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The Economics of Horizontal Government Cooperation[*]

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Abstract

This paper analyzes the ability of intrastate and interstate cooperative agreements to either minimize or capitalize on interjurisdictional externalities. These agreements are commonly referred to as compacts or joint powers agreements (intrastate compacts). The compact mechanism allows regional governments to enter into contractual agreements with one another to coordinate policy choices and to engage in cooperative endeavors. Given the inter-jurisdictional nature of the issues that affect horizontally situated governments, this mechanism is a powerful tool to achieve welfare-enhancing outcomes for citizens.

A review of the legal case law surrounding compacts is conducted to analyze the legal properties from an economic perspective. These economic properties are used to develop a simple game-theoretic environment and a neoclassical growth model. In these two environments, behavior under the compact is compared with regional governments acting in a non-cooperative manner where they take the period actions of the other governments as given. The models demonstrate that the compact mechanism can lead to Pareto-superior outcomes for the signatory governments' citizenry.

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1 Introduction

The legal and political economy literature is replete with articles discussing the benefits of competitive horizontal federalism. However, virtually nonexistent is a serious examination of whether and under what circumstances it may be beneficial for horizontally situated governments to cooperate. This paper begins this line of research by examining how cooperation among horizontal regional governments in certain circumstances may potentially increase the welfare of their citizens either through lower taxes or increased quality or quantity of beneficial public services.

Most discussions regarding intrastate or interstate interactions among regional governments in the United States are based on the belief that competition among regional governments leads to the efficient production of public goods. The basic argument for competition is that through the process of regional governments competing with one another for citizens and firms, they are incentivized to provide efficient levels of public goods. While the literature has embraced this idea, there has been little discussion about cooperative agreements among horizontally situated regional governments.

The problem in applying this competitive model to all interstate and intrastate interjurisdictional issues is that it does not take into account the fact that the decisions of one government affect the welfare and decisions of other governments in ways other than merely through competition. For instance, a problem that has plagued many states is the issue of how to allocate water among different interstate regions. Illinois' decision to divert more water out of Lake Michigan for the purpose of increasing certain services within its territory can have profound effects on the lake levels of the other Great Lakes states. To offer these better public services, Illinois is not the only state to incur costs, the other Great Lakes States will incur a cost as well - a reduction in their lake levels and the corresponding effects that has on their economies.

While compactual agreements between regional governments have the potential to lead to Pareto superior[1] outcomes for their citizens, interstate and intrastate compacts are seldom dis-

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[1] An outcome or economic allocation is Pareto superior if there does not exist another feasible outcome or allocation that makes at least one economic agent better off without making any other agent worse off. If an outcome or allocation is not Pareto superior, it is Pareto inferior and it is Pareto dominated by another feasible allocation that makes at least one agent better off while making the other agent(s) no worse off.

cussed in the academic literature. The reasons often cited for a lack of serious consideration of their use are the high costs associated with negotiating them and the belief that regional governments should always compete with one another, not cooperate.

However, according to data collected by the Council of State Governments on interstate compacts, the supposed high negotiation costs associated with their enactment has not stopped states from entering into numerous compacts with one another. There are approximately 200 compacts that are currently in effect in the United States. On average each state is a member of 25 compacts. Over 20 compacts are national in scope, with several having more than 35 member states. And approximately 20 compacts are regional in scope and have more than eight signatory states (National Center for Interstate Compacts 2010).

No organization tracks intrastate agreements, so there is scant data on the number of such agreements in effect today. However, at least one state's association of cities has recently surveyed its members and found that such agreements are widely used. The League of Minnesota Cities conducted a survey of its member cities regarding how many cooperative endeavors they were currently engaged in with other cities. These cooperative endeavors, as with most other states, are statutorily authorized and are commonly referred to as joint powers agreements.[2] The cities responded that they were party to 1,682 "current cooperative efforts." 433 of those related to police or fire services, 265 related to parks and recreation, and 245 were "general government" agreements, which included planning and joint purchasing agreements (League of Minnesota Cities 2008).

The second argument against compacts often invokes the cornerstone of modern economic thought: competition between potential competitors leads to the efficient allocation of resources, or in this case the efficient provision of public goods. It is generally accepted in the economic literature that competition among economic actors, including governments, generally enhances consumer or citizen welfare through the efficiencies that competition generates. This economic rationale is similar to the underlying justifications for our national policy to encourage competition as embodied in the U.S. antitrust laws. These laws prohibit any (unreasonable) contract, combination,

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[2]Since this paper addresses the economics of these agreements and there is no substantial economic difference whether they are interstate or intrastate, all such agreements will be refered to as "compacts." Compacts thus refer to all contractual or administrative cooperative agreements between regional governments commonly referred to as joint powers agreements.

or conspiracy in restraint of trade or commerce.[3] Economic theory recognizes, however, that there are situations where competition, or even just a basic lack of cooperation, can lead to suboptimal outcomes. Over time federal courts have also come to realize that not all cooperative endeavors among competitors should be per se violations of the antitrust laws, including certain information sharing arrangements among competing firms, industry standards, firms bundling intellectual property rights, and firms engaging in joint cooperative endeavors. These agreements have been found to actually increase consumer welfare even though they diminish or altogether prohibit certain aspects of competition. The lesson to take away from antitrust jurisprudence and economic theory is that competition is generally good, but there are some situations when cooperation will enhance consumer welfare.

This same strand of theoretical argument can also be applied to relationships between regional governments. There are situations in which it is beneficial for regional governments to coordinate their actions or engage in cooperative endeavors even though it is usually optimal for them to compete against one another both for citizens and firms.

It should be noted here that this paper doesn't delve into how compacts are negotiated, and its author doubts that a reliable theory can be developed that would accurately describe all such situations and resolutions. Some economic theories predict that such agreements are impossible to negotiate due to high negotiations costs, hold-out problems, etc. Since, as already shown, regional governments do enter into such agreements, what is needed is a comprehensive general theory that examines the benefits and costs of these agreements once enacted. This paper merely seeks to begin this important line of research.

This paper also does not propose to craft a general rule which prescribes when compacts should be permitted in lieu of encouraging competition (or at least non-cooperation) among regional governments.[4] That is a topic for a paper in and of itself. Rather, this paper does demonstrate that there

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[3]"Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal." 15 U.S.C. 1 (West).

[4]This paper should not be construed as arguing that all compacts are welfare enhancing. Compacts can be used to "legalize" inefficiencies that provide no benefit except for the special interest groups who are responsible for lobbying for their enactment. The recently enacted and now defunct Northeast (Interstate) Dairy Compact is a good example of an anticompetitive compact that led to financial harm for consumers in the form of higher prices.

The following is an excerpt from the website of the Commission created pursuant to the terms of the compact:

are circumstances where cooperation leads to better outcomes than non-cooperation. It analyzes the efficacy of compacts to (1) act as a legal commitment technology for optimal policy choices, (2) solve prisoner dilemma-type situations faced by regional governments, and (3) allow regions to internalize productivity spillovers in a neoclassical growth environment.

2 Legal Review

While there has been economic research on specific compacts, there has been no in-depth analysis of the legal properties of an interstate compact or joint powers agreement from an economic perspective. Both a complete legal analysis and an economic framework are both necessary to arrive at credible conclusions about the ability of a compact to function as a cooperative commitment mechanism for regional governments. This review of compact law considers the legal implications of compact jurisprudence from an economic perspective. This requires a direct review of the relevant law involving interstate and intrastate compacts, the latter being commonly referred to as joint powers agreements.

A major theme flows through the reviewed law - both state and federal courts have a strong disposition to uphold the terms of a compact. Federal courts have held a state to its compactual

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The Northeast Dairy Compact was established in an effort to restore the authority of the six New England states to set prices for Class 1 fluid milk sold in the region. Recognizing the regional character of the northeast dairy industry, the Compact serves several major functions. These functions include assuring the region of an adequate supply of milk, recognizing the cultural and economic benefits of a viable dairy industry in the region and facilitating the Constitutional rights of individual states to act collectively in order to regulate milk prices.

The participating states concluded that their ability to control the price that dairy farmers in the region receive for their product is essential to the public interest. Assurance of a fair and equitable price for dairy farmers ensures their ability to provide milk to the market as well as encouraging the vitality of the northeast economy and preserving open spaces.

The commission attempts to justify the compact as in the public interest, but it is no more than a legally sanctioned price cartel among the representatives of dairy farmers. As with all cartels, the benefits are to the producers for artificially restricting supply and driving up the price. Thus, if the public interest is solely the profitability of the dairy farmers and not the consumers who are forced to pay the competitive market price plus a cartel premium, then the public interest would certainly be served.

Compacts such as these not only hurt consumers but they retard growth in more productive areas of the economy. Due to the artificially inflated profitability of the dairy farmers investments will be inefficiently made in the industry when they otherwise would have been made in more productive sectors. Inefficient investments such as these lead to diminished economic growth. Decreased growth rates are an often overlooked dynamic consequence of misallocations of resources - an often overlooked consequence of a predominant analysis on static economic effects.

obligations even in instances where the state's obligations are in conflict with a plain-meaning reading of its constitution.[5] This strong disposition allows a compact to serve as a commitment technology for cooperative government policies. The fact that the judiciary, with or without the assistance of the other two branches of the federal or state government, will step in to enforce the mutually agreed terms of the compact, implies that regional governments are bound to the terms, or are at least strongly discouraged by an external authority from breaching their obligations. Signatory governments correctly believe that the other governments will adhere to the terms of the compact, and they know they are obligated to do so as well.

2.1 Interstate Compacts

An interstate compact is a constitutional mechanism through which states commit themselves to a legally binding contractual agreement. The following legal analysis is an examination of relevant case law pertaining to interstate compacts from their inception to their termination. While a few legal treatises have been written by interstate compact experts, their analyses focused solely on the political or legal nature of interstate compacts - not the economics. This section is a thorough examination of the landmark cases that define interstate compact jurisprudence analyzed from an economic perspective.

2.1.1 Mechanisms for Resolving Interstate Disputes

An interstate compact is one of two legal mechanisms provided by the Framers of the Constitution for states to resolve interstate controversies in our federal system of government.[6] *Hinderlider v. La Plata*, 304 U.S. 92, 104 (1938).[7] The other is for the states to bring their dispute before the Supreme Court for resolution: "[t]he judicial power [of the Supreme Court] shall extend to ... controversies between two or more states..." ("The Constitution of the United States," Article III,

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[5]See *Washington Metro. Area Transit Auth. v. One Parcel of Land in Montgomery County, Md.*, 706 F.2d 1312, 1316 (4th Cir. 1983).

[6]A third is Congress enacting legislation to remedy the problem. However, the solutions to interstate and intrastate controversies in this paper are limited to those by the regional governments themselves either through litigation or entering into a compact.

[7]When citing to court decisions, this paper follows the Bluebook 19th ed. citation format.

Section 2, Clause 1). While the two mechanisms both lead to a final resolution of the dispute, in one, the states themselves control the outcome; in the other, a third party is the controlling legal authority. The Supreme Court has stated that the interstate compact, at least some of the time, is the preferred mechanism for resolving such disputes. In a case regarding New Jersey's release of sewage into the Upper Bay of New York Harbor, the Court stated:

> We cannot withhold the suggestion, inspired by the consideration of this case, that [this] grave problem ... is one more likely to be wisely solved by co-operative study and by conference and mutual concession on the part of representatives of the states so vitally interested in it than by proceedings in any court however constituted. *People of State of New York v. State of New Jersey*, 256 U.S. 296, 313 (1921).

2.1.2   Interstate Administrative Compacts

Originally, the interstate compact was primarily used to resolve border disputes between states. Consequently, case law up through the early 20th century is predominantly related to state border compacts. Since then the purposes for enacting an interstate compact and the number of signatories to the agreement have greatly expanded. Recent interstate compacts encompass a multitude of states and a multitude of issues - not merely disputes, but cooperative endeavors (Zimmermann and Wendell 1976). The legality of the relatively recent inception of states entering into a compact that delegates administrative authority to an interstate agency has been specifically recognized and unanimously upheld by the U.S. Supreme Court. *State ex rel. Dyer v. Sims*, 341 U.S. 22, 30-31 (1951). When entering into the agreement the signatories cede a specified part of their sovereignty by constraining their activities to comply with the decisions of an interstate administrative agency created by the terms of the compact.

