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Institutional succession in international organizations

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Abstract

We construct and test a model explaining why states sometimes replace existing international institutions. Recent literature in International Relations has theorized the conditions in which states reform existing institutions, shift between existing institutional fora, or create new rival institutions to challenge or constrain incumbents. However, the notion that states might directly swap an existing institution for a new replacement is rarely considered. We show that institutional replacement is a common alternative to either institutional reform, 'regime-shifting' or 'competitive regime-creation,' and offer a strategic bargaining theory explaining the conditions underlying this choice. To test the formal and empirical validity of our argument, we offer a formal bargaining game and detailed empirical evidence from two historical cases.

Keywords

Institutional replacement, bargaining theory, contested multilateralism, inside and outside options.

1 Introduction

On 1 January 1995, the General Agreement on Tariffs and Trade (GATT) was replaced by the World Trade Organization (WTO). The GATT continued to exist in a revised form as the WTO’s umbrella treaty for trade in goods, but it disappeared as an international organization (IO).

The replacement of the GATT is no isolated event. The Organization for European Economic Cooperation (OEEC) was replaced by the Organization for Economic Cooperation and Development (OECD) in 1961; the European Monetary Agreement replaced the European Payments Union in 1958; the Organization for Security and Cooperation in Europe (OSCE) succeeded the Conference on Security and Cooperation in Europe (CSCE) in 1995—to name just a few prominent examples. In total, 61 intergovernmental organizations created since 1930 have one or more predecessors from which they have directly taken over their mandates, members, and core functions (Eilstrup-Sangiovanni 2018, 2020).

Given the high costs and uncertainty involved in building international institutions (Keohane 1984, Strange 1998, Jupille et al. 2013), why do states sometimes dissolve existing IOs only to replace them with new organizations that take over all or part of the prior organizations’ mandate, functions and assets—a practice known as ‘institutional succession’ (Schermers and Blokker 2003). Why, for example, dissolve an existing IO rather than reform it? After all, the GATT was refined and expanded through eight rounds of multilateral trade negotiations between 1948 and 1995 before being supplanted by the WTO. Finally, how can we explain that replacement was initiated by the controlling

members of the GATT rather than by those who were less privileged by the existing institutional setup?

We explain succession as a result of a bargaining process through which dissatisfied parties seek to alter the institutional status quo. Succession is one among several bargaining strategies available to dissatisfied states: others include reform, the shift of negotiations from one institution to another— a practice alternatively known as "forum shopping" (Busch 2007) and "regime shifting" (Helfer 2004, 2009) — or the creation of parallel, rival institutions (Morse and Keohane 2014, Urpelainen and van de Graff 2014, Vabulas and Snidal 2017, Lipsky 2017, Pratt 2019). Unlike rival creation, succession does not lead to institutional proliferation (Benvenisti and Downs 2007, Rabitz 2018) but cleanly wraps up an existing institution before unfolding the new one.

IO succession is an understudied phenomenon. Eilstrup-Sangiovanni (2018, 2020) analyses the circumstances under which IOs terminate. But although she finds that defunct IOs are frequently replaced by new organizations, she does not offer a specific theoretical explanation for this phenomenon. Among the studies that focus on institutional replacement, some approach the question from a normative perspective, considering how legitimacy crises may lead to the replacement of existing norm-sets (Panke and Peterson 2012, Cottrell 2009, 2014). Most studies analyze one bargaining strategy—say, regime shifting—in isolation from the others—reform, rival creation or succession. The only study we are aware of that theorizes succession in relation to other options, by Jupille, Mattli, and Snidal (2013), resorts to a theoretical shortcut. Invoking a form of

bounded rationality, the authors argue that "creation" of a new institution is a last-resort option which states will consider only after other options—"continued use" of a focal institution, "selection" of an existing alternative (that is, regime shifting), or "reform"—have failed to deliver the desired policy change. We use a similarly all-inclusive framework and further add two mechanisms of succession: one "rival" and one "controlled". But rather than resting our reasoning on notions of Knightian uncertainty (Knight 1921) and Simonian bounded rationality (Barnard and Simon 1947), we resort to a full-fledged rational choice framework which assumes that when confronted with a choice between alternative bargaining outcomes, players simultaneously consider each one in relation to all the others. By positing full rationality, our game-theoretic methodology allows us to check the consistency of each strategic choice in relation to all the others, without placing any unnecessary constraint on the occurrence of institutional creation and succession.

We are not trying to explain every possible dynamic of institutional change. Our starting point is dissatisfaction by a subset of member states with an existing institution. From this basis we ask which of several alternative outcomes will prevail: stasis, reform, regime shifting, rival creation, or succession. The only scenario not covered in our model is death—when conflict is so intractable that states prefer to return to a "self-help" pre-regime scenario (Eilstrup-Sangiovanni 2018).¹

¹Since our focus is on bargaining strategies in conditions of widespread dissatisfaction by a subset of parties, we also do not consider change driven by institutional agency or incremental change, which probably is the norm (Pierson 2004; Cappuccio and Kelemen 2007).

We argue that succession, like reform, results from a demand for institutional change that could not have been anticipated. Rather than insuring potential losers against a future loss *ex ante*, member states chose to bet on its not happening, knowing that in the unlikely case that it should happen, they could still fall back on reform and succession. Reform and succession are last-resort means of fixing an institution that was broken by unanticipated events.

Both reform and succession are inefficient, albeit in different ways. Reform is vulnerable to veto players and may involve high transaction costs. Succession, by moving negotiations out of an extant institution, bypasses veto players. However, succession suffers from scale diseconomies, while reform does not. Therefore, depending on which shortcoming prevails, we find that reform will be preferred to succession or vice versa.

We find that the choice between our two versions of succession—“controlled” and “rival”—is one of relative aptitude at collective action. In both cases, bargaining is about the founding of a new institution: a core group makes a proposal to a population of countries that individually decide whether to join and, given that we assume steep scale economies, in the process dissolve the old institution. Which side gets to make the proposal, whether it is the members who control the agenda of the incumbent organization, or those whose only choice is to block or ratify, determines which type of succession will be attempted.

