that all are invertible in the sense of Fennell's argument.

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115 Parisi, Schulz, and Depoorter 2005, 584.

116 Fennell 2004, 927.

117 Fennell 2004, 937.

118 Fennell 2004, 938.

3.2 Complementary Nature of the Anticommons

Anticommons are formed when the inputs to a process are complementary in nature or character. Further, while the complementary nature need not be perfect to obtain a Tragedy of the Anticommons, the welfare loss increases towards abandonment as the complementarity approaches that limit. Finally, there are no formal arguments in the literature that only perfectly complementary services can result in a regulatory Anticommons; on the contrary, imperfect complementarity will also result in an Anticommons.

Perhaps the most important character or aspect of the Anticommons is the dependent inter-relations of the service, good, or resource involved. As Parisi, Schulz, and Depoorter wrote, "[t]he relevant variable along the Anticommons continuum is the degree of substitutability, or complementarity, between the various components of our bundle of property rights."[119]

Thus, the higher the degree of complementary nature, the more fully the Tragedy of the Anticommons will manifest. The nature of the goods or services to be provided need not be perfect complements, as "[c]ases of partial exclusion rights" will suffice."[120]

In examining sequential Anticommons models, they similarly found: "that Anticommons losses increase monotonically in both …; and (b) the foregone synergies and complementarities between the property fragments."[121]

Fennell highlights that the nature of complementary goods needs to be closely examined, for many real-world examples of highly complementary goods can function well without their complete set of complements.[122] As an example, she cites to jigsaw puzzles that lack a piece or two, the image may well be viewable despite the few missing pieces.[123] Similarly, she reports that not all negotiations require the full participation of all participants; that when the exclusionary rights are less than absolute, the effect becomes reduced.[124]

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119 Parisi, Schulz, & Depoorter 2004, 180

120 Parisi, Schulz, & Depoorter 2004, 180.

121 Parisi, Schulz, & Depoorter 2004, 183 ◦

122 Fennell 2004, 971- 972.

123 Fennell 2004, 971.

124 Fennell 2004, 972. However, the logic here is anecdotal and sometimes alluded to as intuitive, but the model suggested is not delivered in a formal syntax.

Having previously reviewed the literature on formal models on complementary goods and services and their roles in enabling the mechanisms of the Tragedy of the Anticommons, Bellantuono's argument that a regulatory complementary 'service' won't suffice needs to be reviewed. He argues that multiple regulatory authorities "must be granted exactly the same right over the resource," that they be granted "have independent but overlapping authority over the same resource."[125] He argument, in a nutshell, is that only perfectly complementary goods or services can result in an Anticommons that could yield a Tragedy of the Anticommons. This is directly contrary to the formal models of Parisi, Schulz, and Depoorter , and separately Depoorter and Vanneste, and later of Sun and Liu, all finding that complementarity need not be perfect, but that the Tragedy worsens as the complementarity approaches the limit.[126]

3.3 More Actors Worsens the Incidence of Tragedy

Already, in 1982, Michelman had suggested that an increasing number of actors was likely to worsen the coordination problem of diversely held property rights, without stating quite how:

> What makes the risks seem heavier for cooperative and political processes is, I suggest, their pronounced multiparty character, which seems to escalate the likelihood that they will constitute "prisoners' dilemmas" or comparably tragic strategic fixes will be, in Mancur Olson's classification, instances of "latent" rather than "privileged" or "intermediate" groups.[127]

Twenty years later, Buchanan and Yoon formally established that the size of the decrease in value is an increasing function of the number of actors simultaneously assigned access or exclusionary rights – that the more the more the actors the worse the decrease in value.[128] Their finding advanced considerably the 'gridlock' anti-network effects raised by Heller, that the more actors holding exclusionary rights, the more the welfare loss appears to be in practice.

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125 Bellantuono 2014, 239-240.

126 NEED THREE CITES for (Parisi, Schulz, and Depoorter) (Depoorter and Vanneste,) and (Sun and Liu)

127 Michelman 1982, 686.

128 Gao & Wang 2008, 1755.

Similarly, Parisi, Schulz, & Depoorter established a formal model and demonstrated that the "Anticommons losses increase monotonically in both (a) the extent of fragmentation; and … ;"[129] confirming that when the model is extended to include multi-step or sequential decisions on how to implement exclusionary rights (or not), that increasing fragmentation of the exclusionary rights will worsen the incidence of the Tragedy of the Anticommons.

More recently in 2016, Major, King, and Marian, in expanding on Coase's model of factory emissions,[130] demonstrated formally that 2-player game has lower withholding prices bid than n-player games do.[131] They provide a formula which can reveal the trend of declining wealth available to be received by each actor as the number of actors grows in that scenario:[132]

$$\pi_c = \frac{n}{(n+1)^2}$$

Table 2: Decrease in Available Player Pay-Off as n Increases

Total number of Actors	Strategic Count for *n*	π_c	Calculated
2	1	$^2/_9$	0.2222…
3	2	$^3/_{16}$	0.1875
4	3	$^4/_{25}$	0.1600
5	4	$^5/_{36}$	0.1388…
6	5	$^6/_{49}$	0.1224

129 Parisi, Schulz, & Depoorter 2004, 183.

130 Major, King, & Marian 2016, 247-248.

131 Major, King, & Marian 2016, 253.

132 See equation 11, Major, King, & Marian 2016, 248; and see equation 16 and the subsequent unnumbered equation on same page, Major, King, & Marian 2016, 252.

It should be understood that these numbers and this formula are specific to this particular model, but the overall trend of increasing welfare loss as an Anticommons faces an increasing number of actors is evident and similar patterns will be found in other formal models of similar circumstances.

Major, King, and Marian further demonstrate that when there are there are (i) multiple individual profit maximizers, (ii) "multiple complementary inputs that necessarily must be bundled for the creation a product", and (iii) the jointly produced product is then sold onto customers, that the outcome will necessarily result in (i) higher retail prices, (ii) lower quantity of output, and (iii) the total overall revenue will be lower than both (a) a monopoly that produces the same goods, and (b) a duopoly of the same nature.[133]

In more direct language, as the number of players increases, and given the need for all players to align and allow use of inputs, the price to customer is worse, the amount available for purchase is worse, and the overall revenue is worse; this stands against monopoly, duopoly, and competitive market-based outcomes. [134]

In considering the application of the Tragedy of the AntiCommons in international law, perhaps Landry put the complexity of the number of players and the corresponding increase of transactions best, in discussing how one might over Anticommons problems facing the development of property rights in outer space:

> The second solution is collective action. Each of the owners could work together, bearing the cost equally. However, this solution gives rise to transaction costs (negotiation and decision-making, for example) and these costs rise with the number of members in the group. The transaction costs between, for example, all of the states on Earth would be, well, astronomical.[135]

In conclusion, the formal models make it clear that the Tragedy of the Anticommons worsens, in terms of welfare lost, as the number of actors with exclusionary rights increases. Those models have been examined experimentally and empirically with relatively small numbers of actors,[136]

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133 Major, King, & Marian 2016, 257.

134 Major, King, & Marian 2016, 257.

135 Landry 2013, 528.

136 See discussion below, infra, at sec 4.1.

when the scale of engagement is global, the potential welfare loss quickly approaches the limit of disfunction and total wastage.

3.4 Price Competition and Binary Policy Choices

In many negotiating or strategic decisions, the issue before the actor is essentially binary in nature or character, to do something or to not do something.[137] Parisi, Schulz, & Depoorter found that in such cases, the pricing models of Anticommons are the operative models, wherein the question becomes, at what price will the actor agreed to not act on their exclusionary rights.[138]

This reflects back to Sonnenschein's work in 1968, reflecting the symmetry of the price and quantity models.[139] If the price demanded is too high, then the activity will be prevented or the resource will go unused and the Tragedy of Anticommons will results.[140]

In this type of case, Parisi, Schulz, & Depoorter found that the complementary nature of the goods or services to be provided need not be perfect complements, in some contrast to the earlier findings of Buchanan and Yoon.[141] Thus, "[c]ases of partial exclusion rights" will suffice to enable the mechanism of Anticommons Tragedy to be operative.[142]

Thus, when a legal is examining a model of an institution wherein policy decisions are made in a binary nature, to undertake or not a policy, to implement a regulation or not, to make an act illegal or not, to permit an activity or not, then the Anticommons models based on pricing competition are the correct models to connect to the legal analysis.

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137 Parisi, Schulz, & Depoorter 2004, 180.

138 Parisi, Schulz, & Depoorter 2004, 180.

139 See, supra, at sec. 2.2.

140 Parisi, Schulz, & Depoorter 2004, 180.

141 Parisi, Schulz, & Depoorter 2004, 180.

142 Parisi, Schulz, & Depoorter 2004, 180.

3.5 Pigouvian Externalities: Core of Tragic Mechanism

Buchanan and Yoon establish that both models, the Tragedy of the Commons and the Tragedy of the Anticommons, are primarily predicated on Pigouvian externalities that arise from the Cournot-effects:

> The basic logic is equivalent in the two cases. The inefficiency arises because the separate decision makers, each of whom acts in exercise of assigned rights, impose external diseconomies on others who hold similar rights.
>
> In the Commons or usage side of the model, persons (or firms) may, by adding a unit of input to the common resource, reduce the productivity of all other inputs and the rents of each person. [143]
>
> In the Anticommons or exclusion side of the model, persons (or firms) may, by reducing inputs to the common facility (via price), reduce the rents available to others who also exercise potential exclusion rights.[144]

Finally, based on that effort, they are able to state a clear rule on Pigouvian externalities as fundamental to the risk from Tragedy of the Anticommons:

> In the limit, if the resource is fully open for usage, all the net value of the resource will be dissipated. Only with full centralization of decision authority within the ''mind'' that is coincident in range with that of potential resource use can full internalization of the potential externalities be guaranteed.[145]

Parisi, Schulz, and Depoorter provide a definition of the Anticommons Tragedy predicated on the externalized costs of enforced exclusionary rights over a group of independent holders of such exclusionary rights primarily because that group of rights holders lack the corresponding rights of usage.[146]

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143 Buchanan & Yoon 2000, 4.

144 Buchanan & Yoon 2000, 4.

145 Buchanan & Yoon 2000, 3.

146 Parisi, Schulz, & Depoorter 2004, 176.

At its core, their model of the Tragedy is one of positive Coasean transaction costs and costly Pigouvian externalities.

> The Tragedy of the Anticommons is the result of common resources remaining idle even when there could be some net social benefit. It occurs simply because the multiple holders of exclusion rights do not fully internalize the cost created by the enforcement of their right to exclude others. [147] (Underscoring added.)

3.6 Coase, Transaction Costs, and the Anticommons

There has been considerable evolution in the literature on the extent to which the Anticommons model is really a model predicated on transaction costs or if the model is centered elsewhere but can be additionally impacted by the transaction costs facing the actors or agencies in the specific scenario. Further, the symmetry of Anticommons has been investigated, is it as easy to re-assemble a bundle of exclusionary rights as it is to disbundle them, or, is it more costly to re-bundle those exclusionary rights?

Parisi, Schulz, and Depoorter note that the transaction costs of responding to a Tragedy of Commons are likely lower in total costs than those transaction costs of tragedy of Anticommons; the argument is quite similar to that of Planck's Statement on the Second Law of Thermodynamics,[148] in that it is simpler to break an egg than to put it back together,[149] it is simpler to break a Commons into bits of private property that it is to reassemble the bundle of exclusionary rights:

> Once the ideal conditions of the positive Coase theorem are relaxed, over-fragmentation poses an interesting situation of asymmetric transaction costs. The presence of such asymmetry is due to the fact that the reunification of fragmented

147 Parisi, Schulz, & Depoorter 2004, 176.

148 "Every process occurring in nature proceeds in the sense in which the sum of the entropies of all bodies taking part in the process is increased." Planck 1903, 100, at section 133.