2.1.3   Compact Ratification and Congressional Consent

A compact is generally ratified when the identical terms of the compact agreement are enacted into law by each state's legislature and signed into law by the governor and, if necessary, after congressional consent has been granted (Zimmermann and Wendell 1976, p. 16). The Compact Clause of the US Constitution requires that "[n]o State shall, without the Consent of Congress,

..., enter into any Agreement or Compact with another State..." ("The Constitution of the United States," Article I, Section 10, Clause 1). A plain language reading seems to indicate that every interstate compact requires express congressional consent. However, as *Virginia v. Tennessee* suggested, congressional consent may be implied or not even necessary at all in some cases.

2.1.3.1 The Requirement of Congressional Consent In *Com. of Va. v. State of Tenn.*, 148 U.S. 503, 519 (1893), the Court in dicta stated the test to determine when congressional consent for a compact is necessary: when the compact's enactment would "[tend] to the increase of political power in the states, which may encroach upon or interfere with the just supremacy of the United States." The Court provided an example of states entering into a compact to drain a malarious and disease-producing district that overlaps both of their boundaries, and stated that there could be no basis for requiring congressional consent. *Id.* The Court stated "[i]t would be at the height of absurdity to hold that the threatened states could not unite in providing means to prevent and repel the invasion of the pestilence without obtaining the consent of congress, which might not be at the time in session." *Id.* at 518. The "*Virginia v. Tennessee*" congressional consent rule was referenced in a number of cases, but became controlling when it was applied in *New Hampshire v. Maine*, 426 U.S. 363 (1976).[8]

In cases where Congressional consent is necessary, Congress can attach specific conditions that the group of states must meet before its consent is given. The Supreme Court upheld the validity of congressional imposition of such conditions in *Cuyler v. Adams*, 449 U.S. 433, 440-441 (1981). The Ninth Circuit Court of Appeals later held that Congress can even require the signatory states to establish a compact agency as a condition necessary for its consent. *Seattle Master Builders Ass'n v. Pac. Nw. Elec. Power & Conservation Planning Council*, 786 F.2d 1359, 1364 (9th Cir. 1986) (cert. denied 479 U.S. 1059 (1987)).

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[8]For a thorough discussion of the evolution of the Compact Clause's interpretation see *U.S. Steel Corp. v. Multistate Tax Comm'n*, 434 U.S. 452 (1978).

2.1.3.2 "Alter, Amend, or Repeal" Consent? If consent is necessary and is granted, a question arises over whether it can be altered, amended, or repealed.[9] While the Supreme Court has never addressed this particular question itself, federal courts have visited, though not ruled on, the issue. In *Tobin v. United States*, the court in dicta reasoned that despite Congress's express reservation of the right to "alter, amend, or repeal" when granting its original consent for the creation of the Port Authority of New York and New Jersey, such a condition is meaningless unless the Constitution gives Congress that authority. *Tobin v. United States*, 306 F.2d 270, 273 (D.C. Cir. 1962). The Compact Clause of the U.S. Constitution grants Congress no such express power, and there is no case which the court could locate which either supports or rejects the proposition that Congress has such authority. To be valid, it must be an implied power of Congress. *Id.* The *Tobin* court believed that the federal plenary powers, such as regulation of interstate commerce, that the Constitution does grant to Congress are sufficient "to supervise and regulate the activities of operational compacts in such a way as to insure that no violence is done by these compacts to more compelling federal concerns."[10] *Id.* The court is thus strongly suggesting that Congress has no authority to withdraw its consent.

2.1.4 Compacts as Contracts between States

The substantive law of interstate compacts is mostly contract law (Zimmerman and Wendell 7). An interstate compact was first explicitly recognized as a contract in *Green v. Biddle*, 21 U.S. 1, 39 (1823). In *Texas v. New Mexico* the Supreme Court said "[a] Compact is, after all, a contract." *Texas v. New Mexico*, 482 U.S. 124, 128 (1987) (quoting *Petty v. Tennessee-Missouri Bridge Comm'n*, 359 U.S. 275, 285 (1959) (Frankfurter, J., dissenting)). The Court explained that a com-

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[9]This is a separate question from whether the Compact restrains Congress's legislative authority after congressional consent has been granted. For a more thorough discussion of this issue see *State of Ariz. v. State of Cal.*, 373 U.S. 546 (1963).

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> We have no way of knowing what ramifications would result from a holding that Congress has the implied constitutional power to alter, amend or repeal its consent to an interstate compact. Certainly, in view of the number and variety of interstate compacts in effect today, such a holding would stir up an air of uncertainty in those areas of our national life presently affected by the existence of these compacts. No doubt the suspicion of even potential impermanency would be damaging to the very concept of interstate compacts. *Tobin* at 273 n. 14.

pact remains a legal document that must be construed and applied in accordance with its terms." *Id.* at 128 (quoting *State ex rel. Dyer v. Sims*, 341 U.S. 22, 28 (1951)).

All contracts require an offer and acceptance to be legally binding. The offer component for an interstate compact is almost always satisfied by each signatory state adopting the exact language of the compact agreement as a statute. However, a state legislature can authorize a state administrative agency to enter into an agreement with another state's administrative agency as long as the terms are sufficiently spelled out in the adopted legislation. This setup means, though, that the exact terms of the compact agreement are not contained in the adopted legislation.[11] Once a state has ratified the terms of the compact, the acceptance requirement is satisfied (Zimmermann and Wendell 1976, p. 8).[12]

2.1.4.1 Breach of the "Contract"   Often a compact is likened to a treaty among states instead of foreign powers. In fact the Supreme Court used principles of treaty interpretation in its discussion of an interstate compact between Arizona and California.[13] However, unlike a treaty between nations, where unilateral action in violation of treaty terms is a feasible action of all signatories, a compact's unique legal standing does not allow for such unilateral actions, unless the compact itself provides for it.

In *Green v. Biddle*, after establishing that a compact was a contract, the Supreme Court quoted a previous holding in which it declared "a State has no more power to impair an obligation into which she herself has entered, than she can the contracts of individuals...." *Green v. Biddle*, 21 U.S. 1, 39 (1823). While the Court's declaration was based on the Contract Clause jurisprudence of the era, which has since fallen out of favor, it illustrates the Court's long-standing tradition of holding states to their compactual obligations. The Court's disposition to enforce the terms of interstate compacts are now based on other legal theories such as the transformation of the terms into federal law.

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[11] See Western States Vehicle Proration and Reciprocity Agreement, and also several bilateral agreements between the states of Kansas and Oklahoma, and North Dakota and Montana.

[12] A compact may not immediately go into effect. Most compacts require a threshold number of states, or a critical mass, to enact the compact implementing legislation before the terms of the compact are in effect.

[13] See *Arizona v. California*, 292 U.S. 341, 359-360 (1934).

2.1.4.2 Basis for Enforcement of Contract: Compacts as Federal Law An interstate compact is transformed into federal law, and thus may preempt state action, if it passes the test laid out in *Cuyler v. Adams*, 449 U.S. 433, 440 (1981). "[W]here Congress has authorized the States to enter into a cooperative agreement, and where the subject matter of that agreement is an appropriate subject for congressional legislation, the consent of Congress transforms the States' agreement into federal law under the Compact Clause." *Id.* "When approved by Congress, a compact becomes a statute of the United States and must be construed and applied according to its terms." *Nebraska v. Cent. Interstate Low-Level Radioactive Waste Comm'n*, 207 F.3d 1021, 1023 (8th Cir. 2000) (quoting *Oklahoma v. New Mexico*, 501 U.S. 221, 236 n. 5 (1991)). Federal supremacy would prohibit any action by a state in conflict with the terms of the compact.[14]

2.1.4.3 Remedies for Breach of Compact The question of remedy for other compact signatory states if a state does not meet its obligations has been specifically addressed in *Texas v. New Mexico*, 482 U.S. 124 (1987). The controversy in the case surrounded the bi-state Pecos River Compact that divides the water from the Pecos River between New Mexico and Texas. *Id.* at 126. The water flow of the Pecos River is irregular and the compact did not specify a particular amount of water that New Mexico was to deliver to Texas annually. *Id.* Rather, the compact stipulated that New Mexico could not deplete the water flow of the river below that which was available to Texas under the 1947 condition by "man's activities." *Id.*

The Supreme Court appointed a Special Master to define what the 1947 condition meant. *Id.* at 126-127. The Special Master's report was approved by the Court and later the methodology was accepted to determine Texas's entitlement. *Id.* at 127. The Special Master determined that New Mexico should have delivered 340,100 acre-feet more water to Texas than it received. *Id.* New Mexico was found to have breached the compact for a period of over thirty years and was continuing to do so. *Id.*

The Court disagreed with New Mexico's assertion that it should not have to remedy the short

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[14]"This Constitution, and the Laws of the United States which shall be made in Pursuance thereof; and all Treaties made, or which shall be made, under the Authority of the United States, shall be the supreme Law of the Land; and the Judges in every State shall be bound thereby, any Thing in the Constitution or Laws of any State to the contrary notwithstanding" ("The Constitution of the United States," Article VI, Section 2).

deliveries of the past thirty plus years, holding that it could "find no merit in [New Mexico]'s submission that we may order only prospective relief, that is, requiring future performance of compact obligations without a remedy for past breaches. If that were the case, New Mexico's defaults could never be remedied." *Id.* at 128. The Court continued "[t]here is nothing in the nature of compacts generally ... that counsels against rectifying a failure to perform in the past as well as ordering future performance called for by the Compact." *Id.* Once it was decided that New Mexico could be ordered to remedy its historic non-compliance, the question became what form such a remedy would take, since the compact itself did not detail any remedies for a breach. *Id.* at 129-130.

The Special Master concluded that monetary damages were inconsistent with the Compact's terms and thus could not be ordered by the Court. *Texas v. New Mexico*, 482 U.S. 124, 130 (1987). However, the Court held that this was incorrect, and that while there was no specific provision for what type of remedy could be awarded in the case of a breach, the compact did not mandate repayment in water as opposed to money damages. *Id.* The Court requested the Special Master to calculate the money damages for New Mexico's default. *Id.* at 132.

Enforcing the Supreme Court's Ruling   The Court noted two potential problems in enforcing its order to provide monetary relief for the past harm caused by the breach. The first was that monetary relief would allow New Mexico to continue to default on its compactual obligation if it determined the benefit associated with its deviation from the terms of the Compact exceeded the cost of the monetary relief to Texas. *Id.* at 132. This outcome, sometimes referred to as efficient breach, is permitted in contracts between private parties.[15] However, the discussion of this concern

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[15]In general, when two non-governmental parties contract, the default remedy for breach of the agreement is an award of "expectation damages" to the breached against party (promisee) by the breaching party (promisor). Expectation damages are a monetary award equivalent to the minimum amount necessary to put the promisees in the position they expected they would have been in when the contract was formed, if the promisor had adhered to the contract's terms. "[A]ny greater sum operates to punish the breaching promisor and results in an unwarranted windfall to the promisee, while any lesser sum rewards the promisor for his or her wrongful act in breaching the contract and fails to provide the promisee with the benefit of the bargain he or she made" (Williston 2009, Ch. 64:1). "Even if the breach is deliberate, it is not necessarily blameworthy. The promisor may simply have discovered that his performance is worth more to someone else. If so, efficiency is promoted by allowing him to break his promise, provided he makes good the promisee's actual losses. If he is forced to pay more than that, an *efficient breach* may be deterred, and the law doesn't want to bring about such a result." *Patton v. Mid-Continent Systems, Inc.*, 841 F.2d 742, 750 (7th Cir. 1988) (emphasis added).

by the Court suggests that it differentiated between a permissible efficient contract breach between private parties and an impermissible compact breach between states.

The Court determined that New Mexico's continued breach of the compact was not a substantial concern, since it could continue to "order remedying shortfalls to be made up in kind, with whatever additional sanction might be thought necessary for deliberate failure to perform." *Id.* Thus the Court was prepared to order "specific performance," or the performance that was specifically called for in the agreement, if New Mexico continued to breach the compact. Specific performance is almost always disfavored as a remedy for breach of a contract between private parties,[16] but in this instance the Court indicated it would not hesitate to order such an extraordinary remedy for breach of a compact between states.