Our discussion proceeds as follows. Section 2 provides an extensive definition of the notion of succession. Section 3 presents our argument regarding the

conditions in which succession occurs. Section 4 introduces a formal bargaining game to explain when different forms of institutional change— regime-shifting, reform or succession—can be expected. Section 5 offers a first empirical illustration: the replacement of the International Sugar Council by the International Sugar Organization in 1968. Section 6 offers a second empirical illustration: the replacement of the International Organization of Vine & Wine by the International Wine and Wine Office in 2001. Section 7 further illustrates the external validity of our argument by briefly considering other cases of institutional succession (like the GATT-WTO succession) which follow a similar logic.

2 Definition

Institutional succession occurs when an international institution, along with its afferent organizational apparatus, is formally dissolved and replaced by a successor that assumes all or part of its functions, assets, and liabilities (Schermers and Blokker 2003:145). Formal replacement entails that the dissolution of an existing institution and the creation of a new replacement is achieved as a single undertaking. As such, succession differs from rival regime creation at large (e.g. Keohane and Morse 2014), since it does not lead to the parallel existence of competing IOs.

Being a legal act, succession must be distinguished from situations in which deeply embedded international norms and practices lose their prescriptive status. Succession should also be distinguished from cases in which an existing IO

is informally replaced by another organization that has been created to serve a similar purpose (Schermers and Blokker 2003). For example, the creation of the Union of African States in 1963 resulted in the eventual disappearance of the Conference of Independent African States (Wessel 2011). Since there was no direct transfer of mandate or functions between the organizations, this is not a case of succession but rather describes a less tightly delimited phenomenon of organizational rivalry leading to the gradual demise of one IO and the eventual assimilation of its functions by a competitor.

When successful, succession may deliver changes that go beyond what could be achieved through reform. The WTO's creation on 1 January 1995 is such an instance. But whilst succession entails institutional change by definition, profound alterations to the status quo are not a necessary feature of succession: reform and succession represent different mechanisms of institutional change, not varying degrees of departure from the status quo.

Another distinction between reform and succession relates to the process through which agreement is reached. In most IO founding treaties, it is generally expected that all state parties participate in the process of amending the initial instruments (Klabbers 2002, Article 40(3) VCLT); reform typically requires some form of super-majority or even unanimity. By contrast, succession, as an extra-institutional strategy, can be initiated by a subgroup of members who can subsequently present a new agreement as a "take-it-or-leave-it" deal (Gruber 2000).

3 Four bargaining strategies

Succession is one of several bargaining strategies that aggrieved parties have at their disposal to alter the institutional status quo in their favor. Other strategies include reform and regime shifting. These strategies are "institutional" in the sense that they seek permanently to modify the distribution of payoffs. As such they differ from the day-to-day decision-making processes that govern standard rule-making within international institutions. The questions at hand are under what circumstances each of these strategies will prevail over the continuation of the status quo, and who initiates the institutional change.

Our discussion builds on a schematized version of an IO as comprising of two coalitions: "top dog" is the coalition that sets the agenda, "underdog" is the coalition that can either block or ratify the measures proposed. Agenda control is a simple, yet realistic way of defining institutional power. It is the institutional equivalent of what is called in game theory a "take-it-or-leave-it" bargaining game.

In an institutional context of this kind, the outcome is both predictable and simple: the agenda setting coalition offers measures that yield low payoffs to the agenda takers, roughly equal to their reservation value (what they would receive absent an agreement), while the agenda setters claim the residual benefits from cooperation for themselves. The deal is stable because, their reservation being met, there is nothing that the agenda takers can do to improve their lot.

Now assume that the initial payoff distribution is disturbed by an unpredictable change of circumstances, advantaging one side over the other. What

can the losing side do to rebalance the payoffs? If the agenda setters are the losers, they will typically do nothing because the initial deal provided them with sufficient value above their reservation value to absorb the current loss and still gain from cooperation.²

Things are different if the losers are the agenda takers. Earning the equivalent of their reservation value, they are operating as if they had their nose right above water, with the result that the slightest ripple spoils their disposition to cooperate under the existing institutional arrangement. They have two alternatives at hand: an inside option and an outside option.

An inside option in the bargaining literature is what the parties can do to improve their final payoffs while they temporarily disagree (Muthoo 1999:137). A textbook illustration is the option for a union to go on a strike during a wage negotiation with a firm; each new day spent striking reduces each sides' value for the game. Inside options in the context of IOs involve reneging on one's obligations within the existing institution in a way that does not elicit retaliation from the other side.

Inside options can take two forms: footdragging and regime shifting. Foot-dragging is an artless yet effective way of reducing the benefits of cooperation for everyone. A more sophisticated way of undermining an existing agreement is "regime shifting"—the shift of deliberations to an alternative forum. The expression was coined by Helfer (2009: 42), who argues that involving another organization in rule-making has the effect to "decrease the clarity of international

²This said, it is true that a very large negative shock could lead the agenda setters to abandon the current organization; the outcome would be death.

law" and introduce "strategic inconsistencies". Imprecision and inconsistencies, albeit legal, de facto mean the suspension, whole or in part, of the initial agreement for both sides. Both strategies are 'inside' options because they present means for altering payoffs from an existing institution.³

Through either footdragging or regime shifting, the agenda takers—the underdogs—are able to cut their own losses. But because they are also inflicting losses on the agenda setters—the top dogs—underdogs will often pursue such strategies with the explicit intent of forcing top dogs to renegotiate an agreement.

In response to the agenda-takers exercising their inside option, or in order to deter this maneuver in the first place, the agenda setters may offer to reform the current distribution of benefits in favor of agenda takers. Reform, if successful, puts an end to renegeing while keeping the agenda setters in the top dog position. Reform, however, may fail, usually because of a split among agenda setters or because some disgruntled player has a lock over the proceedings. Then the only way to break the logjam is then to sink the current organization and charter a successor: the outside option.