149 Or as Michelman wrote, "You can't very easily get eggs out of an omelet." Michelman 1982, 677.

> rights usually involves transaction and strategic costs of a greater magnitude than those incurred in the original fragmentation of the right.[150]

Similarly, in establishing that the welfare loss increases monotonically with regards to both the increasing fragmentation of exclusionary rights and increasing levels of complementarity, they found that the very nature of that monotonousness property requires that the asymmetry of transaction cost

They had earlier stated this observation as a normative proposition; "In the realm of non-conforming property arrangements, positive transaction costs often generate a one-directional stickiness in the transfer of legal entitlements."[151] However, in this format, one can readily observe why this is not a truly positive statement, but rather an expectation of empirical findings within a limited set of cultural institutions on how to handle property law. First, that the transaction costs flow from simple to complex presumes certain types of legal rules that facilitate the disbundling of those rights more than the bundling of those rights. Legal institutions could be designed in alternative ways, to enable the rapid or low-costs bundling, or to even strongly prevent the disbundling of those rights, so that the actual sum of transaction costs to disbundle would be higher than that to rebundle.

For an imaginary example, a state might find itself under 'strong man' control, wherein a hierarchy of strongmen (here meant gender equivalent) are able to claim any assets within their jurisdiction and unify those units into their singular asset. Any disposition of property in that realm might also need pre-review and pre-approval of the relevant strongman, to alert the strongman of properties valued by the community. In such a case, property would tend to accrete to few bigger bundles under the strongmen and people in the community may reduce their level of property transactions, including those involving fragmentation or disbundling, say certain forms of inheritance, to reduce information provided to the strongmen.

Historical anecdotes include cultural traditions that strongly resist the fracturing of family wealth, a strong rule of primogeniture for example. Another example might be the cultural resistance displayed to fragment or privatize certain cultural assets.

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150 Parisi, Schulz, & Depoorter 2005, 585

151 Parisi, Schulz, & Depoorter 2004, 184

Nevertheless, their original point remains, that societies based on the common legal systems of today, with institutions favoring the ability of an asset owner to volitionally dispose of their assets, would create an asymmetry in the basic sale transaction or inheritance transaction itself, which then would result in the one-way flow of transaction costs observed by them.

The assumption made obvious in this present paper, and we believe it to be an original contribution to the discussion, is that within the West's liberal paradigm of volitional contract and sales, a thusly-enabled owner can set their terms for sale or inheritance either unilaterally or with the balance of power in their favor, being that if they didn't agree to the terms that they could avoid the transfer – that there is no counterbalancing rule to override the owner except for dire circumstances. On the other hand, if a contrary rule existed that enabled a buyer to trump the 'volitional' will of the seller, eg a sufficiently profitable offer being made,[152] then the owner would not possess that asymmetrical claim on the property and the transaction cost balance of bunding and rebundling would be restorable. Thus, the asymmetrical emergence of transaction costs, more to rebundle than to disbundle, is simply a reflection on the asymmetry presented in the basic rights of exchange. Should those initial rights controlling the means of exchange be altered, so to would the balance of transaction costs.

However, Major, King, and Marian have formally demonstrated that although the transaction costs issues exist, that the Anticommons acts in a way unexpected for Coasian transaction costs, they break the symmetry of initial allocations.[153]

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152 Posner and Weyl's article on efficient taxation of immovable property comes to mind; see Posner & Weyl 2017, 54; "In this article, we consider a third way, one that involves a system of self-assessed property taxation first proposed by Harberger (1965) for the purposes of raising tax revenue. Under this Harberger tax, as we call it, people periodically report valuations of their property to a government registry; pay property taxes based on these valuations; and are required to sell their property at these valuations to any buyer. A key component of this proposal is that buyers can force sales—limiting a longstanding element of private property, which is that the person who owns property keeps it until she consents to sale. The Harberger tax is a radical departure from our current system of private property in one sense—people are no longer "owners"; they are more like lessees—and yet it at the same time amplifies the operation of the market economy rather than cur- tailing it." Id. (Underscoring added.)

153 Major, King, & Marian 2016, 257-260.

> [T]he rational logic with *n* neighbours and one industrial polluter has been shown to be quite different depending upon which side is given the initial property right; the outcome achieved is far from invariant.[154]

Coasean models routinely assume that the initial allocation of rights are irrelevant for an efficient outcome; the initial allocation merely affect distributional issues.[155] However, in an Anticommons example of a polluting plant, their formal model reveals that an Anticommons of many villagers approving a pollution deal with a factory will reach a very different outcome than when the initial outcome favors the plant to have exclusionary rights over the householders.[156] Explaining the asymmetrical results:

> After all, it fully controls the property right and it knows quite well that there is a preferable price/quantity position available. The factory thus has the incentive and also considerable ability to form the neighbours into a unified cartel, which was lacking in the reciprocal situation when the separate neighbours controlled the property right.[157]

Thus, there are economic advantages which enable the factory to efficiently cover the costs of overcoming the disaggregated householders in negotiating over the pollution emissions. Further, the plant could achieve a Pareto-optimal level of output, whereas the Anticommons version, wherein the householders hold the rights of exclusion, will remain at sub-Pareto-optimality.[158]

In answering the question, "Is the Tragedy of the Anticommons purely a result of transactions costs?," Fennell repackaged the Heller definition to focus more on the transaction costs origin of the Tragedy:

> The same structural problem exists any time a number of entitlements must be assembled together (or "bought up") in order to enjoy any particular use of a

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154 Major, King, & Marian 2016, 260.

155 Cooter 1982, 15 and 28, separately.

156 Major, King, & Marian 2016, 259-260.

157 Major, King, & Marian 2016, 260.

158 Major, King, & Marian 2016, implicitly at 259 after equation 38, and explicitly at 260. "Based on the logic of non-cooperative games and Nash equilibrium calculations, bundling in cases of fragmented ownership – despite a world of frictionless transactions – will occur among rational actors but at a location of Pareto under-utilisation." Id.

> given resource. … Because obtaining permission from any significant number of people is likely to be prohibitively costly, the result is a resource which nobody is able to use. Often, although not always, this leads to an inefficient result. Where this is the case, the result is usually understood as a Tragedy of the Anticommons.[159] (Underscoring added.)

However, when examined with a formal model, Major, King, and Marian demonstrate that in fact, that while Anticommons models do have material transaction costs concerns, a 'zero-cost transaction-cost world' would ultimately provide no relief, the Tragedy of the Anticommons would remain and it would remain below Pareto optimality.[160]

> None of the commentators seem to have observed that Anticommons – based on the separate maximising calculations by multiple actors each with exclusion rights over a necessary input – is a rational inefficiency that challenges Coase theorem conclusions.[161]

This is an interesting research result, one that could inspire additional research, but as it is so recent in vintage, those results in reaction have not yet appeared in the literature.

3.7 Anticommons: Differences in Quantity and Price Competitions

Dari-Mattiacci and Parisi have shown that while both duopolistic models of price competition and duopolistic models of quantity competition can result in Anticommons Tragedy conditions, they do not equally result in tragedy.[162] That is because they found that quantity competition is far more likely to result in Tragedy than price competition.

They found that providing as few as two price substitute goods for the complementary goods in the model could prevent the formation of the tragedy where producers compete in prices. [163]

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159 Fennell 2004, 926 – 927.

160 Major, King, & Marian 2016, 260.

161 Major, King, & Marian 2016, 260.

162 Dari-Mattiacci and Parisi 2006, 338.

163 Dari-Mattiacci and Parisi 2006, 338.

> If substitutes are available for both components, Bertrand-type competition in each sub-market leads to a result where both components are priced at marginal costs, as in perfect competition.[164]

Just to be grammatically clear, that means that in a Bertrand-type competition, each complementary good needs only one substitute of its own, thus one substitute or competitive good for each complementary good, resulting that minimal count of two additional substitutional goods. Also, Dari-Mattiacci and Parisi found that when only one side of the Bertrand-type competition has a substitute, that the marginal price on that side became competitive but left the other Bertrand competitor with monopoly-like pricing powers.

On the other hand, when producers compete in quantities of complementary goods, an increasing number of substitutes does not appear to reduce the incidence of the Tragedy. [165]

> In the case of complementary goods produced by firms that compete in quantity, the result is a race to the lowest quantity: the market supplies a quantity equal to zero, with a total erosion of any consumer or producer surplus from trade. From society's stand-point, this outcome is least desirable, as it minimizes social welfare. … How would such an equilibrium change if there were substitutes for the complementary inputs? … The competition engendered by the availability of substitutes in the market of one complementary good will not affect the overall outcome: In equilibrium firms will in fact produce a quantity equal to zero. In

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164 Dari-Mattiacci and Parisi 2006, 340. Nevertheless, that comes with a caveat, that the result is monopolistic not competitive in nature: "In general, having two producers for each input avoids the Anticommons problem and leads to outcomes that are never worse—and generally better—than under monopoly." Id., 345.

165 Dari-Mattiacci and Parisi 2006, 338.

> the scenario where both components have a substitute, the solution will be the same.[166] (underscoring added.)

Further, they found that in mixed cases, when one firm is competing on price and the other firm on quantity, the result is the same as when both firms are competing on quantity.[167] Thus, forms of quantitative competition in complementary goods always results in the Tragedy.[168]

Based on these models, they note that regulators might face a balancing act, one that might generally discourage mergers to protect consumer welfare but encourage mergers of producers of complementary goods.[169]

3.8 Regulatory Anticommons

3.8.1 Formally Defined

Krosnik appears to be the first economist to have provided an explicit model of a regulatory Anticommons; she writes, "Applying the complementary oligopolistic model to the regulatory sphere is relatively straightforward."[170]

Her model builds on the standard Anticommons models, except to recognize that ***n*** regulatory agencies each have "an independent property right" in a regulatory process that results in the granting of a license to an operator.[171] Each agency requires the payment of a price, p_i, , from the potential operator cum purchaser of permits. The price reflects the costs of necessary "informational studies, bureaucratic reports, and other forms, analyses, and documents necessary

166 Dari-Mattiacci and Parisi 2006, 341.

167 Dari-Mattiacci and Parisi 2006, 342.

168 "when firms compete by choosing quantity, the outcome invariably leads to no production at all, as incentives to undercut the quantity at work in the complements market dominates the Cournot incentives to increase quantity in the substitutes market." Dari-Mattiacci and Parisi 2006, 345.

169 Dari-Mattiacci and Parisi 2006, 342.

170 Krosnik 2012, 208.

171 Krosnik 2012, 208.

for regulatory approval."[172] The 'price' required by each agency is set independently by each agency with no expectations of coordination in this model.[173]

The key phrase in describing the Anticommons nature of this regulatory process captures the complementary nature of the multi-agency approval process:

> Because regulatory approval from all agencies is required before ***q*** is granted, these approvals, whose price is $\boldsymbol{p_i}$, act as strong complements in the production of the final good ***q***. [174]

The painful results of the Tragedy of the Anticommons are formally proved, resulting with this announcement on the loss of welfare increasing as the number of agencies increases:

> the price under a single regulatory agency (Eq 6) is lower than the total price of the composite good under the complementary oligopoly (Eq 4), and that this difference (and the inefficiency and welfare losses that correspond to it) increases with ***n***. [175]

This repeats the findings of the models for non-regulatory Anticommons, that complementary services produced by competitive independent firms will create welfare loss, and that loss increases as there are more players possessing exclusionary rights in the Anticommons.[176]

To expand on what this means for regulatory Anticommons, the price from each agency reflects the various transaction costs of meeting regulatory approval procedures, such as the various costs incidental to an Environmental Impact Assessment (EIA), the costs of running a Århus-type transparency procedure during the permitting process, and similar efforts to gain information and to process it as befits local governance cultures.