The second potential problem was the difficulty of enforcing judgment against a state. *Id.* at 130-131. The Court was not concerned about this in the present case, because if a problem arose with money damages, a specific order would be entered for repayment in water. *Id* at 131. The problem arises when there is no other remedy available to substitute for money damages. This was the situation addressed by the Court in *Com. of Virginia v. State of W. Virginia*, 246 U.S. 565 (1918).

In a suit by Virginia against West Virginia, the Court ordered a judgment of over $12 million to be paid by West Virginia to Virginia pursuant to the original compactual agreement between the states. The compact states the amount of debt West Virginia would assume from Virginia when it was granted statehood. *Id.* at 589. The case was brought by Virginia, invoking the original jurisdiction of the Court to enforce the judgment. The Court noted its authority specifically to enforce judgments between two states. *Id.* at 591. It also noted this is a universally recognized doctrine that has been accepted and applied since the foundation of the United States. *Id.* at 592. West Virginia claimed that the Court could not enforce the judgment if it impeded the authority that the Constitution left to the states. *Id.* at 595-596. The Court, however, affirmed through its holding that it can enforce such judgments even though the appropriate remedy may "operate upon the governmental powers of the State." *Id.* at 600.

The final issue the Court addressed in the proceeding was what remedies are appropriate for

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[16]See Williston (2009, Ch. 64:1).

enforcement. *Id.* "As the powers to render a judgment and to enforce it arise from the grant in the Constitution on that subject, looked at from a generic point of view, both are federal powers, and comprehensively considered are sustained by every authority of the federal government, judicial, legislative or executive, which may be appropriately exercised." *Id.* at 601. The Court continued to detail various means that both Congress and the Judiciary under current legislation can use for enforcement. *Id.*

The Compact Clause gives Congress the power to consent to a contract between states. The agreement becomes operative by the will of Congress. *Id.* This gives Congress the authority to assure that the contract is enforced by appropriate legislation. *Id.* The judiciary may have the power to levy a tax either directly or by an order commanding the legislature of the state of West Virginia to levy a tax, to pay the judgment. *Id.* at 603-604. However, the Court declined to address this issue in its ruling. *Id.* at 604. The Court decided not to act so as to give Congress the "full opportunity" to act on its own behalf. *Id.* at 605.

Damages and Interest   In *Kansas v. Colorado*, 533 U.S. 1 (2001), the Court addressed the issue of damages, specifically the issue of how to calculate the appropriate amount of interest for the damages. The compact at issue was the Arkansas River Compact. It had been negotiated by the two states to apportion the water from the John Martin Reservoir. *Id.* at 5. Colorado had breached the compact and Kansas was claiming damages. *Id.* at 4-5.

The Court was split on how to award prejudgment interest (i.e., the amount of interest to be awarded from the time of the breach of the compact to the resolution of the case). Four of the justices felt that interest should begin accruing from the time the compact was breached. *Id.* at 15 n. 5. However, to gain the necessary fifth vote to reach a majority opinion they decided to let the accrual begin at the time the complaint was filed. *Id.* at 15 n. 5, 16. Several justices were concerned that the modern rule to award interest on damages from the time of the actual breach was not the law at the time the compact was enacted and thus Colorado was not on notice that it would be liable for such damages if it breached the compact (See O'Connor, J. concurring and dissenting).

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2.1.5   Amendment and Termination of a Compact

A compact may lay out specific terms for termination or withdrawal of a signatory. An example of a termination clause is Article X of the Colorado River Compact: "[t]his compact may be terminated at any time by the unanimous agreement of the signatory States. In the event of such termination all rights established under it shall continue unimpaired." An example of a withdrawal clause that has a temporal restriction is provided in Article VI of the Potomac River Compact: "[a]ny signatory body may by legislative act, after one year's notice to the Commission, withdraw from this compact." A compact may be terminated even if there is no specific termination clause if each signatory state, through the same legal means used to adopt the compact, declares it to be dissolved (Zimmermann and Wendell 1976, p. 10).

A compact may also include specific provisions for its amendment or none at all. The recent trend has been for interstate compacts to include specific provisions detailing an amendment process (Zimmermann and Wendell 1976, p. 84). An example of a compact with a specified amendment process is the Yellowstone River Compact. Article VI of the compact states: "[w]hen the Commission has made such determination for any interstate stream, it shall report its findings to the President of the United States and to the Governor of each State in the form of an agreement supplemental to this compact, which agreement shall be in full force and effect from the time of its approval by the Commission until disapproval by the Congress of the United States or by the Legislature of Wyoming or by the Legislature of Montana" (Zimmermann and Wendell 1976, p. 10).

2.1.6   Interstate Compact Legal Conclusions

The purpose in reviewing these cases and some of their factual details is to emphasize that the Supreme Court attempts whenever feasible to hold each state to their agreed upon obligations under the compact. The terms of a compact once ratified by Congress and if related to a federal concern are federal law. While the Court would likely never allow any absolute commitment technology between states, the interstate compact comes as close as a legal mechanism can.

The Supreme Court enforces the terms of a compact by granting monetary damages or an order

of specific performance for past breaches, and by ordering states to adhere to their obligations in the future. The Court has even suggested that it would enlist the powers of the other two branches of government to force a state into compliance if necessary. This strong disposition for upholding the terms of a compact makes an interstate compact a powerful commitment technology for interstate government cooperation and coordination.

2.2 Intrastate Compacts: Joint Powers Agreements

This section examines the intrastate analog of the interstate compact mechanism, joint powers agreements ("JPAs").[17] As a baseline for discussion, since there are numerous provisions in different state codes that authorize JPAs, this paper examines California's Joint Exercise of Authority Act.[18]

This section is markedly shorter than the last section on interstate compacts because there is little authoritative case law concerning the interpretation of the Act. Due to the lack of such a well-developed case law, this section primarily relies on a plain meaning interpretation of the sections of the Act. However, this plain meaning interpretation is supplemented where an authoritative case does exist.

2.2.1 Authority to Enter into JPA

Intrastate governments, referred to in the California Government Code as public agencies,[19] are authorized by state statute to enter into JPAs.[20] This statutory authorization permits the signatory governments to enter into contractual relationships and exercise any power common to them, which

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[17]Throughout the remaining sections of this paper, JPAs will be referred to as compacts between intrastate governments, so as to not confuse the reader that the economic analyses regarding interstate compacts also apply to JPAs.

[18]See Cal. Gov't Code 6500 et seq.

[19]"As used in this article, 'public agency' includes, but is not limited to, the federal government or any federal department or agency, this state, another state or any state department or agency, a county, county board of education, county superintendent of schools, city, public corporation, public district, regional transportation commission of this state or another state, or any joint powers authority formed pursuant to this article by any of these agencies." Cal. Gov't Code 6500.

[20]"If authorized by their legislative or other governing bodies, two or more public agencies by agreement may jointly exercise any power common to the contracting parties, even though one or more of the contracting agencies may be located outside this state..." Cal. Govt. Code Section 6502.

allows intrastate governments to enter into agreements concerning a wide-array of issues.

The statute requires that certain provisions are addressed in the agreement. If the agreement has a specific purpose, then it must specify what that purpose is and how it will be accomplished. If, on the other hand, the agreement states the power that is to be jointly exercised, it must state the manner in which it will be exercised. Cal. Gov't Code 6503.

For example, in *Burbank-Glendale-Pasadena Airport Auth. v. Hensler*, 99 Cal. Rptr. 2d 729 (Cal. Ct. App. 2000), the court of appeal held that three cities, which had entered into a JPA that created an airport authority, had the ability to delegate their eminent domain powers to the authority. The court reached this conclusion because each city already possessed the power of eminent domain and the JPA merely exercised that which was common to all parties. A JPA "grants no new powers but merely sets up a new procedure for the exercise of existing powers." *City of Oakland v. Williams*, 103 P.2d 168, 172 (Cal. 1940).

2.2.2   Creation of an Administrative Agency

An entirely separate entity independent of the signatory governments can be created pursuant to the terms of the JPA. Cal. Gov't Code 6507. Regional governments can thus create an administrative agency that is charged with executing the agreement. The administrative agency "possess[es] the common power specified in the agreement and may exercise it in the manner or according to the method provided in the agreement." *Id.* This agency can "make and enter contracts, ... employ agents and employees, ... acquire, construct, manage, maintain or operate any building, works or improvements, or to acquire, hold or dispose of property or to incur debts, liabilities or obligations, [and it] ... shall have the power to sue and be sued in its own name." *Id.* at 6508.

The agency may have a governing body such as a commission or board that oversees it. *Id.* Such a body would have members representing the various agencies or legislative bodies that enacted the JPA. Despite the fact that these representatives are supposed to represent the wishes of their constituents, they are not obligated to vote in line with the position of the "legislative body" which appointed them. 83 Cal. Op. Att'y Gen. 267 (2000).

The agreement can specify how the debts, liabilities, and obligations of the agency are shared

among the signatory governments and JPA. Cal. Gov't Code 6508.1. By default, the JPA's debts, liabilities, and obligations are those of the signatory governments. However, the signatories are allowed to specify that the JPA alone bears these responsibilities independent of the signatories. *Id.* The agreement does not need to specify any entity beyond the agency itself that will assume the burden if the agency is unable to do so.[21]

2.2.3 JPA Conclusions

As the previous section detailed, there has been significant Supreme Court case law that illuminates the legal properties of interstate compacts. Yet, in spite of their widespread popularity, there is little state case law involving JPAs. Thus the majority of this legal analysis has consisted of a plain-meaning interpretation of the Joint Exercise of Authority Act supplemented by the few cases where a court has had to interpret the meeting of the statute. This review suggests that the interpretations of JPAs in many ways mirrors that of interstate compacts. If signatory intrastate governments renege on their obligations under the terms of the JPA, contract law will operate as the legal framework in which damages should be apportioned and injunctive relief granted. Similarly, just as interstate compacts can create interstate administrative agencies, JPAs can also establish administrative agencies that are independent of the government bodies that entered into the JPA.

2.3 Legal Conclusions

Often scholars state that the main problem with enacting welfare enhancing treaties between sovereign powers is a lack of a third-party external authority that will force the signatories to adhere to the terms of the agreement. Compacts are in some sense treaties between subnational or substate sovereign powers with one exception - the federal or state government can force each to adhere to their obligations under the terms of their compact. The power of the federal or state government to remedy past breaches and enforce compliance with future obligations allows regional

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[21]"[S]ection 6805.1 ... mean[s] [nothing] ... other than what it plainly says, that the debts of the JPA are the debts of the constituent entities unless the agreement specifies otherwise. Here, the agreement specified otherwise, i.e. that the constituent entities would not be responsible for the debts of the JPA. [W]e find [no] ... implication that liability should be imposed because the constituent agencies did not specify an alternative to liability being solely vested in the JPA." *Tucker Land Co. v. State of California*, 114 Cal. Rptr. 2d 891, 897 (Cal. Ct. App. 2001).

governments to avoid the potential pitfalls associated with the unenforceability of international treaty obligations.

As it has been shown through the review of interstate compact case law and the review of JPA law, the federal and state governments will uphold the terms of a compact either under the principles of the supremacy of federal law or contract law. Under federal law, states are obligated to adhere to the terms of the compacts they have entered into under contract law principles and the judicial theory that the terms of the compact are transformed into federal law, and thus are the "supreme" law of the land under the Supremacy Clause. Under state law JPAs are committed to their obligations under the agreement through the principles of contract law.

The next section of this paper examines regional governments that face a prisoners' dilemma type situation. While the compact mechanism is offered as a tool to reach the welfare enhancing cooperative equilibrium, the section concludes that there are situations in which a regional government may rationally wish to breach its compactual obligations despite the knowledge that it will be forced into compliance. This is a consequence of how damages are calculated for the breach of a compact. As already noted, this possibility was acknowledged by the Supreme Court in *Texas v. New Mexico*. The section concludes that the signatory governments, given that they are sophisticated parties relative to private contractual parties, should be able to decide in the compact agreement itself how to calculate damages in the event of a breach.

3   Compacts as a Solution to the Prisoner's Dilemma

States manage their water resources under statutory schemes or common law water doctrines. However, legislators, judges, and other state officials are responsible only to their state's electorate. By the design of our federal system they are not positioned to internalize the effects of their actions on other states. If their goal is to maximize the likelihood of their (re)election, then their only considerations should be to take into account the preferences and welfare of their states' citizens. This can lead to potentially great costs being imposed on the citizens of another state if the resource at issue is common to both states.