Succession comes in two versions depending on who initiates the move to form a new organization: "controlled", if in the hands of the agenda setters who remain in control of the new organization, "rival", if driven by the agenda takers that seize the agenda and become the new top dogs.

Whether controlled or rival, succession has one advantage over reform; it is

³Similar to regime shifting is "forum shopping" (Bush 2007) or "institutional selection", (Jupille et al. 2013) which both entail choosing the most favorable venue among several alternatives. While forum shopping and regime shifting may sometimes be an individual strategic choice, we consider it as a collective move.

not hostage to institutional veto players. In the take-it-or-leave-it bargaining protocol adopted here, reform requires collective bargaining between the coalition of agenda setters and the coalition of agenda takers. If either coalition is divided and paralyzed by internal veto players, bargaining stalls. Succession naturally helps to circumvent veto players by not requiring collective acceptance by any coalition. Bargaining takes place between a core group of proposers and individual other countries. We define a core group as the smallest subset of states belonging to the same coalition that are capable of spontaneously organizing in the absence a pre-existing organization. The core group proposes a new organization and other countries individually decide whether to join it or stick to the old one. Importantly, joining the new organization and leaving the old is done in a single undertaking. If enough states decide to join the new organization and sink the old, succession succeeds.

However, succession has problems of its own. Succession only works if enough members are willing to leave the old organization and invest in the new. Thus, there is a minimum participation threshold, below which succession fails. This is because the type of organization that we are interested in have built-in scale economies: the more members, the more efficient the organization is for its members. An implication of scale economies is that only one organization of a certain kind will ever exist at any moment in time: the new organization draws every party to itself, irrespective of which side controls its agenda, or it does not materialize at all.⁴

⁴Of course, there are plenty of empirical exceptions to this theoretical implication. In our

This is the institutional equivalent of what is called in game theory a "tipping game".

The need to reach a minimum threshold size makes succession costlier than reform. Assuming that a succession is proposed by a core group of either top dogs or underdogs, this subgroup is either large enough to tip the scales in favor of the replacement organization on its own, or — if it does not reach the required critical size — must sway enough other members' allegiance away from the incumbent organization to the proposed successor. Buying off individual members significantly increases the price of succession to the proposing core.

In sum, aggrieved members of an organization whose internal equilibrium has been shattered by random circumstances dispose of four institutional strategies. The agenda takers can break the spirit if not the letter of the agreement by renegeing on part of their past promises (through footdragging or regime shifting) or they can try to build sufficient support for a replacement organization and thereby flip control over the agenda. The agenda setters in turn can offer to reform the existing payoff structure in favor of the agenda takers or, if internal division on either side prevents them from doing so, a subset of them may seek to achieve that goal while still maintaining control over the agenda by proposing their own successor organization. The questions at hand are under what circumstances the two succession strategies—controlled and rival—will be

theory, cases of 'rival regime creation' reflect low scale economies. However, insofar as the parallel existence of rival regimes is always likely to entail some inefficiency costs, rival regime-creation may give way, over time, to 'reconciliation' whereby rival regimes are re-integrated (Verdier, 2021) leading effectively to a form of drawn-out, two-stage succession. We do not directly visit that scenario in this paper.

preferred over the continuation of the status quo or its reform, and if so, which one.

4 The reform and succession game

We introduce a bargaining game which models the choice between reform and succession in the wake of an exogenous shock to an institution. The difference between reform and succession boils down to this: succession is easier than reform because it does not incur transaction costs, but it is more difficult than reform because of the need to reach a critical size to tip the balance in favor of the new organization. Depending on which obstacle prevails (prohibitive transaction costs or difficulty in reaching critical size) we show that reform will be preferred to succession or vice versa.

4.1 Tree and payoffs

Bargaining is over a single issue according to a well-structured sequence of moves (the tree is drawn in Figure 1, the payoffs are collected in Table 1). n countries are divided into two groups, N top dogs and $n - N$ underdogs, with $0 < N < n$. The game starts with the top dogs collectively offering an agreement to each individual underdog.

The agreement consists of the division of a pie of size one into two shares, with x_1 percent going to underdogs and the residual, $1 - x_1$, going to top dogs ($0 \leq x_1 \leq 1$). The individual payoff for an underdog is equal to $x_1 \frac{k}{n}$. With k representing the number of countries joining the organization while variable n

the payoffs, effecting an unanticipated shock. Each underdog still gets x_1 of the available pie and each top dog $1 - x_1$, but Nature adds (or subtracts) an increment from these payoffs depending on circumstances, which can be "negative" for underdogs and "positive" for top dogs or vice versa. If Nature draws negative circumstances for underdogs (and thus positive for top dogs) and the outcome is respected, an underdog receives $x_1 \frac{k}{n} - \theta$ while a top dog gets $(1 - x_1) \frac{k}{n} + \theta$, with $0 \leq \theta \leq 1$. Conversely, if Nature draws positive circumstances for underdogs, each underdog receives $x_1 \frac{k}{n} + \theta$ while each top dog gets $(1 - x_1) \frac{k}{n} - \theta$. Nature draws negative circumstances for underdogs with probability p and positive ones with probability $1 - p$. This probability is common knowledge.

Following Nature's draw, the underdogs have a choice between respecting the initial deal, exercising their outside option (rival succession), or exercising their inside option (reneging through footdragging or regime-shifting).

Respecting the deal means that they receive the modified payoffs and the game is over. The decision to respect is made by the underdogs acting as one.

The second possibility is for the underdogs to pursue a rival succession. This means that an organized subset of underdogs offers an alternative organization to all the other members, be they underdogs or top dogs, who each individually decide whether to join the new organization or stick to the old one.

Payoffs from the rival succession are equal to $y \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$ for each underdog and $(1 - y) \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$ for each top dog. There are two components to an underdog's payoff. The first is y , the percentage of the new pie that is appropriated by underdogs, who are now the agenda setters of the ri-

val organization; top dogs' share is the residual, $1 - y$. The second component (within parentheses) is the size of the new pie. The key variable is S —the size of the underdogs' core group.