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172 Krosnik 2012, 208 -209.

173 Krosnik 2012, 209.

174 Krosnik 2012, 209.

175 Krosnik 2012, 209.

176 See related discussions, supra, at sec 3.3, and infra, at sec 4.1.

3.8.2 Commonplace Nature of Regulatory Anticommons

Bellantuono posits that there are three basic reasons that regulatory Anticommons are to be more readily found than more conventional Anticommons and why, for the same reasons, that they may be intractable, unlike their conventional cousins.[177]

First, the constitutional principle that many countries are founded upon, not only nationally but also at multiple levels of federalism or local governments, prevent centralization and require or encourage a variety of power fragmentations across both vertical and horizontal modes of governance.[178] Bellantuono posits that many ministries or agencies are given "entitled to protect a specific public interest[,]"[179] enabling them to resist rebundling of that regulatory authority. Further, he notes that many ministerial processes recognize sequential approvals across various vertical and horizontal levels of governance,[180] creating sequential versions of Anticommons.[181]

Second, Bellantuono presents an argument that efforts to create super ministries, without truly sweeping all into one ministry, will result in what are effectively fewer but stronger players in an Anticommons distribution of regulatory exclusionary rights.[182] This is obvious a contrast to the recommendations of Gao and Wang, who found in favor of super-ministries, generally.[183]

Third, Bellantuono discusses that many regulatory decisions are not made truly unilaterally, but rather are done in committees composed of actors from across vertical and horizontal elements of the government, and that multiple such committees might possess their own 'franchise' of exclusionary rights cum approval powers.[184]

Thus, the tri-fold argument holds anecdotally true, and if assumed for formal purposes would certainly match the conditions of a regulatory Anticommons. The question would be, does this

177 Bellantuono 2012, 332.

178 Bellantuono 2012, 331.

179 Bellantuono 2012, 331.

180 Bellantuono 2012, 331.

181 See discussion on sequential Anticommons in sec. 2.6.

182 Bellantuono 2012, 331.

183 Gao & Wang, 2008, 1759.

184 Bellantuono 2012, 332.

sequence of assumptions hold up empirically? That remains to be undertaken, as far as can be determined by literature review. But it will likely remain persuasive until empirically falsified.

Bellantuono provides two more reasons why regulatory Anticommons may be more frustrating than their conventional cousins or even be intractable. The first reason is that while fragmentation of exclusionary rights of an asset or resource might be difficult or costly to rebundle, regulatory Anticommons might be constitutionally or administratively prohibited from rebundling.[185]

Second, while the actors in a more conventional Anticommons scenario might be individually self-maximizing, the optimands of regulatory agents are less readily negotiated as their combination of public choice theory motives and their obligatory requirements to take the views of various stakeholders into their considerations, will complicate their own decision-making process and likely render their overall negotiations over Anticommons challenges more poor than those individual actors in the conventional Anticommons scenarios.[186]

Thus there are two reasons why regulatory Anticommons are harder to overcome, (i) legal requirements for their persistence, and (ii) rationally-challenged actors needing to accept lower levels of satisfycing results.[187]

3.9 Anticommons Tragedy over the Long-Run

Ohkawa, Shinkai & Okamura provide a formal model that examines the case of long-run equilibrium, where there are multiple parties with exclusionary rights, who charge for access to the common resource, but have free entry or exit from the resource ownership over time.[188]

They find that the fixed costs of the asset owners is pivotal, increasing fixed costs reduces the number of owners as the costs rise, and increasing fixed costs reduces the number of users as

185 Bellantuono 2012, 334. See also Table 1, id.

186 Bellantuono 2012, 334.

187 Satisfycing here used in the sense developed by Herbert Simon, to satisfy a search process not at a point of optimality, but of 'close enough' fit under a budget condition.

188 Ohkawa, Shinkai & Okamura 2012, 174.

the costs rise.[189] And while downstream demand drives up the number of owners, it appears to have no obvious effect on the total number of resource users.[190]

In observing how this game plays out in the long-term, they find that so long as demand for the resource is sufficient, that the Tragedy of the Anticommons will result and sustain over the long run, even though the holder of exclusionary rights have free entry and exit.[191] It would also appear that the Tragedy lowers the overall level of participation for both owners and users,[192] again signifying underutilization.

3.10 Anticommons Tragedy is Systematic and Rational

King, Major, & Marian present arguments that while the Tragedy can be accelerated or conditioned by frailties of the human condition, that the emergence of the Tragedy in fact necessarily and rationally arises from the incident property conditions that define the Anticommons. Thus, alike Arrovian and Sattherwaitean models in Social Choice Theory, the frustration is in fact computational in nature and not resultant from human mores.

Given that amalgam of history and of recent research, one might expect that the recent literature would be working with clear examples and models. Yet, as reported by King, Major, & Gabriel, two common mistakes exist in the literature.

First, the colloquial models often refer to unclear notions of property rights.[193] Second, they tend to rely on Heller's 'gridlock' metaphor without cautious regard for the underlying economic models; "Far too often, it refers broadly to any occasion of multiple-actor bargaining failure, with little or no reference to the underlying causes."[194] They criticize research that overly focuses on "misperception, intransigence, or bargaining complications" as the source of the welfare loss; as the economic models reveal that the Tragedy of the Anticommons emerges from "the intentional

189 Ohkawa, Shinkai & Okamura 2012, 176.

190 Ohkawa, Shinkai & Okamura 2012, 176.

191 Ohkawa, Shinkai & Okamura 2012, 182.

192 Ohkawa, Shinkai & Okamura 2012, 182.

193 King, Major, & Marian (2016a), 64.

194 King, Major, & Marian (2016a), 64.

maximizing behavior of fully rational actors with perfect information under ideal bargaining conditions."[195]

Their effort is not to belittle or limit the scope of the research program, but rather to demonstrate that the Tragedy of the Anticommons is both logically and systematically derived from the particular results of shared exclusionary rights,[196] that in those cases the problem will necessarily continue to be present until the exclusionary rights are better bundled or otherwise better governed to provide for greater alignment in behavior across those rights holders.

Critically, King, Major, & Gabriel's analyses of models wherein actors do agree to agree on aligned prices to enable a sale of an asset reveal that even in situations wherein actors can individually desire to coordinate, the Tragedy of underutilization will emerge:

> Yet, importantly, inefficient underutilization is likely even when all the separated actors unanimously grant permission and sale is a success, as a consequence of them autonomously selecting the best available strategic position while recognizing that the others are calculating similarly. Behavior that is individually rational and maximizing thus results in outcomes that are collectively perverse and systematically suboptimal. It is a logical consequence when the owners of a scarce resource play against each other as well as against the player who wishes to purchase some share of that resource.
>
> The implication is that the Anticommons Tragedy is deeply inherent and widely pervasive whenever separated owners possess rights of exclusion over a product or activity requiring complementary approvals.[197] (*underscoring added.*)

This result is a stronger result than that assumed by many of the earlier researchers. That the Tragedy itself is the very set-up of the transaction, that the critical exclusionary rights over the singular 'good' is split amongst multiple parties.

As a result of their analyses, King, Major, & Gabriel propose a more limited definition of the Anticommons:

> Anticommons … should be restricted to situations of conscious strategic play over the creation and allocation of a potential positive externality resulting from

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195 King, Major, & Marian (2016a), 77.

196 King, Major, & Marian (2016a), 77.

197 King, Major, & Marian (2016a), 67.

> agreement across separated actors all of whom possess powers of use exclusion over a necessary component.[198]

This definition has refocused on the role of a positive externality that can be blocked by any one of the actors, it is the exclusionary right over the commonly held component that limits access to the positive externality.

3.11 Caveat – Not all Non-Deals are Tragedies

Fennell warns that some scholars might, like Macbeth, see too much in the blowing leaves of the trees.

Sometimes, says Fennell, it won't be transaction costs that prevent a re-bundling of the dis-bundled rights, but perhaps that some rights holders will actually value their rights so highly that it is not Pareto or even Kaldor-Hicks improving to achieve that re-bundling of rights.[199]

Further, not all divisions of exclusionary rights are tragic, again, Fennell notes how by fragmenting control over the permission to drive a car that a driver might be kept safe from drinking and driving.[200] This builds on her analogy of a series of locked doors,[201] that all the door-owners have to unlock simultaneously to provide access, and that sometimes it's in the group's welfare to restrain that access.

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198 King, Major, & Marian (2016a), 77.

199 Fennell 2004, 931; Fennell refers to a Parchomovsky and Siegelman "holdin' " strategy, wherein a party prefers to hold an asset separately rather than sell to achieve a bundled portfolio. Id.

200 Fennell 2004, 970. The reference is to a driver handing her keys to a trusted friend who will exercise independent judgment on the 'driver-readiness' of the car owner cum driver. Id.

201 Fennell 2004, 929.

> "Fragmentation is sometimes important for the very purpose of relinquishing power over a given resource without granting power over the re- source to anyone else, perhaps as a form of precommitment."[202]

Scholars will need to make sure that when they do seek to determine an actual Tragedy of the Anticommons, that they ensure that the scenario meets the key definitional aspects as discussed earlier in this section.

4 EMPIRICAL STUDIES: MORE CATASTROPHE THAN TRAGEDY?

Building on the formal and algebraic models provided in the above reviewed literature, there is a body of empirical research on how human actors respond to scenarios that engage with the Tragedy of the Anticommons. There are also comparative empirical studies that investigate how similarly placed human participants behave with regards to the symmetrical models of Tragedy of the Commons and the Tragedy of the Anticommons.

The results are that human actors do not 'solve' the problem of the Anticommons as well as they 'solve' the problems of the Commons, highlighting the critical importance that the Tragedy of the Anticommons be taken seriously by the community of legal scholars and policy makers.

There are several key claims from the Tragedy of the Anticommons;

i. Tragedy of the Anticommons is harder to spot than those of the Tragedy of the Commons
ii. The more the Actors engaged in the Tragedy, the worse it becomes
iii. Actors respond worse to the Tragedy of the Anticommons than they do to the Tragedy of the Commons, some scholars suggest Tragedy of the Commons vs the 'Disaster' of the Anticommons
iv. Actors frame the two Tragedies differently, and this cognitive bias results in worse reactions under the Tragedy of the Anticommons versus that witnessed in the Commons version

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202 Fennell 2004, 970.

Below, each of these results is analyzed in greater detail.