For example, in the late 19th century, Chicago experienced an outbreak of several illnesses at-

tributable to its drinking water supply from Lake Michigan. Lake Michigan had been contaminated by Chicago releasing its sewage into the Chicago River, which then flowed into the lake (Lynde 1930, p. 243-246). In 1900, Chicago reversed the flow of the Chicago River, so that it flowed into the Illinois River thus eliminating the contamination problem for Illinois, but thereby inflicting it on other states (Percival 2004, p. 720).

The state of Illinois's project to alter the direction of the Chicago River has been called "an epic environmentally unsound public works project" (Hall 2006). This is because the Illinois River flows into the Mississippi then on downstream into the Gulf of Mexico. Thus states that border the Mississippi as it flows south were affected by Illinois's release of sewage. From 1900 to 1906, Missouri unsuccessfully litigated the flow diversion under a public nuisance claim before the Supreme Court (Percival 2004, p. 721-726).

By the mid-1920s, Chicago had increased the flow diversion by over four-fold. In 1924, Wisconsin along with Michigan and New York filed a complaint against Illinois requesting injunctive relief. *Wisconsin v. Illinois*, 278 U.S. 367 (1929). A special master appointed by the Supreme Court concluded that the Illinois diversion had lowered the levels of Lake Michigan and Huron by six inches, and Lake Erie and Ontario by five inches. *Id.* at 407-408. The special master's report stated that the increased diversion had caused damage "to navigation and commercial interests, to structures, to the convenience of summer resorts, to fishing and hunting grounds, to public parks and other enterprises, and to riparian property generally." *Id.* at 408. The special master concluded that this caused "great losses" to the plaintiff states.[22] *Id.* at 409.

Thus while benefitting Illinois and specifically the citizens of the City of Chicago, the diversion imposed severe negative externalities on other states both in terms of its sewage release and the accompanying increased flow diversion which lowered the level of the Great Lakes. However, the Illinois legislators (or CoC officials) who passed the enabling legislation were not responsible to the citizens of the other states. There was no need for them to take into account the effects on the welfare of the the Great Lakes states or the other states downstream.

There are numerous instances of other Great Lakes states imposing similar negative externalities on one another. Such an environment is well-represented by the often noted prisoner's

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[22]See also Hall (2006, p. 419-420)

dilemma, or a special case of it known as the Tragedy of the Commons. Each state is in an environment where it takes the actions of the other states as given. Given these actions, a state chooses its optimal response. While a theoretical benevolent social planner charged with maximizing the welfare of the affected states would take into account, or internalize, the costs and benefits to the states when deciding the appropriate course of action or policy, in this non-cooperative environment each state only takes into account its own costs and benefits.

This lack of cooperation, as illustrated by the example of the Great Lakes, where there is a negative externality by one government imposed on another, results in too much of the negative activity being undertaken. Conversely, in the case of a positive externality such as technological spillovers or productivity gains from investment in shared public infrastructure, governments invest too little in the beneficial activity. In either situation, the fact that a state does not take into account the costs or benefits to all other states leads to a socially suboptimal or Pareto inferior outcome. Absent some agreement that commits states to cooperate with one another over the management of the Great Lakes, they are relegated to the Pareto inferior outcome that plagued them and the Lakes for decades.

The potential for a compact to bind the Great Lakes states, or any group of states that share a common resource, to cooperate in the preservation and use of that resource was discussed in 1925 by future Supreme Court Justice Felix Frankfurter with his colleague Professor James Landis:

> Even before the Constitution we find that the common interest in natural resources, of a region embracing two States, was furthered by an agreement between such States. . . . An exploration of the possibilities of the compact idea furnishes a partial answer to one of the most intricate and comprehensive of all American problems (Frankfurter and Landis 1925, p. 696).

The Great Lakes states did recently make use of the "compact idea." The Great Lakes-St. Lawrence River Basin Water Resources Compact requires the states to adhere to minimum regulatory standards to which all signatory states have agreed. The compact imposes requirements on all the Great Lakes states for new withdrawals of water and in general prohibits transfers of water outside of the Great Lakes Basin. If a state is allowed to make a new withdrawal of water, that state is required to ensure that the water will be returned to the watershed less an allotment

for consumptive uses and that the purpose for the withdrawal meets a "reasonableness" standard. The withdrawal is also to be done in an economic and environmentally sound manner so as to conserve as much water as possible (Hall 2006, p. 435-441). These regulations will improve and then maintain the quality of the Great Lakes watershed and its surrounding ecosystem. This is not only aesthetically pleasing, but necessary for a continuation of the beneficial commercial activity that the Great Lakes generate for their regional economies.

The following sections analyze the general properties of states locked into a prisoners' dilemma environment and under what circumstances a compact can be used to improve the welfare of the states' citizens. Recommendations for how federal and state courts should calculate damages for breach of a compact are discussed in light of a rational regional government's incentive for doing so.

3.1 One Shot PD

The Prisoner's Dilemma (PD) is well-known in both economics and other social sciences. Each "player" in the "game" has two feasible strategies - either *cooperate* (C) with the other player or *defect* (D). Despite the fact that both players know that their individual payoff from the situation where both cooperate is strictly greater, or Pareto superior, than the payoffs in the event both defect, both players' dominant strategy is to always defect, regardless of what they expect the other to do. This can be seen by examining the payoffs in the 2x2 payoff matrix in Figure 1, which is representative of a PD game for two players.

Suppose that the players are two regional governments - Government 1 and Government 2. Government 1's best response to Government 2 playing cooperate (C) is to play defect (D), since it would receive a payoff of 2 as opposed to 1. Government 1's best response to Government 2 playing defect is to play defect (D), since it would receive a payoff of 0 as opposed to -1. Thus, Government 1's dominant strategy is always to defect (D). By the symmetry of the problem, Government 2's dominant strategy is always to defect (D) as well.

A Nash Equilibrium is an equilibrium strategy profile for all players, where for each player its chosen strategy is its best response to the given strategies of all the other players. In the PD

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| | | Government 2 | |
		C	D
Government 1	C	$1,1$	$-1,2$
	D	$2,-1$	$0,0$

Figure 1: Two Governments in a Prisoner's Dilemma

game, since the dominant strategy is always to defect, because it is always the best response to any strategy played by the other player, the Nash Equilibrium is (D;D). This equilibrium outcome is not Pareto optimal: there is another feasible strategy profile that leads to a strictly higher, or Pareto superior, payoff for both players; they could both Cooperate (C;C).

Prisoners Dilemmas come up in many different situations involving horizontally related governments. For example, the fact pattern surrounding *New York v. New Jersey* discussed in the introduction is one such foul case.[23] New Jersey had been disposing of its sewage by releasing it into the Upper Bay of New York Harbor. This created a public nuisance to New York residents and New York filed suit in the U.S. Supreme Court.

The following example is a slight variation of the situation in *New York v. New Jersey*. It details how regional governments can face PD type situations. Suppose that New York and New Jersey each have two options: either dump their respective sewage into the Upper Bay of New York Harbor (D) or transport it to another location (C). The resulting four feasible outcomes would generate payoffs of a PD game.

If both New Jersey and New York cooperate (C), then each receives a payoff of 0, the payoff from maintaining the status quo of neither dumping their sewage into New York Harbor. If only one state dumps (D), the defector receives a payoff of 1 and the the other government receives a payoff of -2. When both dump (D) sewage they each receive a payoff of 1 but incur a payoff of -2 from the dumping of the other government, resulting in each having a net payoff of -1. These payoffs are represented in Figure 2.

In this game, the Nash equilibrium is for New York and New Jersey to dump their sewage into the bay. This equilibrium leads to reductions in the welfare of both states. These welfare losses could have been avoided had the states cooperated.

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[23] See *People of State of New York v. State of New Jersey*, 256 U.S. 296 (1921).

New Jersey

	C	D
C	$0, 0$	$-2, 1$
D	$1, -2$	$-1, -1$

New York

Figure 2: Sewage

If this game accurately captures the dynamics of interaction among governments, regional governments facing a PD type situation are relegated to achieve suboptimal outcomes absent some external mechanism to mandate cooperation. However, such a mechanism does exist, of course, it is the compact. A compact could be used to commit the governments to follow the cooperative strategy thereby achieving the Pareto superior outcome. In the event of a defection, the terms of the compact could specify how damages would be awarded against the breaching government.

Most intrastate and interstate interactions occur over the course of many year, decades, or even centuries. Thus, the next section further explores the compact solution in an environment where regional governments do not interact merely once, but for the foreseeable future in a Repeated Prisoners' Dilemma environment.

3.2 Infinitely Repeated PD

Regional governments typically interact with one another repeatedly over the course of many years with no foreseeable ending. In fact, each year governors and legislatures, county boards, and city councils make decisions about how to interact with one another on a number of policy issues. In the example above, New Jersey might decide to not dump its sewage this year, but next year the governor and legislature are free to change their policy. Likewise City 1 may decide to continue paying City 2 for fire department services this year, but next year decrease or cut its payments due to other funding obligations and expect to free-ride on City 2's services. Thus, a single period or "one-shot" PD does not fully capture the relevant repeated interactions of regional governments. The Repeated Prisoner's Dilemma (RPD) more accurately represents these continuous interactions.

For the purposes of modeling interregional government interactions, it is assumed that each government believes that it will be in existence forever and thus there are an infinite number of

periods of interaction. Each government j discounts future payoffs at the geometric rate β_j, i.e. the discount factor. For readers more familiar with the notion of a discount rate, the discount factor is inversely related to the discount rate. That is, as the discount factor, β_j, increases, the discount rate, r_j, decreases and vice versa. Formally, the two are related by $r_j = \frac{1-\beta_j}{\beta_j}$.

There are two possible ways that cooperation can arise in this environment. The first way is to make it so that both governments cooperate because if they act otherwise by deviating or defecting for a period - the cost will outweigh the benefit. Thus it would be irrational for the government to defect. Such a trigger strategy could involve a strategy rule saying: if you defect, even once, I will defect for T periods. The other way is for an external agent to enforce *ex post* a compact that governments had agreed to *ex ante* and award damages equal to the harm caused by the breach.

The first solution could have New York dump sewage for some sufficiently high T periods if New Jersey dumps sewage even once. This would punish New Jersey by not allowing it to gain the higher payoffs it would have received if both governments had cooperated. Of course this assumes that such a sufficiently high T even exists. Proposition 3.1 below emphasizes that even in the case of a severe punishment such as minimaxing the other government (playing D for T periods), there may not exist a finite length of punishment T such that it is irrational for the other government to defect. However, it likewise may be the case that the resulting costs from invoking the punishment of the trigger strategy on New Jersey *may* be potentially greater than its benefit from defecting one period. Under this scenario, if New Jersey knows that this is New York's strategy *and* also believes that it is committed to following this policy if a deviation occurs, it *may* not be rational for it to deviate from the terms of the agreement.

It should be emphasized that this grim-trigger strategy is only effective if New Jersey cares sufficiently about its future payoffs from the repeated interactions, that is β_2 is sufficiently close to 1, and New York can commit to adhering to this policy *ex post* if a defection occurs. The following proposition illustrates this formally.

Proposition 3.1 *As β_2 tends towards 0, there does not exist a finite number of periods of punishment, T, such that would induce New Jersey to cooperate every period.*[24]

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[24]**Proof.** In this model, New York's only means to induce New Jersey to cooperate is to punish it by playing D if

Thus repeated interactions may or may not lead to cooperative behavior on the part of regional governments if (1) either government cares more about short-term benefits rather than long term ones (β_j is relatively close to 0), or if (2) the other regional government believes that the other will not be able to commit to the T periods of punishment if such a suitable time period even exists.

General Framework The framework described above is useful if there are just two governments and the game is symmetrical. However, real interregional government interactions can occur between numerous governments and their payoffs are not necessarily symmetric. The following framework generalizes the arguments discussed above, in which case two or more governments interact in a RPD framework with different discount factors and different payoffs. However, for ease of exposition it is still assumed that regional governments can only play their pure strategies C and D. That is, they are prohibited from playing mixed strategies that randomize their decision to cooperate or defect in any one period.