We resort to a graph to explain the construction of this payoff (see Figure 2). The horizontal axis represents the number k of countries sticking to the old organization, while the vertical axis is an underdog's payoff. Two curves are drawn. The solid ascending curve plots an underdog's payoff for sticking to the old organization (assuming $n = 100$ and $x_1 = .3$). This payoff increases with member size k . The descending curve plots an underdog's payoff for joining the rival organization (assuming $y = 1$, that is, underdogs collect the entirety of the new pie, and $\beta = 1.1$). It is drawn in counterpoint to the other curve so that if k members stick to the old organization, $n - k$ join the new one. Note that the two curves intersect around $k \simeq 36$. This means that the smallest core group S that would tip the scales in favor of the rival organization is equal to $n - 36 + 1 = 63$ —a tall order. With its lower intercept ($\frac{1}{2}$ instead of 1) and its steeper slope ($\beta > 1$), the payoff function for the rival organization was deliberately designed to be less efficient than the payoff function for the old organization.⁶

Another way of interpreting the graph is to posit an S , say $S = 20$, and calculate the payoff that joining the rival organization for an individual country would yield: in this case, the utility would be equal to -0.369 , way below the

⁶We chose $\frac{1}{2}$ for the intercept rather than an algebraic symbol on which to perform comparative statics because it is redundant with the slope component β : one can make it harder for underdogs to offer a rival succession either by lowering the intercept or by steepening the slope.

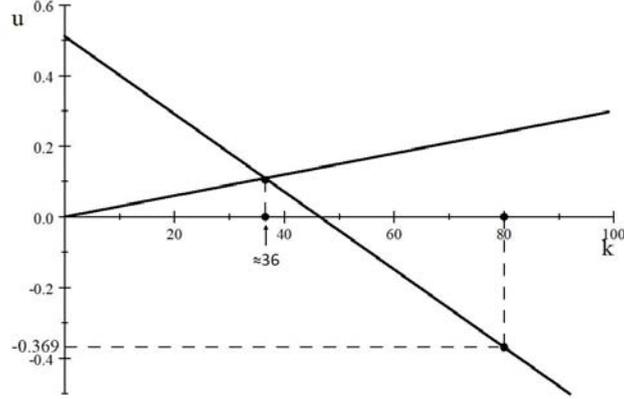


Figure 2: Agent's payoff for rival succession

simulated payoff for sticking to the old organization.

Note that the choice variable y , like the x' s, is a percentage varying between 0 and 1. For the sake of simplification, we set it equal to 1—underdogs appropriate all the benefits of the successor organization.⁷

The third possibility following Nature's draw is for the underdogs to partially renege on the initial deal either by footdragging or shifting regime (their inside option). More specifically, renege implies that δ percentage of the initial agreement is made unenforceable for both sides, with $0 \leq \delta \leq 1$. The decision to renege is made by the underdogs acting as a unitary actor. The inside option payoffs are thus $(x_1 \frac{k}{n} - \theta)(1 - \delta)$ for each underdog and $((1 - x_1) \frac{k}{n} + \theta)(1 - \delta)$ for each top dog.

⁷The presumed effect of that simplification is to make rival succession more difficult. A possible extension of the present game would be to endogenize y .

The reneging rate, δ , is set exogenously, reflecting formal legal and organizational constraints. If δ was made to be a choice variable, one that each underdog would choose, its equilibrium value might often be $\delta^* = 1$, allowing underdogs to reset its reservation value to zero, where it was at the beginning of the game. Apart from informal institutions, we believe that common understanding of the legal constraints imposed by institutions rules out such wholesale reneging.

Upon observing reneging, the top dogs (again acting collectively) have two options: the first is to accept the fait accompli, turning the reneging payoffs into final payoffs. A second option is to propose a renegotiation: a reform. The renegotiation takes a form identical to the initial negotiation, with top dogs proposing x_2 and $1 - x_2$ fractions of the pie to go to underdogs and top dogs respectively, with $0 \leq x_2 \leq 1$.

Next to play, the underdogs can accept or reject the top dogs' reform offer. Accepting yields new payoffs $x_2 \frac{k}{n} - \theta - c$ for each underdog and $(1 - x_2) \frac{k}{n} + \theta - c$ for each top dog. The reform payoffs are patterned after the status-quo payoffs minus transaction cost c , to reflect the fact that some fora are costly to renegotiate because they require supermajorities or consensus.

Even though it is common to model the limits of reform by means of a transaction cost (Lipsy 2017), a potential objection might be that this misrepresents as a deadweight loss what actually is a redistributive issue. Reform typically fails, when it does, not because it destroys value but because veto players ask for excessive rents. Nevertheless, we stick with the transaction cost formulation both because it is a useful simplification and because we believe that it can

be justified as a diversion of value toward veto players made necessary by an excessively qualified majority rule.

If the underdogs reject the top dogs' reform offer, the latter may attempt a controlled succession by proposing a replacement institution which divides payoff $x_3, 1 - x_3$ to the underdogs and top dogs respectively. An underdog that takes the deal would receive $x_3 \frac{N+1}{n} - \theta$, with N the number of top dogs who, forming a core group, are all prepared to join the new organization. A top dog would receive $(1 - x_3) \frac{N+1}{n} + \theta$. Like reform, controlled succession inherits Nature's choice of circumstances θ .⁸

The difference between reform and controlled succession boils down to this: controlled succession is easier than reform because it is not vulnerable to formal veto by underdogs, but it is more difficult than reform because of the need to reach a critical size to tip the balance in favor of the new organization.

Were succession to fail, both underdogs and top dogs would receive their respective reneging payoffs within the old organization.