4.1 Tragedy Increases with Increases in Population of Actors

Stewart and Bjornstad provided experimental settings to examine what occurs as the number of actors increase within a Tragedy of the Anticommons scenario;[203] this is in response to the formal finding that risk would increase.[204]

For the two-player model, their empirical findings matched the formal models with regards to the amount of underusage. But, when they increased the experiment to include four players, the empirical results showed that the scale of the Tragedy had increased beyond that of the formal models.[205] The experiment had participants offer simultaneous prices and over seven rounds of negotiations, [206] and then reassigned to new groups to limit reputational effects.[207]

Their results also found that the experimental group testing behavior against the Commons came much closer to evidencing a trend near the expected Nash Equilibrium, whereas those in the Anticommons experiments did not display such a behavior as their prices remained consistently higher than expected, thus worsening the impact of the Tragedy outcome.[208]

As Gao and Wang commented, this finding is critical because of the specific findings that real-world Tragedy of the Anticommons events with larger number of players engaged creates wastes of underusage "exceeds the theoretical level forecasted by Buchanan and Yoon."[209]

4.2 Humans Respond Poorly to Tragedy of Anticommons Scenarios

Depoorter and Vanneste find that human participants responded in experimental conditions much as the formal models would expect. Overall, they found empirical support for a normative caveat

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203 Stewart & Bjornstad 2002, 3.

204 See discussion on "Actor Plurality Worsens the Incidence", *supra*, at section 3.3.

205 Stewart & Bjornstad 2002, 3.

206 Stewart & Bjornstad 2002, 8.

207 Stewart & Bjornstad 2002, 9.

208 Stewart & Bjornstad 2002, 10, see also Figures 2 and 3, id, 11.

209 Gao & Wang 2008, 1755. See also Major, King, & Marian 2004, discussed supra, in sec. 3.3

for policy makers, that policymakers should be careful in the creation of new property rights, particularly exclusionary rights at the risk of fragmenting difficult to reverse bundles of property rights – implicitly suggesting a burden of duty to evidence that the risk of creating new Tragedies of Anticommons be offset by whatever welfare are expected from the granting of those new rights in property. [210]

In more specific detail, they found:

1. "Anticommons deadweight losses increase with the degree of complementarity between individual parts, and with the degree of fragmentation."[211] (Underscoring added.)
2. "The data illustrates that individual right holders ignore the expected value of bundling and instead focus on the maximum profit he or she could realize by bundling."[212] They also found that "[i]ndividual right holders base their reservation price on a proportion of the expected surplus of the bundler-purchaser. They disregard the objective value of the good altogether." [213] (Underscoring added.)
3. "In cases of uncertainty, the Anticommons dilemma becomes more pronounced. … When deciding the price at which they will sell their rights, sellers seem to disregard potential losses of the purchaser, while they were more willing to take into account uncertainty with regard to profits." [214] (Underscoring added.)
4. "To summarize, our experiment indicates the pricing effect in settings where complementary units are fragmented over individual right-holders. Absent price coordination among these right holders, the independent pricing decisions place a high negotiation burden on a third-party purchaser. … If we assume initial selling prices are sticky, the prospective costs of negotiations might lead to abandonment of value maximizing projects, leading to the tragic outcome of under use or idleness." (Underscoring added.)

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210 Depoorter & Vanneste 2006 (Humpty Dumpty), 22 – 23.

211 Depoorter & Vanneste 2006 (Humpty Dumpty), 21.

212 Depoorter & Vanneste 2006 (Humpty Dumpty), 1.

213 Depoorter & Vanneste 2006 (Humpty Dumpty), 21.

214 Depoorter & Vanneste 2006 (Humpty Dumpty), 21.

Finding Number One accords well with formal models,[215] in that the role of complementary goods or services drive the mechanism of the Tragedy. Perfectly complementary goods and services are at the limit of that rule and have been found to lead to total underuse, ie abandonment.

Finding Number Two reflects well on the assumption of rational self-interest, even when the actor has an awareness of the net results for all of the actors involved in the transaction.

Finding Number Three is worrisome, as it is quite reasonably foreseeable that many real-life Tragedy of the Anticommons will involve multiple vectors of uncertainty and be risk-bearing in decision-making. That such data-driven uncertainty will lead to worsened results within the Tragedy means the risk of dramatic underuse or abandonment will be higher and thus a more serious policy concern to model and anticipate.

Finding Number Four is perhaps the most substantial, as it builds on the prior three findings and models that the actor who is likely to bear the largest proportion of the transactions costs to attempt prevention of the Tragedy's mechanisms will face such high transaction costs that they simply may not bother, resulting in abandonment, the extrema of the Tragedy.

In summary, they have empirically documented that human actors do not fare well with the Tragedy of the Anticommons, not in the settings covered by their methodologies.

4.3 Humans Respond Worse to Anticommons Scenarios than Commons Scenarios

Vanneste, Van Hiel, Parisi, and Depoorter undertook multiple methods to empirically evaluate if human actors responded similarly or differently to the mathematically equivalent systems of Commons and Anticommons Tragedies.[216] In particular, they wondered if there would, per the research results of the Behavioral Economists,[217] be framing issues and other associated problems in addressing the differences of the overuse versus underuse of the two models. As a prelude to

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215 *See* Sun & Liu 2017 for their Tragedy of the Commons model that integrates a general constant elasticity of substitution (CES) function.

216 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 108.

217 By Behavioral Economists, I refer to such researchers as Andreoni, Kahneman, Knetsch, and Thaler.

their findings, their conclusion is that the correct title for the model might be "***Disaster of the Anticommons***":

> Our results unequivocally supported the proposition that Anticommons yields higher prices than the Commons dilemma (Study 1) and that Anticommons dilemmas are more prone to underuse than Commons dilemmas are to overuse (Study 2). If Commons lead to "tragedy" (see Hardin, 1968), Anticommons may well lead to "disaster."[218] (Underscoring added.)

After running multiple experiments and having used different methodological approaches, they found strong evidence that human actors did respond differently to the two models of Tragedy, with actors responding more poorly to the Tragedy of the Anticommons than they did to the Tragedy of the Commons. They also tested for the scenario of how actors will respond when the dangers or risks of the tragedy facing them are explained ex ante before the experiment or scenario is played.[219]

Thus, while the mathematical models are duals and thus equivalent, human forms of rationality are likely to make the effects of the Tragedy of the Anticommons worse than those scenarios when we face a Tragedy of the Commons:

> This suggests that Anticommons and Commons do not necessarily represent symmetrical problems, but rather that the "Tragedy of the Anticommons" presents a greater social threat (underuse from blocking the use of resources by posting very high selling prices) than the Commons dilemma (overuse of resources).[220] (Underscoring added.)

They found that pre-awareness failed to be a sufficient remedy to both forms of the Tragedies forms, in that in both cases the information failed to incentive the actors to avoid their respective tragedies.[221] Worse, their experiments found that, even with that ex ante information, that the actors responded "significantly" worse to the Anticommons Tragedy than they did to the Tragedy

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218 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 117.

219 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 112.

220 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 111 -112.

221 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 116.

of the Anticommons.[222] This result is more than just interesting, as it runs contrary to the earlier forecasted behavior for the Tragedy of the Anticommons, which is for it to be equal in welfare loss to the Tragedy of the Commons.[223] The authors also highlight that these results are quite stable results, as they derive from a set of empirical efforts that include multiple research methodologies, multiple research designs, and multiple modalities.[224]

Given these results, they provide guidance, which they label normative, to be cautious in re-designing property law or in re-allocated property rights, that whenever functional property rights cannot be coordinated, it may be public-welfare-wise to prefer the creation of Commons than Anticommons, or that caution should be applied to avoid transforming Commons into Anticommons:

> For example, whenever it is not possible to divide the common garden of a condominium building, Commons regimes may be preferred to Anticommons regimes. Condominium owners should be allowed to use the common resource without needing others' permission. Even <u>though this regime may lead to an overuse of the common resource, the resulting inefficiency would be lower than the inefficiency generated by an Anticommons regime</u>, where condominium owners could use the common garden only when all others gave them permission to do so.[225] (Underscoring added.)

Behavioral economics suggests that this may have to do with framing, that actors will view the cure to Tragedy of the Commons as gains-based scenario whereas the actors will view the cure to Tragedy of the Anticommons as loss-based scenario:

> Anticommons owners have a right to exclude others and a right to veto any transformation of the common resource. The <u>prerogatives of an Anticommons owner are perceived as something that they "own," and psychological attitudes are triggered for the protection of such entitlement</u>. No sense of "harm" is associated with one's exercise of the property right, even though others may

222 "In line with Hypothesis 3, it was shown that participants made significantly higher bids in the Anticommons than in the Commons dilemma condition;" Vanneste, Van Hiel, Parisi, & Depoorter 2006, 116.

223 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 116; with reference to Buchanan and Yoon (2000) and Schulz, Parisi, & Depoorter (2003)

224 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 116 - 117.

225 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 117.

> suffer a possible economic prejudice. Commons users instead do not perceive their opportunity to use the Commons as something that they own. When overexploiting a common resource, they fully realize that they are imposing an economic prejudice to others and partially restrain from such abusive behavior.[226] (Underscoring added.)

This conceptualization reflects Kahneman's earlier findings that actors will respond asymmetrically to selling an item versus paying for the same item; that actors expect to get paid much more than they would be willing to pay for the same item.[227]

It is important to revisit that these results do not lessen nor challenge the formal mathematical models of the Tragedy of the Anticommons, but rather reveal that most human actors are likely to add forecastable human behaviors that would worsen the already welfare reducing loss of activity, underusage, or abandonment from the Tragedy's rational formal models.

In a follow-up study on how social framing impacts the human actors facing both tragedy of the Commons and Tragedy of the Anticommons,[228] the cognitive interpretation of first actors judging second actor's motives for the behavior of the second actors was investigated. It was found that the "participants' causal attributions for the other party's cooperative and noncooperative behavior in the Commons and the Anticommons" did differ between the two kinds of tragedy.[229] In particular, they wanted to analyze why experimental participants required higher prices to overcome the Tragedy of the Anticommons than they did experimentally for the Tragedy of the Commons.[230]

Interestingly, they report that the study found that unlike for Tragedy of the Commons, the participants did not cognitively identify the issues of cooperative and noncooperative behavior as centrally in frustrating the efforts to solve the Tragedy of the Anticommons;[231] although they still found that noncooperative behavior was reported as frustrating the efforts. Thus, the prosocial motivations of the participants was less critical for the Anticommons dilemma than it was for the Commons dilemma.

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226 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 117.

227 Vanneste, Van Hiel, Parisi, & Depoorter 2006, 117.

228 Van Hiel, Vanneste, & De Cremer 2008, 174.

229 Van Hiel, Vanneste, & De Cremer 2008, 174.

230 Van Hiel, Vanneste, & De Cremer 2008, 190.

231 Van Hiel, Vanneste, & De Cremer 2008, 191.

Further, it appears that 'fear', meaning unclear strategic behavior in the face of uncertainty, did enhance the Tragedy of the Anticommons, but from an unexpected angle. It was those actors with 'cooperative' behavior that was most impacted under 'fear' before the Anticommons.[232] It appears that cooperative behavior itself, as a strategy, is being conserved and thus protected by additional caution:

> In the Anticommons dilemma, it is clear that when the buyer declines the bids of the various owners, the group members still have to continue cooperating with each other. Thus, cooperative targets are perceived to be afraid to ask their share because asking too much money for one's belongings may jeopardize future cooperation.[233]

Thus, those parties most likely to coordinate to resolve the Tragedy of the Anticommons also display behaviors that suggest that they protect the ability to cooperate in future rounds of interactions of avoiding the Tragedy, which tragically worsen the ability in the immediate round to cooperate. This is not only tragic, but tragic in a 'Catch-22' sense, that those most likely to cooperate to avoid the Tragedy of the Commons are less likely to be cooperative in any particular round of the Anticommons Tragedy due to a perceived need to conserve resources for future efforts of cooperative strategies – we can't be as cooperative today for we hope to be cooperative tomorrow, yet tomorrow will again be a 'today'. Again, this alludes to the earlier phrasing of the Disaster of the Anticommons, versus the 'lesser' Tragedy of the Commons.[234]

4.3.1 No Sense of Loss or Tragedy?

In analyzing the their findings, as discusses above at , Van Hiel, Vanneste, & De Cremer cite to Vanneste, VanHiel, Parisi, and Depoorter's argument that it would appear from experimental and empirical work that in the case of the Anticommons, that actors do not sense that they are losing

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232 Van Hiel, Vanneste, & De Cremer 2008, 193.