Let the set of governments who are affected by one another's interactions be $\mathcal{P}$ and let the number of such governments be denoted by P. $V_j(S_{-i}, S_i)$ is the period game value to government

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it does not. New York's strategy would then be to play C in the first period and every period after unless New Jersey played D in the last period, in which case New York will play D for $T < \infty$ periods. Thus New York's strategy is to minmax New Jersey for T periods unless New Jersey cooperates.

If in period t New Jersey defects and dumps its sewage, its discounted payoff from that period and the resulting T periods when New York also dumps its sewage is:

$$\beta_2^t \cdot 1 + \beta_2^{t+1} \cdot -1 + \beta_2^{t+2} \cdot -1 + \dots \beta_2^{t+T} \cdot -1$$
$$= \quad \beta_2^t \left(1 + \beta_2 \cdot -1 + \beta_2^2 \cdot -1 + \dots \beta_2^T \cdot -1\right).$$

If New Jersey had instead adhered to the agreement not to dump sewage, and played C in period t through at least period $t + T$, its discounted payoff would have been

$$\beta_2^t \cdot 0 + \beta_2^{t+1} \cdot 0 + \beta_2^{t+2} \cdot 0 + \dots \beta_2^{t+T} \cdot 0 = 0.$$

Therefore for it to be rational for New Jersey to defect and dump in period t, its gain from the one period deviation must be greater than the loss it incurs from New York dumping for the subsequent T periods. That is:

$$\beta_2^t \left(1 + \beta_2 \cdot -1 + \beta_2^2 \cdot -1 + \dots \beta_2^T \cdot -1\right) > 0,$$

which is equivalent to

$$\frac{\beta_2 - \beta_2^{T+1}}{1 - \beta_2} < 1.$$

As β_2 gets closer to 0 New Jersey cares more about the present and less about the future. Defection will always be beneficial regardless of the number of periods New York commits to punishing New Jersey, T. ∎

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j when government i plays $S_i \in \{C, D\}$ and the other $P - 1$ governments $(-i)$ play $S_{-i} \in \{C, D\}^{P-1}$.

Assumption 3.1 *The period payoff to each government j from all P governments cooperating exceeds the payoff to government j from all P governments defecting. That is,*

$$V_j(C_{-j}, C_j) > V_j(D_{-j}, D_j) \ \forall j \in P$$

Assumption 3.2 *State j's best response to all other governments' strategies in the period game is to defect (D), i.e. for all $S_{-j} \in \{C, D\}^{P-1}$,*

$$D = \arg \max_{S_j \in \{C,D\}} V_j(S_j, S_{-j})$$

Assumption 3.3 *If any government defects in a given period the payoff to all other players in that period decreases, ceteris paribus.*

These assumptions yield an environment that is equivalent to a P-regional government RPD. In this P-government RPD environment, cooperation may be possible absent any agreement enforced by an external party if governments can commit to the agreed to punishment for defection and all governments care sufficiently about the future (β_j is close to 1 for all j). The following proposition 3.2 states an existence result: cooperation *can* be attained if all governments are sufficiently patient and agree and can commit to a sufficiently long number of periods of punishment under a trigger strategy.

Proposition 3.2 *There exists a T^* and a $0 < \beta < 1$ such that if $T \geq T^*$ and $\beta_j \geq \beta$ for all $j \in P$ the cooperative equilibrium <u>can</u> be achieved.*[25]

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[25]**Proof.** Assumptions 3.2 and 3.3 imply that the lowest payoff that any group of governments can impose on another government is $V_j(D_{-j}, D_j)$. This is the minimax value. That is $(D_{-j}, D_j) = \arg \min_{S_{-j} \in \{C,D\}^{P-1}} \max_{S_j \in \{C,D\}} V_j(S_{-j}, S_j)$.

Assume each government agrees to the following: in the first period it will play C and in each subsequent period it will play C as long as all other governments played C in the preceding period. If one or more governments in the preceding period play D, then the government will play D for T periods.

Without loss of generality, examining the case of government j, its discounted payoff from defecting in period t and

That is, there exists an equilibrium in the P-government RPD game in which the Pareto optimal cooperative outcome can be achieved each period if the length of punishment for defection from playing the cooperative strategy is higher than some number of periods T^* and all governments value the future sufficiently, $\beta_j \geq \beta$ for some β sufficiently close to unity.

Corollary 3.1 emphasizes the limitation of this result.

Corollary 3.1 *There exists a $0 < \beta < 1$, such that if $\beta_j \leq \beta$ the dominant strategy for government j will always be to play D.*[26]

the resulting T periods of defection by all other governments is,

$$\beta_j^t V_j(C_{-j}, D_j) + \beta_j^{t+1} \cdot V_j(D_{-j}, D_j) + \ldots + \beta_j^{t+T} \cdot V_j(D_{-j}, D_j).$$

State j's discounted payoff from cooperating in period t and the subsequent T periods that it would have been punished had it defected is,

$$\beta_j^t V_j(C_{-j}, C_j) + \beta_j^{t+1} \cdot V_j(C_{-j}, C_j) + \ldots + \beta_j^{t+T} \cdot V_j(C_{-j}, C_j).$$

Therefore for defection not to have been advantageous, it must be the case that:

$$\beta_j^t V_j(C_{-j}, C_j) + \beta_j^{t+1} \cdot V_j(C_{-j}, C_j) + \ldots + \beta_j^{t+T} \cdot V_j(C_{-j}, C_j) >$$
$$\beta_j^t V_j(C_{-j}, D_j) + \beta_j^{t+1} \cdot V_j(D_{-j}, D_j) + \ldots + \beta_j^{t+T} \cdot V_j(D_{-j}, D_j),$$

which can be simplified to the following condition,

$$\frac{1 - \beta_j^{T+1}}{1 - \beta_j} V_j(C_{-j}, C_j) - \frac{\beta_j - \beta_j^{T+1}}{1 - \beta_j} V_j(D_{-j}, D_j) > V_j(C_{-j}, D_j).$$

As $\beta_j \rightarrow 1$, not defecting is rational for government j when,

$$T \left[V_j(C_{-j}, C_j) - V_j(D_{-j}, D_j) \right] > V_j(C_{-j}, D_j) - V_j(C_{-j}, C_j).$$

By Assumption 3.1 $V_j(C_{-j}, C_j) - V_j(D_{-j}, D_j) > 0$ and by Assumption 3.2 $V_j(C_{-j}, D_j) - V_j(C_{-j}, C_j) \geq 0$. Therefore a time period T can always be found that will cause State j to not Defect, i.e. Cooperate. By letting $\beta_j \geq \beta$, where β is sufficiently close to 1, and by letting T^* be the maximum of the T periods that satisfies the above condition for each government j, there necessarily exists a $(T^*, \beta) \in \mathbb{N} \times (0, 1)$ such that if all $\beta_j \geq \beta$ and $T \geq T^*$ the governments cooperate. ∎

[26]**Proof.** Given that the other governments would punish a government for T periods after it defected even once, it would not be advantageous for it to defect if

$$\frac{1 - \beta_j^{T+1}}{1 - \beta_j} V_j(C_{-j}, C_j) - \frac{\beta_j - \beta_j^{T+1}}{1 - \beta_j} V_j(D_{-j}, D_j) > V_j(C_{-j}, D_j)$$

As $\beta_j \rightarrow 0$, the inequality approaches

$$V_j(C_{-j}, C_j) > V_j(C_{-j}, D_j)$$

which by Assumption 3.2 is never true. Thus government j will defect as β_j gets arbitrarily close to 0 regardless of the number of periods of punishment, T. ∎

It implies that it is <u>not</u> the case that for all $0 < \beta < 1$, there exists a T such that the cooperative equilibrium can be reached. That is, it is not the case that a suitable T can always be found to induce cooperation among the governments even if they could commit to the punishment strategy. If the governments care little about future payoffs relative to payoffs today, their dominant strategy will always be to defect regardless of the length of punishment T. This is an unfortunate result given that benevolent regional governments do not determine the preferences over future versus current payoffs of the citizens that they are elected to represent, and non-benevolent regional government officials may have their own agenda that effectively reduces the value of β_j. Therefore, in some circumstances, cooperation among governments absent an agreement enforced by an external third party may not be possible even in a RPD environment.

Moreover, even if cooperation is possible given some length of punishment T for the trigger strategy, governments may not punish a defecting government for the full length of T, because they might have a strong incentive themselves to cooperate again before the T periods of punishment have passed. The would-be defecting government realizes this and thus believes the other governments will not act on their threats after a defection occurs, which will make it more likely to defect in the first place. Regional governments that would have cooperated know this and will be likely to refuse to enter an agreement. However, an agreement enforced by an external third party could allow the governments to overcome these obstacles to cooperation.

The Compact Solution   Consider another possible way to induce cooperation: the regional governments enter into a compact. Such a compact could take two forms. The first depends on whether there is a suitable T for each government that if enforced would make defection in any one period irrational. If there is such a value for T, then the compact could be used to force all the participating governments to adhere to the punishment policy of defecting for T periods after a member government defects. The compact would commit the participating governments to the T periods of punishment, even if a government has a strong desire to begin cooperating before then. This would require the federal or state government to be able to force the signatory governments to adhere to the punishment laid out in the terms of the compact. Whether or not this is feasible would depend on the subject of the compact and the agreed to punishment for defection.

The second possibility, and the one studied in this paper, is for the terms of the compact to stipulate that a government will be liable for the damages of all the other governments in the compact if it deviates from the terms of the compact (defects). As explained in the legal review section, damages for compacts are based on damages for breach of contracts. The default measure of damages are "expectation damages" - a monetary award equivalent to the minimum amount necessary to put the breached parties in the position they expected they would have been in when the contract was formed, assuming governments had adhered to the compact's terms.[27] However, as the Supreme Court discussed in the case of *Texas v. New Mexico*,[28] it may be the case that a regional government wants to breach its compactual obligations despite the fact that it knows it will be forced back into compliance in some future period. In this infinitely repeated prisoners' dilemma environment, a rational regional government j will breach the terms of the compact if the benefits from doing so, B_j, exceed the liability it would incur Δ_j. Thus it may be rational for a government to breach a compact for a few periods even if it knows the court will force it back into compliance and order it to pay damages.

The court can influence the value of Δ_j which will affect the cost to regional government j for breaching the compact as well as the amount of compensation that the other regional governments receive for the breach. The Court can do this through controlling the period in which it begins awarding interest on past damages. In the case considered in the interstate compact legal review section, the Court began awarding interest from the time the complaint was filed by the other state, instead of from the time the breaching state knew or should have known it was in breach of its compactual obligations, or from the time the breach actually occurred. This decision made it less costly for the breaching state to breach the compact and it also inadequately compensated the breached against state for its losses. The Supreme Court and state courts, or alternatively by state statute, should announce at their next opportunity that interest will accrue from the time a compact is breached in all future cases. This will increase the cost associated with breaching a compact, deterring regional governments from breaching their compactual obligations. It will also more completely compensate breached against governments.

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[27]See section 2.1.4.3, p. 11.
[28]See section 2.1.4.3.

Another alternative is that regional governments, as relatively sophisticated parties, could be permitted to determine how damages are calculated even if that means that the the total damage award would exceed the default expectation damages amount under common law contract principles. As noted in the legal review section, when there is a large degree of uncertainty over the amount of damages, courts hesitate to award damages in an any amount. This lessens the expected liability, Δ_j, from a compactual breach making a state more likely to breach the compact, and also completely precludes the possibility of an efficient breach by the breached against state(s) because they can never recover their true losses. Allowing unbounded liquidated damages would allow states to mutually determine *ex ante* how to deal with such uncertainties rather than granting such authority to courts *ex post*.

Conclusion In a prisoners' dilemma or Tragedy of the Commons type environment, regional governments that are unable to reach the Pareto superior outcome even when they interact with each other repeatedly either due to being impatient or lacking the ability to commit to punish a defecting government, can obtain the social welfare maximizing result by entering into a compact that requires cooperation on the part of all governments. This compact will be enforced by the federal or state government in the event of a breach through the awarding of damages and the imposition of an injunction to order the breaching government back into compliance. Because the damages for breach of a compact will likely be calculated based on the expectation damages measure, it is important to analyze the incentives that determine whether a signatory government will breach the compact by examining its benefit and liability from doing so. If such an analysis concludes that damages from a breach will be difficult to calculate because of large uncertainties, then the parties should be able to contract freely for liquidated damages that may exceed the expectation damages amount. Negotiations over a liquidated damages scheme would also likely be intertwined with negotiations over the ability of a regional government to withdraw from or terminate its compactual obligations. This is because unlike private parties, regional governments will likely be ordered to adhere to their compactual obligations in the future. Regional governments should determine ex ante how to deal with a regional government that does not meet its obligations or wishes to withdraw from the compact.