We have so far described the left branch of the tree, in which Nature chooses negative circumstances for underdogs. If Nature chooses positive circumstances instead—right branch—the payoffs and sequence of moves are identical to those on the left branch except for the sign on circumstance θ , which is reversed. What was a loss for underdogs and a win for top dogs on the left side becomes a win for underdogs and a loss for top dogs on the right side.

⁸The structure of the problem would not be altered by assuming the opposite—that the controlled succession is not affected by Nature's circumstances. It would only make controlled succession easier to achieve.

Table 1 recapitulates all individual payoffs.

Table 1: list of individual payoffs		
	underdog	top dog
Prior to Nature's Move		
– pre-deal reservation value	0	0
Left Branch $\theta < 0$		
– respect [Resp]	$x_1 \frac{k}{n} - \theta$	$(1 - x_1) \frac{k}{n} + \theta$
– outside option (rival succession) [Riva]	$y \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$	$(1 - y) \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$
– inside option (reneging) [Rene]	$(x_1 \frac{k}{n} - \theta) (1 - \delta)$	$((1 - x_1) \frac{k}{n} + \theta) (1 - \delta)$
– reform [Refo]	$x_2 \frac{k}{n} - \theta - c$	$(1 - x_2) \frac{k}{n} + \theta - c$
– controlled succession [Cont]	$x_3 \frac{N+1}{n} - \theta$	$(1 - x_3) \frac{N+1}{n} + \theta$
Right Branch $\theta > 0$		
– respect [Resp]	$x_1 \frac{k}{n} + \theta$	$(1 - x_1) \frac{k}{n} - \theta$
– outside option (rival succession) [Riva]	$y \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$	$(1 - y) \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$
– inside option (reneging) [Rene]	$(x_1 \frac{k}{n} + \theta) (1 - \delta)$	$((1 - x_1) \frac{k}{n} - \theta) (1 - \delta)$
– reform [Refo]	$x_2 \frac{k}{n} + \theta - c$	$(1 - x_2) \frac{k}{n} - \theta - c$
– controlled succession [Cont]	$x_3 \frac{N+1}{n} + \theta$	$(1 - x_3) \frac{N+1}{n} - \theta$

The peculiar sequencing of the various choices, with underdogs pondering the wisdom of a succession long before top dogs do, is immaterial to the solution. Reversing the sequence would be of no consequences because actors are rational and anticipate all options before making a choice.

4.2 Solution

We are solving for a subgame-perfect Nash equilibrium. Backward induction is helpful in disposing of the right branch of the tree, the case when circumstances are good for underdogs. Underdogs always respect the deal as modified by Nature. None of the moves past that point are ever visited by the equilibrium.

Things are different on the left branch of the tree, when circumstances are bad for underdogs. After Nature has altered the initial deal, the underdogs choose between five possible equilibria: respect the new status quo, renege, reform and the two types of succession. The potentially large number of solutions disqualifies any further use of backward induction.

Instead, the structure of the game—the fact that top dogs always set the agenda—allows us to follow the mechanism design approach. We first identify the five above-mentioned possible equilibria (there are five only because that in which the underdogs turn down the initial deal never is a Nash equilibrium). We then calculate the conditions that the top dogs' offers must meet—the incentive constraints—for each equilibrium to obtain. Finally, we choose between equilibria by selecting the one that maximizes the top dogs' payoffs.

Since every equilibrium is *a priori* possible given the right parametric configuration, the results cannot be expressed simply. The full identification of the five competing equilibria would require a multi-dimensional space impossible to visualize. We resort instead to a series of unassuming two-dimensional graphs, starting with a simplified parametric configuration—a benchmark—that we modify as we go along. (See technical appendix for supporting proofs.)

4.2.1 Benchmark ($c = .5, p = .5, N = 5, S = 4$)

The benchmark panel zeroes in on three out of the five outcomes: respect, renegeing, and controlled succession. The present and all the following panels assume the number of countries to be ten ($n = 10$) and a somewhat inefficient outside option ($\beta = 1.5$). In the present panel, reform is assumed away because of high reform costs ($c = .5$) and so is outside option because underdogs face a steep collective action problem ($S = 4$). Uncertainty is maximal ($p = 0.5$) and top dogs are relatively numerous ($N = 5$). The intensity of the circumstances θ and the renegeing rate δ are allowed to vary between their smallest and highest values, zero and one.

Figure 3 maps the various institutional equilibria that characterize the benchmark case: respect (*Resp*), renegeing (*Rene*), and controlled succession (*Cont*). They each come with subscripts, for instance $Rene_0$ and $Rene_2$, because each equilibrium involves two components: an outcome (respect, renegeing, controlled succession) and a value for the initial offer x_1 . Although in some cases x_1 will be equal to zero, in most cases the top dogs will have to offer an extra incentive to deter the underdogs from declining the deal at the outset. If x_1 is equal to zero, the outcome is denoted with a zero as in $Rene_0$. If x_1 is superior to zero, it will usually take one of several possible values, here respectively denoted 2 or θ .

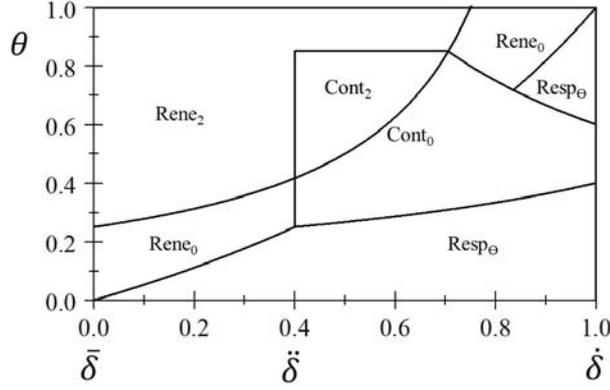


Figure 3: Benchmark

To interpret the results, we start from the origin, where both δ and θ are equal to zero. There is no shock at that point ($\theta = 0$), which means that top dogs offer underdogs their reservation value of zero ($x_1 = 0$), and the deal is respected per force since $\delta = 0$. Moving away from the origin on the horizontal axis by increasing δ does not change the outcome because even though the underdogs may have the capacity to exercise their inside option ($\delta > 0$), they will not do so because in the absence of a shock ($\theta = 0$) they are being offered the non-negative payoff of zero and would not improve on it by reneging.