233 Van Hiel, Vanneste, & De Cremer 2008, 193.

234 "If Commons lead to 'tragedy' (see Hardin, 1968), Anticommons may well lead to 'disaster.'" Vanneste, Van Hiel, Parisi, Depoorter, 2006, 117, underscoring added. This reference also alludes to the 'disaster' reference in the title of their article, id, at 105.

anything, as that which could be gained in welfare was not yet present or manifest,[235] quite contrary to the obviousness of the context of Tragedy of Commons scenarios wherein the wasted or lost asset(s) are obvious to one and all. One can readily see a fish stock dwindle or a pastured be ravaged, it is far harder to perceive the loss of that which never was yet to be.

Opportunity costs are those opportunities forgone to attain or achieve a specific opportunity. In the case of the Tragedy of the Commons, the opportunity costs, the potential risks, of not solving the tragedy are obvious to the actors and can become internalized into decision making procedures, as Ostrom and others have repeatedly demonstrated. (Not arguing that such always occurs, as the risk of Tragedy remains with Commons if appropriate behavior rules are not adopted.)

Yet in the case of the Anticommons, as what is wasted or lost is in the yet-to-be prospective fruit of cooperation, it can become external to the decision process of the actor, much as the inclusion of yet-to-be future generations can cause problems in other areas of law and in economic modelling. Rational models of such prospective events might include forms of probabilistic event modelling, probabilistic-based temporal discounting, or various models of incomplete information, all of which could lessen or eliminate the value of that perfected fruit of 'no operation of exclusionary rights' from full recognition in the decision making of each actor.

And it bears reminding that this discussion is not a discussion on the formal mechanisms of the Tragedy of the Anticommons, which has been shown to occur with full awareness of the risk of wastage, but rather is a discussion on the contextual framing that could have knock-on effects on the behavioral economics of the actors involved, a set of effects likely to worsen the actors' ability to overcome the Tragedy of the Anticommons.

5 Overcoming the Tragedy of the Anticommons

One cannot long tell the tale of Hardin's Tragedy of the Commons without updating the audience that the Tragedy was mostly solved in antiquity and that the very definition of Commons that Hardin relied upon in his narrative was actually a well-governed type of property, verily defined

235 Van Hiel, Vanneste, & De Cremer 2008, 195.

by customary rules and local laws.[236] Indeed, Elinor Ostrom received the Noble Prize for her efforts in researching, discovering, and documenting the various and many forms of societal solutions to that Tragedy of the Commons.

Nevertheless, the internal mechanisms as identified by Gordon and Scott remain dangerous, unless solved by approaches beyond the initial construct. Thus, hereunder the identified solutions to the Tragedy of the Commons are discussed, followed by a discussion on the potential remedies to the Tragedy of the Anticommons.

And as noted earlier,[237] Parisi, Schulz, and Depoorter noted that sequential notions of Anticommons may well be reflected in the theories of economic growth, thus it is imperative that we understand the connections between sequential Anticommons problems, their legal solutions, and the continued potential to improve welfare via legal instruments, especially in international settings coordinated by international law.

5.1 Solutions to the Commons Tragedy

Michelman, in perhaps the earliest description of the optimand for finding solutions to the Tragedy, wrote:

> Coordination always entails some direct ("transaction") costs, and the existence of those costs always leads to some shortfall from perfect coordination: the coordinating society always to some degree approaches **S*** and never attains it. The value of the shortfall is the society's "deadweight loss"; and the total of the deadweight loss and direct costs of coordination is the society's economic waste.

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236 Despite the known problems, Hardin's article remains widely used in education and is often mistaught; *see* Janssen, Smith-Heisters, Aggarwal, & Schoon 2019, which provides an empirical study of the uses and misuses of Hardin's article in recent education. Ready examples of scholarship correcting much of Hardin's arguments can be found in Feeny, Berkes, McCay, & Acheson 1990.

237 See the discussion on definitions of Anticommons Tragedies and the potential connection to theories of economic growth, supra, at 2.5, and in further detail at footnote 76.

> From the standpoint of a concern for efficiency, the object of composition rules is minimizing economic waste.[238] (Underscoring added.)

Heller lists three methods for solving or preventing the emergence of the Tragedy of the Commons: (i) the privatization of the Commons into private property, (ii) cooperative engagement via local, folk, or customary rules outside of formal legal institutions, and (iii) political advocacy and public regulation, i.e., to use public law to limit access to the common resource.[239]

First, the benefits of assigning private rights to what might otherwise be a commonly held property are well covered in the literature. Demsetz provide a framework for when private property right would or could evolve within a community, which amongst other features, Heller notes that Demsetz identified a conservation effect as a motivation and justification for the privatization of otherwise property held in common.[240]

This mechanism works via microeconomics' marginal cost analysis, to set the costs of marginal acts of use against the marginal revenues (or marginal services) received for that act of use. By so doing, when in reasonable levels of competition with other resources, the resource being measured will be kept at its socially optimal usage, which may well include in many cases not being used in the current time period.

Second, Ostrom provided many examples of how cooperative engagement function in various communities faced with stewarding a resource in common.[241] So-called cooperative structures can include a variety of social mechanisms including shame, gossip, magical taboos, and other social modes of interaction to provide incentives, both positive and negative, outside of more formal legal institutions, to guide individual behaviors to coordinate on use of the common assets.

Third, Heller posits that "state coercion can solve overuse."[242] There are two sides to this strategy. First, public law and public officials are what enable the acts and virtues of private property and of privatization for individual members of society, by providing a public good of

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238 Michelman 1982, 671

239 Heller 2013, 11.

240 Heller 2013, 11.

241 Heller 2013, 11.

242 Heller 2013, 12.

'governance and safety' that reduces the cost of maintaining the exclusionary rights associated with private property. Second, public institutions can directly regulate the access to the common resource, either directly via officers and controls on gate/access or by enforcing licenses and permits to access the common resource.

5.2 Literature on 'Governance' of Anticommons

The literature on how to address and prevent the arising of the Tragedy of the Anticommons is not as advanced as the literate to overcome the property rights issues associated with the Tragedy of the Commons; surely no Nobel Prize has yet been awarded.

Thus, hereunder represents an effort to collect the known means or recommendations of how the Tragedy might be best voided. However, there is a general theme running through them, much as Buchanan and Yoon earlier forecasted for groups facing multiple holders of exclusionary rights:

> Here we clearly are in an Anticommons setting, and any solution will involve less than efficient utilization of the commonly shared facility. The wastage of value will be a function of the number of decision-making units that are assigned rights to exclude users—rights that may be simultaneously exercised. As this number increases, the wastage of underutilization increases, and, in the limit, the resource will be completely unused.[243]

To which they add an additional caveat, that 'conventional' incentives might not untangle the mechanisms of the Tragedy:

> allowance for noneconomic motivation suggests that the ''natural'' pressures toward efficiency represented by the implementation of agreements, mergers, or contractual arrangements generally among affected parties may be much less effective than the for- mal analysis seems to imply. The genuine zealot, as either user of or excluder from a potentially valuable resource, may be insensitive to proffered compensations.[244]

The below *almost dozen* listed strategies are primarily dedicated to finding ways to reduce the wastage by reducing the number of parties holding exclusionary rights.

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243 Buchanan & Yoon, 2000, 5.

244 Buchanan & Yoon, 2000, 12.

Parisi, Schulz, & Depoorter identify that a central issue in both the creation of the Tragedy of the Anticommons and ultimately in its avoidance is the concept of a unified or re-unified bundle of rights that better aligns the rights of use and exclusion:

> Once a common resource is subject to multiple exclusion rights held by two or more individuals, each co-owner has incentives to prevent other users from using the resource at an efficient level. Despite the fact that the common resource would be used to its highest and best use by a single owner, the existence of co-owners seeking to exert their individual exclusion rights will cause them to fall short of the net social benefits of the asset. [245]

This statement, in many subtle ways, is a rephrasing of Cournot's original observation, that complementary oligopolies would perform worse than monopolies.

5.2.1 Team Sports Against the Anticommons

"Be a team player" might be the final anthem against all Anticommons ever, suggesting both a goal of a team win and the need for individual sacrifice, even if in a limited sense.

Many sports teams face the Anticommons Tragedy in ever single game played in competition. As noted by Major, King, and Marian, a football team is composed of many excellent players who need to coordinate with each other's talents and skill sets to win as a team yet simultaneously need to maximize their own metrics and game-time data events, such as points scored by the player.[246] Each player knows that unless the team works together, and that each player yields on their personal optimal metrics, that there is a high risk that the team may lose and all players lose on fame and income. .[247] Yet, every player knows that each player, especially professional players where income is all critical, is watching and maximizing their personal metrics and individual displays of greatness to best increase their career earnings, including from non-team income such as personal sponsorships and advertising. .[248] Thus each player needs the glory of the team win while each player hopes to selfishly achieve break-through moments of game

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245 Parisi, Schulz, & Depoorter 2004, 176.

246 Major, King and Marian 2016, 251.

247 Major, King and Marian 2016, 251.

248 Major, King and Marian 2016, 251.

play that launch their earnings trajectory higher.[249] Football teams face the Tragedy of the Anticommons in every professional game they play.

The challenge of coaches and team owners is to find a way to optimize both each player's own personal performance and to best ensure that the team actually wins the game. While I have yet to find a formal model of teamplay that can universally be applied to legal issues, it can be reassuring to legal researchers that many people have spent careers looking for ways to overcome hidden Anticommons problems; indeed, some have found the human condition enjoys coordinating to yield a bit in order to win as a team. Perhaps the Behavioral Economists will have more to add as research evolves on how to best address the incentive packages, the mechanism design approach, to achieve more general solutions to the Tragedy of the Anticommons.

5.2.2 Gabriel's 'Game of Chicken' Model

Gabriel provided a model of Tragedy of the Anticommons conditions by employing a 'Game of Chicken' model from game theory. The model follows Fennell's models and King, Major, & Gabriel's use of Fennell's model.[250]

The Game of Chicken can be as simple as two players who need to jointly coordinate but will fail to optimally coordinate:

> The Game of Chicken is a model of a social dilemma arising from non-coordination among rational players. Each player in the game benefits more from bilateral cooperation than from bilateral defection; however, if one player expects the partner to cooperate, he/ she will have incentives to defect in order to save its resources and still benefit from the realization of the project.
>
> There are rational maximizing strategies, Nash best response, which consists of one side playing the best strategy possible by recognizing the preferences of other side across options, and each of the other sides doing correspondingly. The Nash equilibrium results in suboptimal returns both in the aggregate and to each

[249] Major, King and Marian 2016, 251.