4 Government Commitment

Kydland and Prescott (1977) showed that if consumers and firms are rational when forming their expectations about future government policies, changes in government policy in the future will be anticipated by consumers and firms today negating the welfare maximizing benefits of the "welfare maximizing" policy choice. Selecting an optimal policy and having some mechanism commit the government(s) to the policy indefinitely is welfare maximizing, because consumers and firms expect that the government policy will be in effect in the future and will thus make the choices that the policymaker sought when announcing the policy instrument in the first instance. This allows the policymaker to correctly evaluate the benefits and costs of each policy and select the optimal one.

The concept of the welfare losses and gains to be had from the adoption of a welfare maximizing policy, and commitment to it, can best be illustrated by an example. Specifically, a slight modification of one of the examples provided in Kydland and Prescott (1977). This modified example is motivated by the substantial property destruction that occurred during "The Great Flood of 1993." In 1993, the Mississippi River flooded significant portions of land along its course in the midwest. The destruction from the flood was estimated at around $20 billion. Entire towns were flooded, fertile farmland was destroyed, and 50,000 homes were either swept away by the currents or severely damaged by the standing water (Johnson et al. 2004). While the destruction was extensive and resulted from a realization of low probability events, it illustrated the unavoidable problems of property ownership along the Mississippi flood plain.

Suppose that a group of states along the Mississippi River decide that the government costs associated with the periodic flooding of homes and businesses in certain regions near the river could be minimized by interstate cooperation. Professional response teams might be formed and obligations for their perpetual funding developed. The response teams would be comprised of flood plain experts and relief workers who could be deployed to the affected areas in the event of a flood. Further, the state governments, concerned about the total cost of the significant property damage and the heightened risks associated with large populations living in the flood plain, could enact a set of uniform laws stating that if consumers or businesses build structures in an affected

area, they will not receive any state financial aid when the river floods and destroys their property.

A policy such as this will prevent rational citizens from building structures in the area only if the citizens expect the state to adhere to the stated policy in the future. However, if citizens expect state government to provide assistance to them if they build in the flood plain and then face flood losses, they will go ahead and build and the suboptimal outcome will occur - citizens will build homes and businesses in the flood plain.

Now suppose that instead the states enter into a hypothetical "Flood Plain Compact." The terms of the compact are exceedingly straightforward: (1) each signatory state shares the cost of funding the response teams according to a cost-sharing scheme that induces each state to desire the same amount of aggregate investment in the program, and (2) signatory states are prohibited from providing state assistance to those residents and firms who choose to build new structures in the Mississippi's designated flood plain no-build zone.

The enactment of the compact forces each state's citizens and firms to realize that their state is bound by the terms of the compact. Each signatory state knows that it must fund the response teams at the amount it agreed to under the terms of the compact. If it does not, it knows that the federal government will force it into compliance and mandate that it pay damages for the breach of its obligations. Citizens and firms know that their state cannot provide them assistance if they build in the plain and a flood subsequently damages or destroys their property. Therefore, they do not build homes or businesses in the flood plain.

This example illustrates how compacts are not merely a tool for the implementation of a regional policy, but also a tool with a commitment technology that prohibits regional governments from wavering from that policy in the future. This, in particular, makes compacts more than a system of uniform laws adopted by several regional governments, but a mechanism that commits the governments to the desired policy, enhancing its welfare maximizing potential.

5   Compacts That Internalize Productivity Spillovers

While prior to 1921 compacts were primarily used to settle boundary disputes, that year the states of New York and New Jersey entered into the first modern regulatory compact which was de-

signed to provide for "the common harbor interests of New York and New Jersey." The compact established what is now referred to as the Port Authority of New York and New Jersey.

Due to the close proximity of the New York and New Jersey ports, there are significant spillover effects to New Jersey from investment by New York and to New York by investment from New Jersey. Absent any coordination, each would be taking the investment decisions of the other as a given, and then choosing its optimal investment amount. While the investment alone would lead to increases in productivity for both regions, greater increases in productivity could be realized by the coordination of investment in both regions. That is, if the spillover effects between the jurisdictions could be internalized, both regions could be made strictly better off.

This potential benefit from coordination was recognized by the states and was the impetus for the compact. In the preamble to the compact both states acknowledged this by reciting the following reasons for entering into the agreement: they shared a common resource - the port; coordination was preferred to unilateral action; investment in the infrastructure of the port and surrounding area would lead to "great economies;" and this investment would require significant resources on the part of both states (New Jersey Statutes, Title 32, Chapter 1, Article 1).

This section addresses the ability of regional governments to coordinate their activity so as to internalize beneficial productivity spillovers that cross jurisdictional boundaries. These spillovers affect households' welfare indirectly through the productivity effects on the region's inputs of production such as capital and labor. This paper adopts the view that in certain circumstances regional governments can invest in "public capital" that benefits the region's economy. For instance, a state may invest in roads, bridges, airports, and seaports that reduce the resource costs associated with the transport of capital from one location to another, or make it less costly for laborer's to commute to work thereby increasing the geographical radius of which they can be employed.[29]

The following model analyzes two mechanisms for public capital investment by the regional governments. They can tax their representative household and invest in their region's public capital stock, taking as given the investment decisions of the other governments, or the regions can enter into a compact that can coordinate their spending on public capital investment. Both the re-

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[29]Such labor search costs have recently been recognized as an important aspect of economic development by the Nobel Committee when it awarded the 2010 Economics Memorial Prize to Diamond, Mortensen and Pissarides.

gional governments' and compact authority's objective is to maximize the welfare or utility of the representative household in their particular region or the welfare of all compact signatories' representative households according to the terms of the compact. The terms of the compact are modeled as a social welfare functional that takes as inputs the net discounted utility of all the signatories' regional government's representative households.

5.1 Model

A group of P regional governments is denoted by $\mathcal{P} = \{1, \ldots, P\}$. The productivity of their private capital and labor, that is, their total factor productivity (TFP), is affected by their region's public capital as well as the spillover effects from the other $P - 1$ regions' public capital. The degree by which each region i's public capital benefits, or spills over into, region j's public capital is given by $\omega_{j,i}$, where $\omega_{j,j} = 1$ by definition. The public capital in each region depreciates at the uniform rate δ_h and is most easily thought of as consisting of public infrastructure or essential government services.

Each region has a representative household that lives forever and whose preferences over consumption in any period are represented by the utility function $u^j(\cdot)$. The household discounts next period utility at the rate β and is endowed with an amount of private capital in period 0, $k_{j,0}$.

The household owns all shares of the representative firm's stock in its region. All profits from the firm are remitted to the firm's shareholder - the household. The household accumulates private capital by purchasing an investment good on an aggregate market that consists of all the regions. Private capital depreciates at the uniform rate δ_k and is rented to the region's firm at the regional rental rate $r_{j,t}$. The household receives wage income at the regional market wage rate $w_{j,t}$. The price of the consumption and investment goods on the aggregate market in period t is p_t.

Each region's representative firm rents capital from the regional rental market and in conjunction with the inelastically supplied labor from its own representative household produces output which it sells on the aggregate market at the unit price p_t.

5.1.1 Representative Household's Problem

The objective of the household is to maximize its net discounted future utility stream subject to its budget and capital investment constraints. Each period, taking as given the regional, $(r_{j,t}, w_{j,t})$, and aggregate market, (p_t), prices, the household purchases a consumption good $c_{j,t}^h$, that is taxed at the rate τ_j, and it also purchases an amount of private capital investment $x_{j,t}$. The consumption and investment goods are purchased on the aggregate market consisting of all regions.

The household's purchases of its consumption and investment goods are constrained by the income it receives each period from the return on its accumulated private capital, the amount of labor it supplies in the regional labor market, and the dividends paid by the region's firm. The unit return the household receives on its accumulated private capital stock, $k_{j,t}^h$, is $r_{j,t}$. The household supplies labor $l_{j,t}$ up to an amount l_j in the regional labor market and receives in return payment at the wage rate $w_{j,t}$. Since the household is the sole shareholder of the region's firm, it receives all, if any, of the profits each period, $\pi_{j,t}$. The amount of private capital next period, $k_{j,t+1}$, is the sum of the non-depreciated private capital this period $(1 - \delta_k)k_{j,t}$ plus the amount of investment $x_{j,t}$.

Definition of Household's Problem   Given the regional sales tax rate τ_j and regional $(r_{j,t}, w_{j,t})_{t=0}^{\infty}$ and aggregate market prices $(p_t)_{t=0}^{\infty}$, each household $j \in \mathcal{P}$ chooses $(c_{j,t}^h, x_{j,t}^h, k_{j,t+1}^h, l_{j,t}^h)_{t=0}^{\infty}$ to solve

$$\max_{(c_{j,t}^h, x_{j,t}^h, k_{j,t+1}^h, l_{j,t}^h)_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u^j(c_{j,t}^h)$$

$$\text{s. to} \quad (1 + \tau_j)p_t c_{j,t}^h + p_t x_{j,t}^h \leq r_{j,t} k_{j,t}^h + w_{j,t} l_{j,t}^h + \pi_{j,t}$$

$$k_{j,t+1}^h \leq (1 - \delta_k)k_{j,t}^h + x_{j,t}^h$$

$$l_{j,t}^h \leq l_j$$

$$c_{j,t}^h, x_{j,t}^h, k_{j,t+1}^h, l_{j,t}^h \geq 0$$

$$l_j = 1$$

$$k_{j,0}^h \text{ given.}$$

5.1.2 Representative Firm's Problem

The objective of each region's representative firm is to maximize its profit each period. Given the aggregate market price for its output, p_t, and the regional prices of capital and labor, $(r_{j,t}, w_{j,t})$, the firm chooses the amount of private capital $k_{j,t}^f$ and the amount of labor $l_{j,t}^f$ to use in the production of its output $y_{j,t}$. The firm receives an increase in the productivity of its inputs, that is an increase in TFP, from the amount of investment in public capital by the regional government, $h_{j,t}$ as well as the spillover productivity effects from the other regions' public capital investments $\sum_{i \in \mathcal{P} - \{j\}} \omega_{j,i} h_{j,t}$.

Definition of Firm's Problem Each period given regional $(r_{j,t}, w_{j,t})$ and aggregate market prices (p_t) and the effective amount of the public capital in the region $h_{j,t}'$, each regional firm $j \in \mathcal{P}$ chooses $y_{j,t}^f$, $k_{j,t}^f$, and $l_{j,t}^f$ to solve

$$\max_{y_{j,t}^f, k_{j,t}^f, l_{j,t}^f} \pi_{j,t} \equiv p_t y_{j,t}^f - r_{j,t} k_{j,t}^f - w_{j,t} l_{j,t}^f$$

$$\text{s. to} \qquad y_{j,t}^f = F^j(h_{j,t}', k_{j,t}^f, l_{j,t}^f)$$

$$y_{j,t}^f, k_{j,t}^f, l_{j,t}^f \geq 0$$

where $h_{j,t}' = \sum_{i=1}^{P} \omega_{j,i} h_{j,t}$.

5.1.3 Balanced Regional Government Budget

The regional government runs a balanced budget each period. That is the cost of investment in the region's public capital stock $p_t i_{j,t}$ is exactly equal to the tax revenue from the government levying a consumption tax on the household $\tau_j p_t c_{j,t}$. The region's public capital stock next period is the sum of the non-depreciated amount of public capital this period, $(1 - \delta_h) h_{j,t}$ plus the amount of period investment $i_{j,t}$.

Definition of Balanced Regional Government Budget For all regional governments $j \in \mathcal{P}$,

$$
\begin{aligned}
p_t i_{j,t} &= \tau_j p_t c_{j,t} \\
h_{j,t+1} &= (1 - \delta_h) h_{j,t} + i_{j,t}.
\end{aligned}
$$

5.1.4 Market Clearing

The output from all of the regional firms, $\sum_{j \in P} y_{j,t}^f$, is sold on the aggregate market. This supply of output is equal to the amount of consumption and investment goods demanded by all of the regions' households, $\sum_{j \in P} c_{j,t}^h + \sum_{j \in P} x_{j,t}^h$, plus the amount of investment goods for all of the regions' public capital stocks by their respective governments, $\sum_{j \in P} i_{j,t}$.