Consider now a move away from the origin up the vertical axis ($\theta > 0$) in the absence of inside option ($\delta = 0$). Then, the underdogs face the prospect of negative expected payoffs, against which the top dogs must insure them lest there be no deal in the first place (recall that the underdogs will never accept an initial deal that has a negative expected value). This means that the top dogs' initial offer x_1 must be strictly greater than zero. If, in addition, we allow

the underdogs to exercise their inside option ($\delta > 0$), then the top dogs face two alternatives: insure the underdogs against the risk by offering them an $x_1 = \theta$ that will fully offset the bad circumstances (the *Resp $_{\theta}$* respect equilibrium), or not and watch the underdogs exercise their inside option by sabotaging δ percent of the initial payoff stream (the *Rene $_0$* renege equilibrium).

The respect equilibrium can be thought of as an insurance equilibrium, in which underdogs respect the initial deal because that deal insures them against risk. This is an expensive strategy for top dogs who, in addition to insuring underdogs against negative *expected* benefits (all equilibria do so) insures them as well against negative *actual* payoffs in the case where Nature chooses bad circumstances for underdogs. In contrast, renegeing is less expensive than this because top dogs only insure underdogs against expected negative payoffs. This lower cost, however, does not come cheap: the underdogs' response to bad circumstances is to drag their feet or shift forum and destroy part of the initial deal at the top dogs' detriment.

Which of the two evils top dogs choose is a function of the relative values of θ and δ . If the expected shock is severe (high θ) but the potential harm caused by renegeing limited (low δ), letting the underdogs renege is not so bad. Conversely, if uncertainty is low (low θ) but the potential harm caused by renegeing substantial (high δ), then avoiding renegeing by insuring the underdogs against actual losses is the better option.

The respect equilibrium would be the dominant equilibrium if underdogs had the option of freely choosing the value of δ —a situation that, we believe,

is indirectly approximated in obligation-free informal organizations. In this hypothetical case, there would never be any value lost to renegeing because top dogs, fearing the possibility of a high δ , would always insure underdogs against losses.

Note that as θ further increases, $Rene_0$ turns into $Rene_2$, which is the same equilibrium except with an initial offer $x_1 > 0$. There is a very specific reason for this higher bid which is not represented in the graph: the fact that, in addition to the inside option, the underdogs also have an outside option—they could create a rival organization. To deter this, the top dogs simply must raise the ante.⁹

Besides respect and renegeing, a third possible outcome is controlled succession (*Cont*). The shape of the controlled succession solution, an island in a sea of respect and renegeing, reflects several logics. First, succession becomes a plausible alternative to the existing organization only if harms from renegeing are substantial enough ($\delta > \delta^*$). As a rule, top dogs prefer controlled succession to renegeing because it allows them to overcome the latter's destructive effects. However, they cannot immediately pursue controlled succession because the smaller scale of its conception— $N + 1$ instead of n —is a source of inefficiency. Basically, N top dogs must offer the N^{th} plus one underdog a transfer that is sufficient to tip the scales in favor of succession.

Second, as shown in Figure 3, the scope of the controlled succession outcome first expands and then vanishes with the intensity of circumstances θ . This is

⁹The number "2" subscript in $Rene_2$, $Cont_2$, and, later on, $Refo_2$, all imply an initial offer x_1 designed to deter the underdogs from exercising their outside option.

because two contradictory effects are at play, fueled by the single fact that what are bad circumstances for underdogs are good ones for top dogs. On the one hand, top dogs look for alternatives to reneging as θ gets higher. On the other hand, as θ gets too high, underdogs require a higher x_3 in order to accept the controlled succession, an x_3 that must also cover for the built-in inefficiencies of controlled succession and ends up throwing that option out of bound.

Last, note that, as for reneging, the threat of an outside option is responsible for the upgrading from the $Cont_0$ equilibrium into the $Cont_2$ equilibrium.

In the following figures, 4 and 4bis, we respectively increase and decrease the likelihood p of bad circumstances for underdogs. A higher p shrinks the spaces devoted to reneging and controlled succession in favor of respect, whereas a lower p expands them. The reason is that what is a bad circumstance for underdogs is a good one for top dogs (θ features in the top dogs' payoffs with a positive sign). Since increasing p means increasing the beneficial incidence of θ on top dogs' payoffs, top dogs are less likely to tolerate inefficiencies than before. Conversely, since decreasing p improves the underdogs' expected payoffs, it is easier for top dogs to pursue the Pareto-inferior strategies of reneging, controlled succession, or even rival succession.

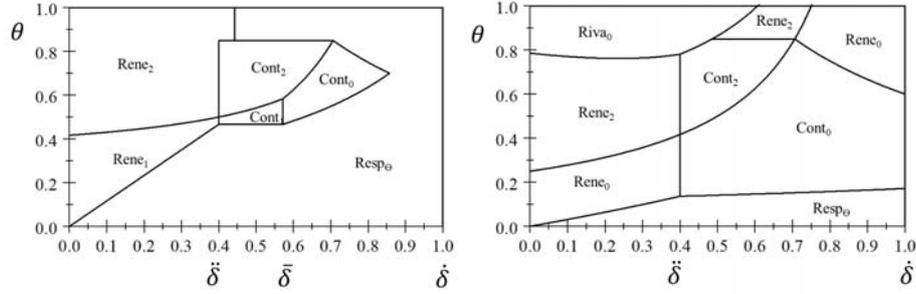


Figure 4: Benchmark with high p Figure 4bis: Benchmark with low p

The appearance of the outside option equilibrium on the top-left in Figure 4bis reflects two logics. It appears at the top, first, because it is the only equilibrium that clears underdogs' payoffs from the bad circumstances loss θ , making it most relevant when θ hits high values. It appears on the left, second, because, the only difference between the inside and outside options (both interchangeable ways for underdogs to cope with bad circumstances) is that rival succession is more likely to be used when reneging is unavailable (low δ).