[250] UPDATE - Fennell 2004, Fennell 2011, King, Major, & Marian (2016a)

> of the separate game players than had there been a central authority assigning compulsory tasks.[251] (*underscoring added.*)

The Game of Chicken is usually presented as a multi-stage iterative model, wherein each round of failure to bilateral cooperation enables a subsequent round of Chicken. Failure could result from acts of non-concessions or breach of promises, as both parties seek their second-best outcomes. [252] These strategies result in Nash Equilibria of repeated suboptimal results, and each stage incurs costs to both parties. [253]

Gabriel presented two payoff matrices, one for the initial stage and a second for all subsequent rounds:[254]

Table 3: Pay-Offs from First Round of Chicken

Pay-off Rule: $\alpha > \beta > \gamma$			
Initial Stage		**Player 2**	
		Concede	**No Concession**
Player 1	**Concede**	(β , β)	(γ , α)
	No Concession	(α , γ)	*Next stage*

Table 4: Pay-Offs from Second and Subsequent Rounds of Chicken

Pay-off Rule: $\alpha > \beta > \gamma$			
Later Stages		**Player 2**	
		Concede	**No Concession**
Player 1	**Concede**	(β , β) - Costs	(γ , α)- Costs
	No Concession	(α , γ) - Costs	*Next stage*

251 Gabriel (2018), 34.

252 Gabriel (2018), 34.

253 Gabriel (2018), 34.

254 Gabriel (2018), 34 and 35.

The logic of these pay-off matrices can be explained by examining what happens when one player assumes that the other player will concede. When a player examines their own choices from that assumption of expected concession, they earn a larger reward (α) if they defect and don't match the other player's concession than the reward (β) earned from harmoniously conceding along with the other player. Thus, both players will seek to not concede when they expect the other player to concede.

Analysis of the reverse case, when a player expects the other side to not concede, is more complex and depends on how that player models the value of the 'next stage' box as a sum of all future rounds until concessions are reached. Nevertheless, the choice facing the player in that situation is to choose between (γ) and that modelled value of the 'next stage' box; a foreseeable series of 'no concessions' would also reflect a sum of ***n*** * costs across those ***n*** stages, thus, again the strategic choice would be to choose to not concede so long as those costs reduce the expected value below (γ).

Gabriel posits that the triune problems of (i) truly independent actors, (ii) mutually assumed strategies of self-interest, and (iii) and that group welfare function depends on all actors acting in agreement, will "result is underparticipation and loss of efficiency than had there been a more unified authority regime."[255]

In order to avoid the Tragedy of the Anticommons under this Game of Chicken model would require the existence of "some authority or rules outside this rational game that is exerted on those involved in order to enforce cooperation at maximally constructive levels."[256] Gabriel refers to a critical "collective bundle of all the permissions,"[257] that without which, the Tragedy arises.

5.2.3 Full Exclusion: Re-Unify the Bundle of Exclusionary Rights

Heller proposes that for Tragedy of the Anticommons cases of *full exclusion*, that governments or international organizations, such as the EU, could approve or coordinate the expropriation of the

255 Gabriel (2018), 38.

256 Gabriel (2018), 38.

257 Gabriel (2018), 33.

fragmented exclusionary rights back into a more unified bundle,[258] approaching a singular right of exclusion to reduce the amount of underuse.

Parisi, Schulz, & Depoorter found a similar argument, that private property law, especially within the common law, had established a toolset to re-unify the bundle of exclusionary rights.

> Likewise, other legal rules may create default reunification mechanisms. Time limits, statutes of limitation, liberative prescription, rules of extinction for non-use, etc., can all be regarded as legal devices to facilitate the (otherwise costly and difficult) reunification of non-conforming fragments of a property right.
>
> These legal solutions can be analogized to a gravitational force, reunifying rights that, given their strict complementarity, would naturally be held by a single owner.[259]

In the review of their public Anticommons model, Gao and Wang advise that the Chinese government can avoid such situations by, in the right judicious circumstances, implement 'super-ministries' that could be granted re-bundled rights of exclusion; ie, unitary approval powers.[260]

Landry proposed, in the context of space law and property claims in 'outer space,' that a central international authority be established to re-bundle the allocation of exclusionary rights currently handled by a portfolio of treaties and related UN organizations;[261] he advocated that by rebundling the rights to assign property (in alignment with conventional "possession requirements")[262] that the authority could prevent future acts of fragmentation and creation of Anticommons in space.

5.2.4 Group Exclusion: Public Control over Exclusionary Rights

Heller proposes that for Tragedy of the Anticommons cases of *group exclusion*, that governments or international organizations provide public regulatory control of the exclusionary rights:

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258 Heller 2013, 18.

259 Parisi, Schulz, & Depoorter 2005, 587.

260 Gao & Wang 2008, 1759.

261 Landry 2013, 566 -567.

262 Landry 2013, 567.

> For both group access and group exclusion, the full array of market-based, cooperative, and regulatory solutions is available. Although self-regulation may be more complex for Anticommons resources, close-knit fragment owners can sometimes organise to overcome Anticommons Tragedy. For group exclusion resources, the regulatory focus should be support for markets to assemble ownership and removal of road- blocks to cooperation.[263]

Heller is essentially making an argument for a Coasean re-allocation in support of negotiations to re-bundle the exclusionary rights.

5.2.5 Complementary Goods and Services: Integration of Decision Makers

In the case of complementary services or good, facing decisions by independent suppliers or vendors, the Tragedy of the Anticommons might be best avoided by finding a means to integrate the decision makers into a singular structure;[264] e.g., in business terms, a merger of the business owners could enable an efficient decision on how to coordinate the provision and supply of the complementary goods and services.[265]

Parisi, Schulz, & Depoorter explain how Coase's theory of transaction costs suggest that under ideal conditions, that the actors ought to be able to re-organize and re-bundle the exclusionary rights to better align with the rights of usage to prevent the Tragedy of the Anticommons, but that those ideal conditions rarely exists and thus asymmetrical transaction costs are likely to prevent that rebundling of the exclusionary rights.[266] That a single owner faces few if any substantial transaction costs in dividing her bundle of rights into separate rights, [267] much as a landowner might bequest their land in separate parcels to various heirs. However, the ability of those heirs, or their subsequent heirs, to overcome the complexity of multi-parties' self-interest and the cumulative transactions costs of those efforts, are likely to be far more expensive than the original division of those rights. [268]

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263 Heller 2013, 18.

264 Heller 2013, 21.

265 Heller 2013, 21.

266 Parisi, Schulz, & Depoorter 2004, 183.

267 Parisi, Schulz, & Depoorter 2004, 183.

268 Parisi, Schulz, & Depoorter 2004, 183.

Thus, a key aspect of overcoming or preventing the emergence of the Tragedy is to first carefully limit the amount of segmentation of the rights, and second, where possible, provisions could be undertaken to reduce the costs of rebundling the exclusionary rights. Perhaps a Coasean re-allocation could be enacted to better enable certain parties to more efficiently rebundle those rights; of course, this means establishing a bias or reflecting some form of preference for some parties over others. Perhaps that could be addressed via political institutions or socially supported narratives of justice. Or, a public agency might have funding allocated to it to enable capital to be employable to facilitate the necessary negotiations.

Not mentioned by Heller, but this could in terms of public goods become an argument for coordination of governance structures such as by re-assigning the decision making to higher and thus more integrated levels of federalism or by joining into 'singular' jurisdiction for the purposes at hand, such as 'unitization' of an international oil field or the singular Port Authority of New York and New Jersey.

It is also worth observing that in the theoretical approaches of public choice theory, each agent of public service seeks to maximize their rents from that service, they are viewed as individualist maximizers that interact within roles of public service.

5.2.6 Reduce Institutional Grants of Exclusionary Rights

With patent rights, which are suggested to be an area of increasing quantities of governmental grants of exclusionary rights to overlapping research results, Heller reports on a body of research that finds that a potential work-around is to simply make the obtaining of such rights more difficult or rare to obtain.[269] Heller also reports on similar issues arising in areas of broadcast spectrum property rights,[270] in technology patenting,[271] and in areas of art and music,[272] such as in sampling of sounds or images.

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269 Heller 2013, 21.

270 Heller 2013, 22, with reference to Hazlett's work on the 'tragedy of the telecommons.'

271 Heller 2013, 22, with reference to Ziedonis's work on patent acquisition and welfare loss risks.

272 Heller, 2013, 22, with reference to his book *Gridlock Economy*.

It has been noted by several researchers that such efforts might have been implemented within the historical development of property law within common law, Heller has called this jurisprudential tendency a 'boundary principle' in American property law.[273] The approach that common law courts took to a variety of less common assignment of rights, which could accumulate over time to provide extensive sets of exclusionary rights dispersed across numerous parties, reflects a clear tendency to limit those grants of exclusionary rights. [274] Legal concepts such as prediality, 'touch and concern' in common law, and the *numerus clausus* principles from civil law all feature historical treatments to limit them to contractual rights versus property rights cum rights in realty.[275]

Researchers have repeatedly emphasized the normative policy that legal policy makers, be they judges or legislators, strong consider the development of rules that resist the fragmentation and disbundling of exclusionary rights.[276]

Beyond the historical accretion of common law rules to limit the granting of fragmentary acts of disbundling exclusionary rights, policy makers could enact new rules that could more actively seek to time limit or reverse the process of fragmentation, especially when it occurs within a regulatory context:

> Theoretically, the Anticommons tragedy exists because it is a game theoretic coordination problem without a socially optimal dominant solution. Legally, the Anticommons tragedy continues to exist due to path dependency (Brunetti, 1991; Heller, 1998; Parisi et al., 2005). Rules involving statute of limitations, liberative prescriptions, and rules of extinction for non-use all work to reconsolidate fragmented property rights holders, but rarely have these been applied, or perhaps even could be applied, in a regulatory setting.[277] (Underscoring added.)

Thus, it is important for legal scholar to recognize that legal Anticommons exist because legal rules or court decisions create assignments of rights that enable the Anticommons mechanism; the

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273 Parisi, Schulz, & Depoorter 2004, 186, with citation to Heller 1999, 1173–1174, wherein he discusses judicial limits against the rule against perpetuity, zoning and subdivision restrictions, property taxes and registration fees.

274 Parisi, Schulz, & Depoorter 2004, 185.

275 Parisi, Schulz, & Depoorter 2004, 185.

276 Major, King, & Marian 2016, 261.; citing to Parisi 2002, without a pin-cite.

277 Krosnik 2012, 211.

creation of legal Anticommons is wholly artificial and can be re-regulated by active policy makers if they so choose to do so.

5.2.7 Pervasive Awareness of the Tragedy of the Anticommons

Perhaps due to the massive education exposure that the Tragedy of the Commons has received, or perhaps due to simply routine human experience, early empirical studies suggest that in laboratory experiments that individuals are more likely to act individualistic in the face of an Anticommons Tragedy scenario than in the face of a Commons tragedy.[278] It is not a long jump, given the repeated statements on how it is more difficult to spot Anticommons tragedies than it is to spot Commons tragedies, that perhaps greater awareness might enable different responses to the emergence of the incidents of Anticommons tragedies and thus facilitate adoption of the above potential strategies to mitigate those risks.