The amount of capital demanded by each region's firm, $k_{j,t}^f$, is equal to the amount supplied by that region's household, $k_{j,t}^h$. Similarly, the amount of labor demanded by each region's firm, $l_{j,t}$, is equal to the amount supplied by that region's household, $l_{j,t}^f$.

Definition of Market Clearing

$$
\begin{aligned}
\sum_{j \in \mathcal{P}} y_{j,t}^f &= \sum_{j \in \mathcal{P}} c_{j,t}^h + \sum_{j \in \mathcal{P}} x_{j,t}^h + \sum_{j \in \mathcal{P}} i_{j,t} \\
k_{j,t}^f &= k_{j,t}^h \quad \forall j \in \mathcal{P} \\
l_{j,t}^f &= l_{j,t}^h \quad \forall j \in \mathcal{P}.
\end{aligned}
$$

5.1.5 Assumptions

Each region's household experiences diminishing marginal utility of consumption.[30] Second, there is diminishing marginal productivity of the inputs of production.[31] Third, regional production is homogenous of degree one in private and public capital.[32] Fourth, there will be some non-zero amount of each production input used by each region's representative firm.[33]

It is further assumed that all regions are on a balanced growth path in equilibrium[34] and that the necessary interior first order conditions for each regional economy, $j \in \mathcal{P}$, hold.

Result 5.1 *The ad-valorem consumption tax is equivalent to a lump-sum tax on the household.*[35]

Given Result 5.1, and for the ease of exposition and calculation, the sales tax will be replaced

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[30]

Assumption 5.1 $u^j : \mathbb{R}_+ \to \mathbb{R}_+$ *is strictly concave.*

[31]

Assumption 5.2 $F^j : \mathbb{R}^3_+ \to \mathbb{R}$ *is concave.*

[32]

Assumption 5.3 $F^j(h, k, l)$ *is homogenous of degree one in* (h, k).

[33]

Assumption 5.4 $\lim_{h \to 0} F^j_h(h, k, l) = \infty$ *and* $\lim_{h \to \infty} F^j_h(h, k, l) = 0$.

Assumption 5.5 $\lim_{k \to 0} F^j_k(h, k, l) = \infty$ *and* $\lim_{k \to \infty} F^j_k(h, k, l) = 0$.

Assumption 5.6 $\lim_{l \to 0} F^j_l(h, k, l) = \infty$ *and* $\lim_{l \to \infty} F^j_l(h, k, l) = 0$.

[34]That is, for each region $j \in P$ in equilibrium there exists a $g_j > 0$ such that $\frac{c_{j,t+1}}{c_{j,t}} = g_j$, $\frac{x_{j,t+1}}{x_{j,t}} = g_j$, $\frac{k_{j,t+1}}{k_{j,t}} = g_j$, and $\frac{h_{j,t+1}}{h_{j,t}} = g_j$ for all t.

[35]**Proof.** The first order necessary conditions for the household's problem require

$$\frac{u^j_c(c^h_{j,t})}{\beta u^j_c(c^h_{j,t+1})} = r_{j,t+1} + (1 - \delta_k).$$

This is also the condition that is required by the household's problem where the sales tax is replaced with the lump-sum tax. Further, on the balanced growth path, the household's budget constraint and law of capital accumulation remain unchanged and the government budget and resource constraints are also unchanged when $p_t T_{j,t}$ is substituted for $\tau_j p_t c^h_{j,t}$. The firms problem and the market clearing conditions are unaffected as well. Therefore, a lump-sum tax that is defined to be $p_t T_{j,t} = \tau_j p_t c^h_{j,t}$ is equivalent to the consumption tax on a balanced growth path. ∎

with a lump-sum tax, T_j from this point forward. It should be noted, however, that any of the results obtained also hold when the $\tau_j p_t c_{j,t}$ is substituted for $T_{j,t}$.

Result 5.2 *Each region's household will purchase an amount of goods from the aggregate market equal to the amount of goods that the regions's firm produces and sells on the aggregate market.*[36] *That is,*

$$c_{j,t}^h + x_{j,t}^h + T_{j,t} = F^j(h'_{j,t}, k_{j,t}^h, l_{j,t}^h).$$

Thus, while each region participates in the aggregate market for consumption and investment goods, the regional economies may be modeled as though the household purchases only those goods which are produced in its region. This paper will use this result to simplify the analysis by writing each region's problem as though it is a closed economy, except for the increase in productivity it receives from the spillovers from the other regions' public capital stocks.

Each regional government that has not ceded its decision making sovereignty to a compact authority is assumed to be benevolent. That is, its objective is to maximize the net discounted utility of its representative household, $\sum_{t=0}^{\infty} \beta^t u^j(c_{j,t})$. Each is also assumed to have complete

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[36]**Proof.** The household's period t budget constraint is

$$(1 + \tau_j)p_t c_{j,t}^h + p_t x_{j,t}^h \le r_{j,t} k_{j,t}^h + w_{j,t} l_{j,t}^h + \pi_{j,t}.$$

Given Result 5.1 and Assumption 5.1, the household budget constraint can be rewritten as

$$p_t c_{j,t}^h + p_t x_{j,t}^h = r_{j,t} k_{j,t}^h + w_{j,t} l_{j,t}^h + \pi_{j,t} - p_t T_{j,t}.$$

Given the definition of $\pi_{j,t}$ from the firm's problem,

$$\pi_{j,t} = p_t y_{j,t}^f - r_{j,t} k_{j,t}^f - w_{j,t} l_{j,t}^f$$
$$\text{where } y_{j,t}^f = F^j(h'_{j,t}, k_{j,t}^f, l_{j,t}^f),$$

the firm's budget constraint can be written as

$$r_{j,t} k_{j,t}^f + w_{j,t} l_{j,t}^f + \pi_{j,t} = p_t F^j(h'_{j,t}, k_{j,t}^f, l_{j,t}^f).$$

And from the market clearing condition $k_{j,t}^h = k_{j,t}^f$ and $l_{j,t}^h = l_{j,t}^f$. Therefore,

$$c_{j,t}^h + x_{j,t}^h + T_{j,t} = F^j(h'_{j,t}, k_{j,t}^h, l_{j,t}^h).$$

∎

and perfect information about the representative household and firm in its region. That is, each knows, given the tax amounts, how each sector of the regional economy will respond in terms of making allocative decisions. Formally, this means that each regional government knows that through its choice of taxes it implicitly selects the equilibrium allocation for its region according to the characterization in Result 5.3 below.

Result 5.3 *Letting* $f^j(h, k) = F^j(h, k, 1)$ *and given* $((T_{i,t})_{t=0}^{\infty})_{i \in \mathcal{P}}$, *each region's, for* $j \in \mathcal{P}$, *equilibrium allocation is characterized by*

$$\frac{u_c^j(c_{j,t})}{\beta u_c^j(c_{j,t+1})} = f_k^j(h'_{j,t+1}, k_{j,t+1}) + (1 - \delta_k)$$

$$c_{j,t} + x_{j,t} + T_{j,t} = f^j(h'_{j,t}, k_{j,t})$$

$$k_{j,t+1} = (1 - \delta_k)k_{j,t} + x_{j,t}$$

$$h_{q,t+1} = (1 - \delta_h)h_{q,t} + T_{q,t} \qquad \forall q \in \mathcal{P}$$

$$k_{j,0} \text{ given}$$

$$h_{j,0} \text{ given}.$$

where $h'_{j,t} = \sum_{i=1}^{P} \omega_{j,i} h_{j,t}$.

5.2 Non-Cooperative v. Cooperative Equilibria

There are two possible ways in which the regions can choose the optimal tax amount each period: (1) the regions can either make decisions without cooperating with the other regions, or (2) the regions to enter into a compact that details an investment schedule for all signatory regions.

5.2.1 Non-Cooperative Equilibrium

In the non-cooperative equilibrium, each period regions choose the tax rate that maximizes their welfare given that they know, based on the observable decisions of the other regions, what the spillover effects of the other regions will be next period. This may be criticized as a strong assumption. However, it captures the assumption of non-coordination among regional governments

in their investment decisions.

Region j's Government's Problem   Each government $j \in \mathcal{P}$ takes as given the investments of the other $P - 1$ governments, $((T_{i,t})_{t=0}^{\infty})_{i \in \mathcal{P}-\{j\}}$ and thus the value of their public capital stocks $((h_{i,t})_{t=0}^{\infty})_{i \in \mathcal{P}-\{j\}}$. In each period t, regional government j chooses its optimal value of public capital in period $t + 1$, $h_{j,t+1}$, so as to satisfy

$$\max_{(T_{j,t},h_{j,t+1},c_{j,t},x_{j,t},k_{j,t+1})_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u^j(c_{j,t}) \tag{1}$$

$$\text{s. to} \quad \frac{u_c^j(c_{j.t})}{\beta u_c^j(c_{j,t+1})} = f_k^j(h'_{j,t+1}, k_{j,t+1}) + (1 - \delta_k) \tag{2}$$

$$c_{j,t} + x_{j,t} + T_{j,t} = f^j(h'_{j,t}, k_{j,t}) \tag{3}$$

$$k_{j,t+1} = (1 - \delta_k)k_{j,t} + x_{j,t} \tag{4}$$

$$h_{q,t+1} = (1 - \delta_h)h_{q,t} + T_{q,t} \qquad \forall q \in P \tag{5}$$

$$c_{j,t}, k_{j,t+1}, x_{j,t} \geq 0 \tag{6}$$

$$k_{j,0} \text{ given} \tag{7}$$

$$T_{q,t} \text{ given} \qquad \forall q \in \mathcal{P} - \{j\} \tag{8}$$

$$h_{q,0} \text{ given} \qquad \forall q \in P. \tag{9}$$

where $h'_{j,t} = \sum_{i=1}^{P} \omega_{j,i} h_{j,t}$.

Definition of Non-Cooperative Equilibrium   A Non-Cooperative equilibrium is a set of regions $\mathcal{P}$, and for each region $j \in \mathcal{P}$ an allocation $(c_{j,t}, x_{j,t}, k_{j,t+1}, h_{j,t})_{t=0}^{\infty}$ and a system of taxes $(T_{j,t})_{t=0}^{\infty}$ that satisfy Region j's Government's Problem.

Result 5.4 *Noting that $\omega_{j,j} = 1$ by definition, the regional government's problem, given $((T_{i,t})_{t=0}^{\infty})_{i \in \mathcal{P}-\{j\}}$,*

is characterized by

$$\frac{u_c^j(c_{j,t})}{\beta u_c^j(c_{j,t+1})} = f_k^j\left(\left(h_{j,t+1} + \sum_{i \in P-\{j\}} \omega_{j,i} h_{i,t+1}\right), k_{j,t+1}\right) + (1 - \delta_k)$$

$$\frac{u_c^j(c_{j,t})}{\beta u_c^j(c_{j,t+1})} = f_h^j\left(\left(h_{j,t+1} + \sum_{i \in P-\{j\}} \omega_{j,i} h_{i,t+1}\right), k_{j,t+1}\right) + (1 - \delta_h)$$

$$c_{j,t} + x_{j,t} + T_{j,t} = f^j\left(\left(h_{j,t+1} + \sum_{i \in P-\{j\}} \omega_{j,i} h_{i,t+1}\right), k_{j,t}\right)$$

$$k_{j,t+1} = (1 - \delta_k)k_{j,t} + x_{j,t}$$

$$h_{q,t+1} = (1 - \delta_h)h_{q,t} + T_{q,t} \qquad\qquad \forall q \in P$$

$$k_{j,0} \text{ given}$$

$$h_{q,0} \text{ given} \qquad\qquad \forall q \in P.$$

5.2.2 Compact Equilibrium

The other option is for regional governments to enter into a compact where each agrees to a pre-scribed level of investment either by the terms of the compact, or according to investment decisions made by an administrative agency created pursuant to the compact. The compact would specify the tax rate at which consumption should be taxed in each region with the proceeds to be invested in that region's public capital stock. Unlike the non-cooperative equilibrium where regions make decisions individually taking as given the period investment decisions of the other regions, this option would internalize the productivity spillovers of each region's public capital investments into the others.[37]

To analyze this environment, a few assumptions must be made. Assume that there is a subset of regions $S \subset P$ that enter into a compact. Each affected region that is not a member of the compact never engages in any public capital investment (i.e., $h_{j,t} = 0$ for all t and for all $j \in P - S$). The compact authority's objective is to maximize $\mathcal{U} : \mathbb{R}^S \to \mathbb{R}$, the "terms of the compact," which is a

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[37]For purposes of this analysis, it is implicitly assumed that the regions cannot renege on their compactual obligations.

strictly increasing function that takes as its inputs the net discounted period 0 utility of each region that is a signatory to the compact, $j \in S$.