4.2.2 Lower c ($c = .2, p = .5, N = 5, S = 4$)

This simulation reduces the transaction cost c incurred through reform to a level that makes the reform equilibrium competitive. As Figure 5 shows, reform ($Refo_0$ and $Refo_2$) displaces part of the respect equilibrium and all the controlled succession ones for values of $\delta > \hat{\delta}$. It is only in the very far corner of the graph, with very high values of θ and δ , that reform, like controlled succession earlier, is disqualified by its transaction cost c . Were that c to be equal to zero, $Refo_0$ would take over the top-right corner.

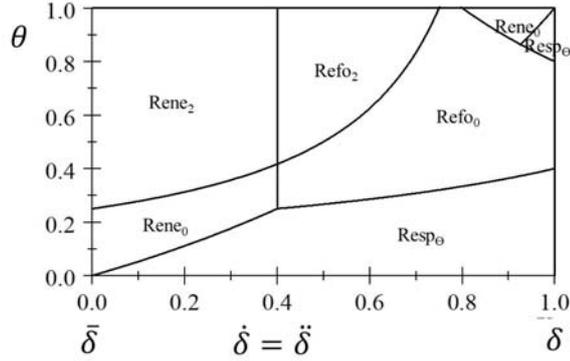


Figure 5: low c

Modifying the probability of bad circumstances p for underdogs has an effect similar to that in the benchmark panel. A higher p shrinks the spaces devoted to renegeing and reform in favor of respect, whereas a lower p expands them (not graphed). The reasons are the same as earlier: a low likelihood of bad circumstances ($p < \frac{1}{2}$) makes the top dogs willing to resort to inefficient methods such as renegeing, reform (and controlled succession in Figure 4bis).

4.2.3 Higher S ($c = .2, p = .5, N = 3, S = 5$)

So far we have assumed that the underdogs faced an overwhelming collective action problem thwarting them from presenting a viable alternative to the top dogs' proposals. We now reverse this assumption, positing that the number of underdogs able to form a core group is higher. Although we must assume that the number of top dogs is small ($N = 3$), since a large S implies a small N , we nevertheless maintain the prior panel's assumption (Figure 5) that reform is easy ($c = .2$) and thus that the underdogs find both their outside and inside

(leading to reform) options desirable.

Although the larger S opens the possibility of a rival succession—underdogs exercising their outside option—paradoxically such is neither the immediate nor the sole effect. The immediate effect, as the value of S rises from four in the benchmark case (Figure 3) to five in the present case (Figure 6), is to expand the range of the respect equilibrium at the expense of the other available equilibria—renegeing and reform. The rationale goes like this. Raising S makes the outside option more attractive, thereby forcing the top dogs to increase their initial offer x_1 in order to deter the underdogs from exercising their outside option. But as the value of x_1 is increased, it prices out both the reform and renegeing equilibria in relation to the respect equilibrium because the former two suffer from built-in inefficiencies whereas the latter is perfectly efficient—no value is lost to renegeing (δ) or transaction costs (c)—only the top dogs must choose an $x_1 (= \theta)$ that is sufficiently high to insure the underdogs against the risk of bad circumstances.

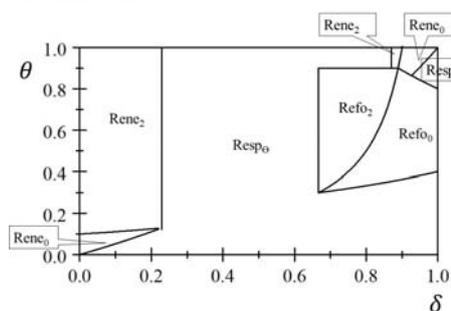


Figure 6: High S

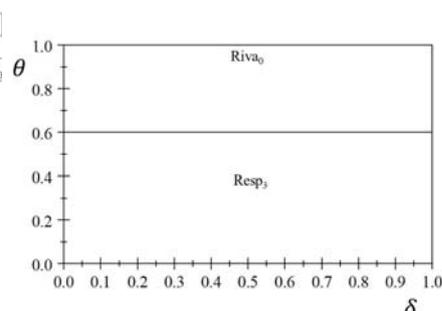


Figure 6bis: Very high S

Decreasing uncertainty by moving p away from its median value of one half generates the same changes as registered above: an increase in p expands the

presence of the respect equilibrium at the expense of the reneging and reform equilibria, whereas a decrease in p does the reverse (not graphed).

Further raising S ($= 7$) brings the outside option equilibrium ($Riva_0$) into the picture in a one-on-one contest with the respect equilibrium ($Resp_3$), all the other equilibria having given up the fight so to speak (Figure 6bis). In the extreme and unlikely case where the value of $S = 9$, the outside option is the only equilibrium left standing (not graphed).

Focusing on Figure 6bis, modifying the probability of bad circumstances for underdogs p affects the boundary between the two equilibria in what has become now a predictable way: a higher p pushes the boundary upward, in favor of the respect equilibrium, whereas a lower p brings it down, expanding the scope of the rival succession equilibrium. This effect is in keeping with those observed with respect to the other inefficient strategies (reneging, controlled succession, and reform): only if facing bad circumstances are top dogs willing to submit to a rival succession.

A final way of expanding the scope of the rival succession outcome is to make the rival organization more efficient (choosing a lower β). Raising S and lowering β are functional substitutes (not graphed).

4.2.4 Higher N ($c = .5, p = .5, N = 6, S = 2$)

The last comparative statics of interest is an increase in the number of top dogs. The present panel reproduces the benchmark except for an N of 6, instead of 5 (Figure 7). As the top dogs are better able to tip the scales in favor of a

successor organization, the controlled succession equilibrium becomes dominant. The effect is dampened by a rise in the value of p while amplified by a drop (not graphed) according to a logic that is now familiar.