Almost as if Michelman were telegraphing hope to the reader, he provided a critique of Hardin's notion of tragedy, that it was its unavoidableness, based on humanity's incapacity to cooperate, countering that any notion of private property required the existence of trust and of cooperation:

> Where can the regress end, if not in uncoerced cooperation, the untragic Commons of constitutional practice founded on a "rule" that there is no one to enforce but that people on the whole adhere to, though adherence is in the interest of no one who does not trust that (most) others will adhere to it, by "mutual agreement." In other words: no trust, no property. In the very survival of proprietary institutions we have empirical evidence of the possibility of trust; as we have in the electorate's behavior each election day.
>
> Short of absurdity, then, the metaphor of the Commons cannot speak to us more powerfully of the rational necessity of social cooperation than of its rational possibility. In this dialectic of necessity and possibility, private property emerges as a possible device or instrumentality for social cooperation-available, as such, only to agents *who have, in the first place, a capacity for cooperative action.* The

278 Heller 2013, 22, with reference to Vanneste et al 2006.

> initial premise has to be that of cooperative capacity; it cannot be the contradictory of that.
>
> Since cooperation is - has to be - both possible and existent without and prior to property, the domain of property cannot be coextensive with that of the Commons (all Commonses). Property is a scheme of social cooperation whose utility is always a question for judgment and choice, dependent on multiple considerations varying with the circumstances, rather than impelled by some universal and inexorable grim logic of welfare. In any given Commons, property may offer the best mode of cooperation, but it also may not. (Underscoring added.)[279]

5.2.8 Evading Regulatory Anticommons

Bellantuono provides two recommendations, he calls them 'principles', on how to best avoid the problems of regulatory Anticommons circumstances:

> **Principle no. 1 for regulatory Anticommons**: *Overlapping jurisdictions: If fragmentation cannot be reduced (which is usually the case), rely to the largest possible extent on overlapping jurisdictions and confer each of them a high degree of autonomy.* (Emphasis and bold as in original.)
>
> **Principle no. 2 for regulatory Anticommons:** *Alternative jurisdictions: To avoid inertia, delay or hold out, always provide for alternative regulatory jurisdiction and for an authority of last resort.* (Emphasis and bold as in original.)

The first principle is well recognized in many names, it an argument to place the act of regulation at the appropriately high level to enable efficient governance of the issue. However, this will be of limited success, both for reasons from economic analysis and from reasons due to desires to limit the powers of political agency. It is of course, unclear how this principle functions given Bellantuono's own hesitations about super-ministry concentration and the impact on regulatory Anticommons.[280] But the practical result of these thoughts is the simply stated hard to do task of setting each regulatory task at the correct level and placements in both vertical and horizontal

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279 Michelman 1982, 687 – 688.

280 See discussion, supra, at sec, 3.8

consideration. I see no evidence presented that this challenge would be any less complex or more readily computable than the underlying Anticommons Tragedy.

Principle 2 is less fully revealed as to its mechanisms and to its potential advantages. The simple fact that the mechanism requires a judgement call of when to re-locate a regulatory decision in the middle of a complex process of approvals would at first blush appear to enhance the regulatory Anticommons presented, and not to reduce it.

Thus, these principles can be seen as calls for efficient federalism and regulatory assignments of authority and for super-ministries. The first is likely too complex in itself to be a more efficient alternative and the call for super-ministries engages so many political and economic questions that one doubts it would appeal without both substantially more research to support its efficacy in real-world settings and severe and obvious political crisis from which democratic approvals could be sought.

Krosnik found three reforms might be of use to limit the negative efficacy of entrenched areas of regulatory Anticommons. First, policy makers could "create a lead regulatory agency with primacy rights over" a particular regulatory concern. Second, they could "to outright eliminate some of the duplicative, fragmented regulatory rights holders which weigh down the system," to declutter the number of actors to a much smaller set of actors.[281] Finally, she recommends regulatory action to better facilitate cutting the Gordian Knot of Anticommons by:

> The theoretical solution to any Anticommons tragedy is to coordinate the perspectives of disparate rights holders, either through force (the lead agency concept), diminution of the number of rights holders (organizational reform), or simply better communication, organization, and alignment of expectations of existing rights holders.[282]

Thus, Krosnik recommends a notion of super-ministry, a reduction in the number of agencies with overlapping regulatory zones, and efforts to facilitate coordination of the agency-actors.

It might be useful here to place a reminder of Krosnik's guidance on how to overcome the path-dependency lock-in that gives rises to many of the persistent forms of regulatory

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281 Krosnik 2012, 212; see also the discussion, supra, at sec. 3.8.1, wherein Krosnik establishes that the welfare loss increases as the number of agencies increases.

282 Krosnik 2012, 212.

Anticommons.[283] Her advice was to time limit the application of regulatory frameworks, or to at last require a review before extending their period of application, so that an exit remains to the Anticommons-creating conditions.[284] Particularly with regards to Anticommons created by acts of law, private and/or public, the removal of that enactment will also terminate the Anticommons. This is different from products, services, or resources, wherein their source of complementary character stems from technological notions of complementarity.

5.2.9 Corporations and Capitalism

It appears, at least anecdotally at this stage of research, that the growth of certain firms might benefit from a cascade of solutions to Anticommons challenges in their operative spaces of commerce. That beyond merely taking advantages of scale, that there might be a separate technology engaged, an ability to spot instances of Anticommons and see viable solutions where the market does not yet see those solutions.

One example could be how early Standard Oil was begun by acquiring a sequence of oil storage facilities along the emerging railways of the Midwest. Another might be Google or Apple acquiring other technologies firms that 'fit' their inner visions of corporate development.

Thus, a note on the ability to overcome Tragedies of the Anticommons, there would be a strong tendency observed in corporate history, that certain firms are able to leverage certain efficiencies in accumulating and bundling what were once never-integrated complementary assets. That a skill or a 'lucky streak' in solving observed Tragedies of the Anticommons could lead to more efficient efforts in solving subsequent related problem spaces.

5.2.10 Avoidance of Ruin from Depletion - From Commons towards Anticommons

Further, the arising of Anticommons may itself be the result of a chosen welfare enhancing pathway, complete with society's endorsement.

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283 See discussion, supra, at sec 5.2.6

284 Krosnik 2012, 211.

As Parisi, Schulz and Depoorter noted, in alignment with Heller's historical settings of the Anticommons emergent in Russia, "[t]he transition from Commons to privatization, while beneficial in terms of the creation of private incentives for research, generates a gradual proliferation of exclusion rights with resulting Anticommons problems."[285] Thus, one must be careful in becoming a Cassandra of the Anticommons, not all Anticommons are fully characterized as tragic, as they may well indicate a beneficial but incomplete capture of a useful resource space.

This is especially so in light of those situations wherein a Tragedy of the Commons shares a space with a Tragedy of the Anticommons. In those cases, the granting of rights of exclusion may prevent the worst-case scenario of exhaustion and depletion of a resource yet could result in a 'Tragedy' of the Anticommons where that resource remains utilized but underutilized.

The avoidance of ruin doesn't guarantee efficient use of the resource, but that half-solution to avoid the first form of ruin is not necessarily a failure of policy but rather a recognition that two counterbalancing rule sets are needed to avoid both ruin of resource by exhaustion and ruin of welfare by total avoidance and non-use of the resource.

The emergence of the Anticommons itself is a sign, in the transition from pure Commons, to a more stable environment to seek additional answers on resource management.

5.2.11 Strategic Choice -- Comedy of the Anticommons

Heller reports that Rose's comedy of the Commons, wherein positive benefits can accrue to a community from certain types of Commons,[286] could also provide a rationale to a Comedy of the Anticommons, where in multiple parties exercising their exclusionary rights might actually created a public good, such as in protecting a natural area from commercial development.

This theme has been picked up by a variety of scholars, in finding that Anticommons can be very useful legal constructs when a resource should be strongly guarded but not necessarily placed beyond no access, 'merely' requiring all members to concede and agree to its limited usage:

> A number of scholars have suggested that an Anticommons regime is a desirable allocation of property rights when non-use of the resource is the preferred equilibrium; such as in the context of conservation management or

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285 Parisi, Schulz, & Depoorter 2004, 184

286 *See* Rose 1986, 723.

> environmental preservation of resources (Mahoney, 2002; Parisi, Depoorter, and Schulz, 2005).[287]

The Tragedy of the Anticommons can be used a multi-gate barrier to access, to protect certain assets that should only see use when all stakeholders have agreed to their use. In this sense, following Rose, there is no Tragedy, only a very well-guarded resource.

An example can be given from American constitutional law.[288] To add a new federal statute, most bills must pass votes in both the House of Representatives and in the Senate, then they must be signed by the President, and finally, not be overturned by the Supreme Court for any reason. This amounts to four actors, each with exclusionary rights to prevent passage of the statute.

On the other hand, amending the Constitution itself requires a super-majority passge in both the House of Representative and in the Senate (2/3^{rds} in both Houses), followed by a large group of States (3/4th, currently 38 of 50 states) to approve the new amendment (each state being its own internal Tragedy of Anticommons of multiple actors all needing to not exercise rights of exclusion), and finally, not be overturned by the Supreme Court. While not in perfect complementarity, as unanimity of the States is not required, this process would still require far more actors than those required to simply add new federal statutes.

Given these procedures in comparison, one can see that regulatory Anticommons have been created to preserve the unchanged nature of the law and Constitutions of the United States, but the Constitution has been placed into a deeper, more guarded, Anticommons arrangement than that of the basic federal statutes.

The Tragedy of the Anticommons has been leveraged to protect specifically treasured legal resources.

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287 Bertacchini, de Mot, & Depoorter 2009, 171.

288 The account here follows from the process as decribed by the National Archives, who administers the process; available at https://www.archives.gov/federal-register/constitution . See also Article V of the US Constitution: "The Congress, whenever two thirds of both houses shall deem it necessary, shall propose amendments to this Constitution, … , when ratified by the legislatures of three fourths of the several states, … ."

6 APPLICATIONS FOR INTERNATIONAL LAW

Clearly, international law is full of opportunities to discover situations wherein a group of actors each hold exclusionary rights over a common objective, from peace treaties to ocean exploring compacts, each relies on a well agreed upon framework to enable coordination and end-goal objectives of those convention, compacts, and treaties.

> It is important to note that the legal problems to which the complementary oligopoly and Anticommons theories have been applied have the common characteristic of the uniqueness of the complements. Fragmented owners face an Anticommons problem to the extent that the complementary rights that they seek to acquire cannot easily be substituted with other rights. Only in such cases does each fragment owner have an opportunity to exercise hold-up strategies against the owners of complementary products. There is a wide range of situations where uniqueness or quasi-uniqueness can be found. Unique and nonsubstitutable are the votes of the five members of the United Nations Security Council (as long as unanimity is the rule); … [289]

Situations like the UN Security Council might be well modelled by Buchanan and Yoon's parking lot model, wherein cars need to gain multiple tickets from vendors, possessing "autonomous exclusion rights,"[290] the tickets themselves being complementary in nature.

This section first notes where researchers in international law have already identified Anticommons in the areas covered or addressed by international law. Next, the section sets out to identify new potential areas of research.

6.1 Previous Literature on Anticommons in International Law

Certain areas have received attention but were essentially extensions of US legal issues into international spaces.

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289 Dari-Mattiacci & Parisis 2006, 337.

290 The terminology of 'autonomous exclusion rights' appears to source to Parisi, Schulz, & Depoorter 2000, 10, footnote 11.

The issues surrounding intellectual property and the accessibility of patent rights and data rights, as their own form of excludable private assets, have been well covered by many scholars.[291] In a similar path of exploration, genetic resources and their utilization have come into the international law space.[292]

There have been other comparative studies on property law from the perspective of how different countries reacted to the emergence of Anticommons in legal assignments of immovable property assets.[293]

6.1.1 Bellantuono and EU Coordination

Bellantuono found that EU efforts to coordinate on environmental and climate change issues were bound in regulatory Anticommons, but his observations were not functionally limited per se to environmental issues but were more broadly indicative of EU functions at large, and thus of many multi-state coordination compacts.