The compact authority has the same information available to it that the signatory regional governments possess - complete and perfect information about the representative household and firm in each of the signatory regions. Formally, this means that the compact authority knows that through its choice of taxes it implicitly selects the equilibrium allocation for each signatory region according to the characterization in Result 5.3.

Definition of Compact Authority's Problem   The compact authority's problem is to choose taxes $((T_{j,t})_{t=0}^\infty)_{j \in S}$ and thus $((h_{j,t+1}, c_{j,t}, x_{j,t}, k_{j,t+1})_{t=0}^\infty)_{j \in S}$, so as to solve,

$$\max_{((T_{j,t},h_{j,t+1},c_{j,t},x_{j,t},k_{j,t+1})_{t=0}^\infty)_{j \in S}} \mathcal{U}((\sum_{t=0}^\infty \beta^t u^j(c_{j,t}))_{j \in S}) \tag{10}$$

$$\text{s. to} \quad \frac{u_c^j(c_{j,t})}{\beta u_c^j(c_{j,t+1})} = f_k^j(h'_{j,t+1}, k_{j,t+1}) + (1 - \delta_k) \tag{11}$$

$$c_{j,t} + x_{j,t} + T_{j,t} = f^j(h'_{j,t}, k_{j,t}) \tag{12}$$

$$k_{j,t+1} = (1 - \delta_k)k_{j,t} + x_{j,t} \tag{13}$$

$$h_{j,t+1} \le (1 - \delta_h)h_{j,t} + T_{j,t} \tag{14}$$

$$c_{j,t}, k_{j,t+1}, x_{j,t} \ge 0 \tag{15}$$

$$k_{j,0} \text{ given} \tag{16}$$

$$h_{j,0} \text{ given.} \tag{17}$$

where $h'_{j,t} = \sum_{i=1}^P \omega_{j,i} h_{j,t}$.

5.3   Non-Cooperative Equilibrium v. Compact Equilibrium

Since the objective of this paper is not to empirically estimate the specific benefits of a particular compact on a given region, but rather to analyze the general effects of a compact on the growth rate of a regional economy relative to a non-cooperative agreement, this subsection assumes that

all regions are identical, so that general results can be proved.

5.3.1 Symmetric Environment

In a Symmetric Environment all regions have identical preferences $u^l(c) = u^m(c)$, identical production technologies $f^l(h, k) = f^m(h, k)$, identical initial endowments of public and private capital $h_{l,0} = h_{m,0}$ and $k_{l,0} = k_{m,0}$, and identical productivity spillovers which are normalized to unity $\omega_{j,i} = 1$ for all $l, m \in \mathcal{P}$.

It is further assumed that since all regions are identical, that in any compact equilibrium the terms of the compact are such that all compact regions will be taxed the same amount by the compact authority each period, that is, $T_{l,t} = T_{m,t}$ for all periods t and for all $l, m \in S$.

Proposition 5.1 *In a Symmetric Non-Cooperative Equilibrium, all compact regions' $j \in \mathcal{P}$ equi-*

librium allocations are characterized by the following system of equations,[38]

$$\frac{u_c(c_t)}{\beta u_c(c_{t+1})} = f_k\left(Ph_{t+1}, k_{t+1}\right) + (1 - \delta_k)$$

$$\frac{u_c(c_t)}{\beta u_c(c_{t+1})} = f_h\left(Ph_{t+1}, k_{t+1}\right) + (1 - \delta_h)$$

$$c_t + x_t + T_t = f(Ph_t, k_t)$$

$$k_{t+1} = (1 - \delta_k)k_t + x_t$$

$$h_{t+1} = (1 - \delta_h)h_t + T_t$$

$$k_0 \text{ given}$$

$$h_0 \text{ given.}$$

Proposition 5.2 *In a Symmetric Compact Equilibrium, all compact regions' $j \in S$ equilibrium*

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[38]**Proof.** The above assumptions along with the definition of a Non-Cooperative Equilibrium guarantee that constraints 3 through 9 in Region j's Problem are equivalent. Further, since $u_j(\cdot)$ is a strictly increasing function and all region's problems are equivalent, the Region j's Problem can be written equivalently as

$$\max_{(T_t, h_{t+1}, c_t, x_t, k_{t+1})_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u^j(c_{j,t})$$

$$\text{s. to} \quad \frac{u_c(c_t)}{\beta u_c(c_{t+1})} = f_k(h_{t+1} + h'_{t+1}, k_{t+1}) + (1 - \delta_k)$$

$$c_t + x_t + T_t = f(h_t + h'_t, k_t)$$

$$k_{t+1} = (1 - \delta_k)k_t + x_t$$

$$h_{t+1} \leq (1 - \delta_h)h_t + T_t$$

$$c_t, k_{t+1}, x_t \geq 0$$

$$h'_t \text{ given} \qquad \forall t$$

$$k_0 \text{ given}$$

$$h_0 \text{ given.}$$

where $h'_t = (P - 1)h_t$. The first order necessary conditions and the resource constraints for this problem give the characterization. ∎

allocations are characterized by the following system of equations,[39]

$$\frac{u_c(c_t)}{\beta u_c(c_{t+1})} = f_k\left(Sh_{t+1}, k_{t+1}\right) + (1 - \delta_k)$$

$$\frac{u_c(c_t)}{\beta u_c(c_{t+1})} = Sf_h\left(Sh_{t+1}, k_{t+1}\right) + (1 - \delta_h)$$

$$c_t + x_t + T_t = f(Sh_t, k_t)$$

$$k_{t+1} = (1 - \delta_k)k_t + x_t$$

$$h_{t+1} = (1 - \delta_h)h_t + T_t$$

$$k_0 \text{ given}$$

$$h_0 \text{ given.}$$

5.3.2 Results

Proposition 5.3 *The growth rate of regional governments in a Symmetric Compact Equilibrium, where $S \subset P$ with $S > 1$, is greater along a balanced growth path than any region in a Symmetric Non-Cooperative Equilibrium.*[40]

Corollary 5.1 *As the number of signatory regions, S, increases all regions grow at a faster rate.*

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[39]**Proof.** The above assumptions along with the definition of a Symmetric Compact Equilibrium guarantee that constraints 12 through 17 in the Compact Authority's Problem are equivalent. Further since $\mathcal{U}$ is a strictly increasing function and all regions' problems are equivalent, the Compact Authority's Problem can be written equivalently as

$$\max_{(T_t, h_{t+1}, c_t, x_t, k_{t+1})_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u^j(c_{j,t})$$

$$\text{s. to} \quad \frac{u_c(c_t)}{\beta u_c(c_{t+1})} = f_k(Sh_{t+1}, k_{t+1}) + (1 - \delta_k)$$

$$c_t + x_t + T_t = f(Sh_t, k_t)$$

$$k_{t+1} = (1 - \delta_k)k_t + x_t$$

$$h_{t+1} \leq (1 - \delta_h)h_t + T_t$$

$$c_t, k_{t+1}, x_t \geq 0$$

$$k_0 \text{ given}$$

$$h_0 \text{ given.}$$

The first order necessary conditions and the resource constraints for this problem give the characterization. ∎

[40]**Proof.** The "effective" public to private capital ratio, $\frac{Sh_{t+1}}{k_{t+1}}$ for the Symmetric Compact Equilibrium along the balanced growth path is given by

$$f_k\left(Sh_{t+1}, k_{t+1}\right) - Sf_h\left(Sh_{t+1}, k_{t+1}\right) = \delta_k - \delta_h.$$

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Proposition 5.4 *If $S = \mathcal{P}$, the regions are strictly better off by entering into a compact than if they had not.*

5.4   Conclusions: Compacts Internalizing Productivity Spillovers

The models in this section demonstrate that the compact can be a useful mechanism for regions to coordinate their investment in public capital that has spillover effects into other regions. As Proposition 5.3 states, the compact leads the regions to a strictly higher rate of growth than if each had acted independently. Further, this higher rate of growth leads to increases in welfare for all of the signatory regional economies as proven by Proposition 5.4. Thus interregional coordination through a coordinating compact can be a powerful tool to achieve greater economic growth and

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Let this ratio be denoted by κ_{Com}. Due to the fact that f is homogenous of degree one, the above condition can be rewritten as

$$f_k\left(\kappa_{\mathrm{Com}}, 1\right) - S f_h\left(\kappa_{\mathrm{Com}}, 1\right) = \delta_k - \delta_h.$$

The growth rate for the regional economies in a Symmetric Compact Equilibrium can be found from the following necessary first order condition

$$\frac{u_c(c_t)}{\beta u_c(c_{t+1})} = f_k(\kappa_{\mathrm{Com}}, 1) + (1 - \delta_k)$$

Similarly the capital to labor ratio Ph/k for the Symmetric Non-Cooperative Equilibrium along the balanced growth path is given by

$$f_k\left(Ph_{t+1}, k_{t+1}\right) - f_h\left(Ph_{t+1}, k_{t+1}\right) = \delta_k - \delta_h.$$

Let this ratio be denoted by κ_{NA}. Due to the fact that f is homogenous of degree one, the above condition can be rewritten as

$$f_k\left(\kappa_{\mathrm{NA}}, 1\right) - f_h\left(\kappa_{\mathrm{NA}}, 1\right) = \delta_k - \delta_h.$$

The growth rate of the regional economies in a Symmetric Non-Cooperative Equilibrium can be found from the following necessary first order condition

$$\frac{u_c(c_t)}{\beta u_c(c_{t+1})} = f_k(\kappa_{\mathrm{NA}}, 1) + (1 - \delta_k)$$

Thus given the strict concavity of u and f, if $\kappa_{\mathrm{Com}} > \kappa_{\mathrm{NA}}$, the growth rate will be higher under the Symmetric Compact Equilibrium. Given that f is strictly concave, it is straightforward to see that

$$\begin{aligned} f_k\left(\kappa_{\mathrm{Com}}, 1\right) - S f_h\left(\kappa_{\mathrm{Com}}, 1\right) &= \delta_k - \delta_h \\ \text{and } f_k\left(\kappa_{\mathrm{NA}}, 1\right) - f_h\left(\kappa_{\mathrm{NA}}, 1\right) &= \delta_k - \delta_h \end{aligned}$$

imply $\kappa_{\mathrm{Com}} > \kappa_{\mathrm{NA}}$. ∎

greater prosperity for interaffected regional economies.

6   Conclusion

The compact is a valuable mechanism for regional governments to engage in cooperative endeavors or as a coordination mechanism for interjurisdictional policies. Compacts are more than just the adoption of a uniform set of laws or regulations by a group of regional governments. They are binding legal agreements that are enforced by an external authority. They cannot be altered or repealed unilaterally unless the agreement permits such actions. Compacts are legally analogized to contracts between private parties. When a regional government enters into a compactual agreement it assumes a duty to uphold its obligations to the other regional governments. If a regional government breaches its obligations, the other signatories may plead for injunctive or monetary relief before either state or federal courts.

The compact is a useful tool to deal with interjurisdictional externalities whether they be negative or positive. They can be used to overcome prisoner's dilemma or tragedy of the common's type situations by the terms of the agreement or by establishing an authority or regulatory body to make decisions on signatory governments' behalf. An administrative agency compact can be used to coordinate spending on productive activities that have spillover effects into other regional governments' jurisdictions, such as a government's investment in public capital or other services. Absent a compact or other agrement regional governments acting independently do not internalize the total benefits or costs that their actions have on other regions. A compact can be used to internalize these effects leading the regional governments to a Pareto superior outcome over non-cooperation.

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Appendix: Court Decisions Involving Interstate Compacts

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