In evaluating the function of an EU Directive on green infrastructure, Bellantuono identifies that the basic existence of a directive requires the coordination of each Member State, thus depending on the level of complementarity of the directive initiatives, as measured by inter-state complementarity (eg, is Italy's compliance complementary to Germany's compliance?), the incidence of the tragedy can be forecasted.[294] The more complementary the intra-state compliance is under the directive's initiatives, the worse the Tragedy of the Anticommons becomes for that particular directive.

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291 See Aoki 1998, MORE

292 See Safrin 2004, MORE

293 See

294 Bellantuono 2012, 334-340. His argument is made with reference to what are known as the Renewable Energy (RES) Directives, *see* id,, 335; both Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance) and the Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. Available at: https://ec.europa.eu/energy/en/topics/renewable-energy/renewable-energy-directive

Noting Bellantuono's model of regulatory Anticommons,[295] it is also clear that each Member State is likely to be pre-occupied with its own internal regulatory complexity in determining its own compliance strategy with the directive's requirements. Of course, that process will face the challenges of public choice theory and of social choice theory, so the overall probability of the Member State to act efficiently is not likely to be high.

6.1.2 Major on EU Debt Relief for Greece

The Tragedy of the Anticommons has been formally applied to the circumstances of international debt relief involving a group of states, or state banks, and a state-recipient of debt relief.

Major found that a formal model of a Tragedy of the Anticommons could be used to describe the financial behaviors of multiple EU states in their efforts to coordinate with Greece and its governmental debt crisis.[296] Building a model for any number, n, of Eurozone countries,[297] to independently provide 'financial services' to the singular purchaser of those services, Greece, he robustly found the classical Tragedy of the Anticommons, that Greece would need to pay too high a price for those services and receive too few services,[298] versus the potential outcome of an aligned and unified effort by the EU, wherein EU member states "coordinate their assistance programs,"[299] to provide a similar offering of 'financial services.' Further, he provides a proof for the EU Member States also achieving less 'welfare' by being in this Anticommons arrangement for delivering financial relief to Greece.[300]

Major also provides a discussion on how an exogenous authority, such as the IMF, might be brought in to oversee the debt relief program, to calculate the roles and payments between each Member State and with Greece. Given a game of open, symmetric, and complete information for all Member States and for Greece, then the levels of financial relief, the roles and capital flows

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295 See the discussion on regulatory Anticommons, supra, at sec. 3.8.

296 Major 2014, 426.

297 Major 2014, 432.

298 Major 2014, 435.

299 Major 2014, 434.

300 Major 2014, 435.

between each Member State and Greece, separately, and the 'welfare' obtained by each Member State for its role in participation in the debt relief process, could be efficiently achieved.[301]

6.1.3 Antarctica, Space, and UNCLOS too – Landry and Jacobsen

Landry has written on the various international conventions that limit acts of both private and sovereign actors in their activities and legal claims in outer space, on the moon, and in related space law issues.[302] Similarly, Jacobsen found that currently the development and exploration of space faced a Tragedy of the Anticommons if additional legal improvements are not made:

> In essence, the "Tragedy of the Anticommons" theory suggests that from an economic and commercial perspective, outer space is being underutilized. Until private actors are afforded a legal regime that guarantees a recognized right to recoup their investments-and, more importantly, an opportunity for a return on those investments-the market will remain at a standstill.[303] (Underscoring added.)

Jacobsen goes on to illustrate how that the Anticommons that he identifies in space law is actually a mirror of the Anticommons present in a wide variety of ocean law,[304] Antarctic law,[305] and other laws facing those places far and away.[306]

Delicately on the side of these observations, Wang has found another area of potential Anticommons in the area of space debris,[307] of the injuries and accidents resulting from bits and pieces of worn-out space craft colliding into functioning spacecraft or satellites. However, once

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301 Major 2014, 435. On the other hand, information games, of hiding information and providing information in strategic and costly manners, will doom the process of an overseeing authority to seizing on Greece's ability to render repayment as common resource for the Member States, could convert the process to a Tragedy of the Commons, depleting Greece's ability for recover. Id, 436.

302 Landry 2013, see the list of issues at id., 523-524.

303 Jacobsen 2015, 172.

304 Jacobsen 2015, 173.

305 Jacobsen 2015, 174.

306 Jacobsen 2015, 174-175, with specific reference to the conventions and rules developed for the Guano Islands Act of 1856.

307 Wang 2013.

introducing the potential for Anticommons in space debris, Wang spends the remainder of the article wholly focused on concerns of Commons, so this area remains largely a research green field.

6.2 New Areas of Research for International Law

This article has covered a lot of new ground and that much of it combined law and economics together, sometimes in ways new and complex. The existence of an Anticommons can be useful or frustrating, depending on whether we are seeking the benefits of efficient resource usage or seeking to protect that resource by underuse.

International law clearly plays a role in both encouraging the use of certain resources, such as the Area under the rules of UNCLOS, or protecting that resources from discouraging its use, such as the rules on protecting the atmosphere from harmful emissions, as seen in the UN Framework Convention for Climate Change and the Montreal Convention.

Where scholars of international law can focus, at least in the near term, is to try and identify where Anticommons phenomena are to be found. When considering how an international treaty works or operates, does it contain the necessary ingredients of an Anticommons?

i. **Multiple Inputs**: Are there multiple inputs, actors, or agencies involved in a process?
ii. **Anticommons mechanism**:
    a. Do the various actors have some type of exclusionary rights, can they block or prevent actions or decisions, or, do they have 'rights of necessary approval'?
    OR
    b. Are there procedures that need to happen together making something result, either simultaneously or sequentially?
iii. **Contrast of Singularity**: Can you see how things could be done better if all the actors (or inputs) coordinated as-if they were a singular entity (occurred altogether)?

If a legal researcher finds that questions (i) and (ii) can both be answered yes, then that researcher likely has an Anticommons on their plate. But the answer to question (iii) reveals what is lost by the presence of the Anticommons.

And these types of patterns are commonly found in international law.

Where one finds a committee that holds votes wherein one veto can derail a process, you have an Anticommons. Where you find a peace process that requires all parties to submit to a process, say allowing inspectors to examine something, and if breach by any party could breach and risk the loss of the accords, then you have an Anticommons. If you have an environmental treaty that attempts to gain controls over the emissions of a pollutant to a river, signed by parties upstream and downstream, but if it only takes only polluter to ruin the water, then you have an Anticommons. If you have an international process that requirements a process and approval (could be recognized as merely "completing" a process) from multiple authorities or NGOs, then you have an Anticommons. And there are many more ways that the simple idea of an Anticommons can crop up in international law.

Because the emergence of an Anticommons means the reduce use or loss of use of a resource, or a reduction or elimination of the objective of a project in international law, it is very important for scholars in international law to begin to recognize them. Equally, when international lawyers are assigning rights in the design of a new instrument of international law, they must take care to avoid creating the elemental pieces of an Anticommons. And if those acts of disbundling are necessary and required to achieve the objective of that international instrument, perhaps to achieve peace, then the drafters should consider placing safety devices into those legal instruments, to limit the impact and longevity of those newly created Anticommons, much as Krosnik advised.

And it's important to recall that not Anticommons are 'tragic', as some can be used in wonderful ways to protect assets and institutions that our cultures and communities seek to safe-guard. We can truly speak of potential Comedies of the Anticommons.

7 SUMMARY AND CONCLUSIONS

There are a variety of Anticommons models, each designed to test different versions of the core model. We have learned a lot from the various models, and I would like to report on these learnings to you here in summary:

1. We have learned that the Tragedy of the Anticommons fundamentally is the same result as Cournot's models of complementary oligopolies and of firms competing with complementary goods, these models originated in the early 1800s and are well understood;
2. The core problem in the Tragedy of the Anticommons is one of Pigouvian positive externalities;
    a. "The Tragedy of the Anticommons is the result of common resources remaining idle even when there could be some net social benefit. It occurs simply because the multiple holders of exclusion rights do not fully internalize the cost created by the enforcement of their right to exclude others"[308]
    b. The positive externality of coordinated production is ignored in the math of self-interest and utility/profit maximization;
    c. In contrast, the Tragedy of the Commons has a core problem of negative externalities;
3. The Tragedy of the Anticommons is systemic and rational; its underuse of resource is embedded in the mathematical structure of the game – it is not a result of psychology, of contextual framing, of behavioral economics, or of human weaknesses – it is a calculated mathematical result given the standard model;
4. Anticommons are created when multiple inputs to a process are complementary, meaning that the process cannot happen nor complete without the full set of inputs;
    a. This is equivalent to saying when a group of actors all have individual rights of exclusion to a common resource
    b. Each actor's exclusionary right(s) needs to be unconstrained when examined in social settings; similarly, the inputs must actually be complementary in nature
5. The inputs need not be perfectly complementary, but the more complementary they are, the worse the effects of the Anticommons will become;
6. Inputs can be complementary in both horizontal and vertical senses.

[308] Parisi, Schulz, & Depoorter 2004, 176.

   a. Horizontal means simultaneous, at the same time. Exclusionary rights can be simultaneous. Like coffee powder and water are needed to make coffee, both are needed at same time.
   b. Vertical means sequential, upstream and downstream. Exclusionary rights can be sequential. First you gain approval from Agency A, then you can get approval from Agency B, then you can receive permit to perform activity.
7. The more input that are required the worse the Tragedy of the Anticommons will become;
   a. Another way to say this, is the more actors that hold exclusionary rights over a process, the worse the Tragedy of the Anticommons will become
8. In modelling binary policy choices, economists rely on 'pricing competition' models of the Anticommons;
9. It is likely easier to fragment rights than to re-assemble them again – the 'Humpty Dumpty' rule:
   a. Transaction costs to dis-bundle rights to property are low in most legal systems
   b. Transaction costs to re-bundle rights to property are high in most legal systems
   c. In most cases, there will be asymmetrical tendency to accumulate more Anticommons than 'solve' them by rebundling the exclusionary rights
   d. Anticommons will emerge in many systems, almost *as if* a function of time
10. Regulatory Anticommons exist and are readily modelled;
   a. Pricing models are a common model for regulatory Anticommons;
   b. Eg, agencies have overlapping areas of regulatory authority;
   c. Political science provides many logical reasons for decentralizing power across both horizontal and vertical axes of governments, so multiple vectors of Anticommons can arise
   d. Multiple reasons more difficult to cure than 'market-based' Tragedy of Anticommons events
11. Anticommons persist over the long run, they don't 'self-cure'[309]

[309] Ohkawa, Shinkai & Okamura 2012, 174 -176.

12. Anticommons can be strategically good; sometimes they are an efficient means to protect certain resources or properties;
13. Early Empirical Studies and Results are Available
    a. Human actors find it more difficult to spot the circumstances of Anticommons than that of Commons
        i. Anticommons are waste of un-manifested events (missed chance),
        ii. Commons are waste of manifest events (ruined fish stocks),
    b. The larger the number of human actors with exclusionary rights, the worse the Tragedy of Anticommons becomes,
    c. Human actors frame the two Tragedies differently, and this cognitive bias results in worse reactions under the Tragedy of the Anticommons versus that witnessed in the Commons version
        i. No sense of loss from what never was, versus loss of previously exploitable Commons resource
        ii. "Disaster of Anticommons vs mere Tragedy of Commons?"

So there we have it, the basic scholar's toolkit for the Tragedy of the Anticommons.

We have a working understanding of what the Anticommons really are at this point, and, we can connect that understanding to a wide array of legal ideas and concepts.

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