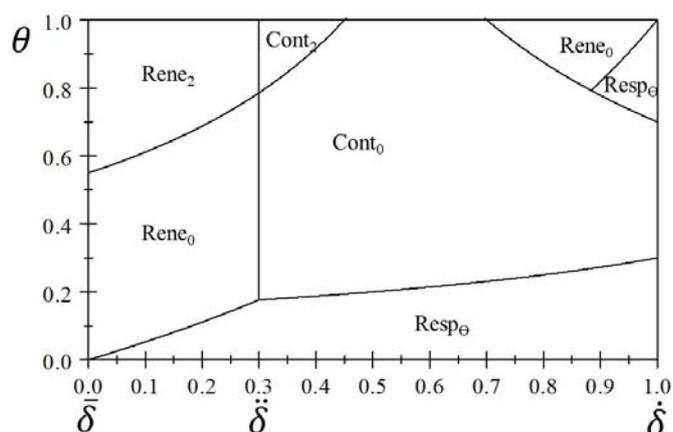


Figure 7: High N

4.3 Hypotheses

4.3.1 Stasis

A first set of propositions addresses the question of whether the organization will survive as is (respect equilibrium) or whether it will undergo change (reneging, reform, or succession). Three parameters speak to this question: p , δ , and θ .

First, a larger p means that players expect bad circumstances. For underdogs, bad circumstances present two options—the inside option (reneging) or the outside option (rival succession). Both options are Pareto-inefficient in the sense that they create deadweight losses. This means that even if the underdogs

manage to improve their lot by resorting to them, the top dogs have to take that loss. As a result, top dogs have an incentive to offer the underdogs an initial deal that is good enough to compensate them for the bad circumstances and entice them to stick to the initial deal (respect). Even though the respect equilibrium is expensive for top dogs (recall that it not only insures against expected losses but actual ones as well), it is realistic if the deadweight losses incurred by the other strategies are high. This is why a high p tends to yield the respect equilibrium. In contrast, a lower p puts a lower weight on the deadweight losses incurred on the left side of the tree but a higher weight on the respect equilibrium of the right side (recall that the underdogs always respect the initial deal when the circumstances are good for them). As a result, top dogs are less intent on avoiding losses and more likely to offer an initial deal that is lower but destined to be rejected if bad circumstances strike.

The second parameter that determines whether the organization goes on unaffected or incurs change is the rate of renegeing δ . The reasons are the same as for p . Parameter δ determines the extent to which the inside option damages the top dogs' payoffs. If high, the top dogs have an incentive to deter the underdogs from exercising their inside option by offering a deal that is good enough for them to choose respect.

The third parameter predicting change is the intensity of the random shock, θ . The lower this shock is, the less expensive for the top dogs to insure the underdogs against it. In almost all panels, the respect equilibrium is located at the bottom of the space, under both the reform and succession equilibria.

In sum, a rise in p or δ or a drop in θ increase the likelihood that underdogs are going to exercise one of their options, thereby giving top dogs an incentive to offer a more generous deal at the outset (that is, when designing the initial institution), one that the underdogs can respect no matter the circumstances. This yields the first proposition about the likelihood of change, internal or external:

Proposition 1 *The more likely the negative shock (high p), or the higher the reneging rate (δ), or the less intense the random shock (θ), the more likely the top dogs are to insure the underdogs against losses and preempt a change of the existing institutions.*

4.3.2 Reform

Assuming that the conditions for change are met, when will that change take the form of reform as opposed to succession? Although both reform and succession involve inefficiencies, these inefficiencies differ: reform is vulnerable to veto players, while succession is not, but succession suffers from scale diseconomies, while reform does not.

Predictably, reform happens when its cost c is low (there are no outlier veto players that may want to hold out for a better deal or they can be overcome through consensus) and when a rival succession is impractical because the underdogs cannot rally sufficient allies to their rival organization. Alternatively, easiness in organizing on the top dogs' side (high N) or on the underdog's side (high S) may lead each side to prefer succession over reform.

Proposition 2 *Assuming that the conditions for change are met, reform hap-*

pens when its costs are low and/or both forms of succession are impractical.

4.3.3 Controlled v. rival succession

Assuming the conditions for change are met and reform is costly (there are veto players within coalitions), succession will be the default outcome, but which type; controlled or rival? The condition for controlled succession to prevail is that the underdogs must find being invited to join a successor organization more appealing than founding a rival organization of their own. Of course, this choice is endogenous to bargaining, for dependent on how generous the agenda setters are willing to be to steer a successful controlled succession. Nevertheless, controlled succession becomes more likely if rival organizing is thwarted by deficient collective action (core group S is small while core group N is large).

Proposition 3 *Assuming the conditions for change are met and reform is costly, controlled succession happens when underdogs find it difficult to organize while top dogs do not.*

In contrast, the obvious requisite for rival succession is the plausibility of an outside option. Plausibility is not an easily generalizable category; in the sugar case developed below, for instance, the South offered a plausible rival coalition by building it off the UN system.

Note, however, that the existence of a plausible outside option does not necessarily lead to a rival succession. The existence of an outside option is often sufficient to induce top dogs to raise underdogs' payoffs across equilibria in order

to prevent underdogs from exiting and undermining the top dogs' control over the existing organization or its successor.

Therefore, a rival succession will occur when two conditions are met. The first is intuitive: if the underdogs face no serious collective action problem (S is high). The second reason is less intuitive: if the random shock $\mathbf{\blacksquare}$ is high. Even though the top dogs would benefit from the high $\mathbf{\blacksquare}$, they cannot afford to insure the underdogs for the risk that the latter incur and prevent them from exercising their outside option.

Proposition 4 *A rival succession happens when circumstances are bad for the underdogs, the underdogs are organized, and the shock is large.*

Our case selection is informed by several scope conditions. The first is a standard cooperation game. Two sides are locked into a bargaining relation: while both sides agree to capture gains from cooperation, they disagree on their distribution. More precisely, a random shock makes one side dissatisfied with the existing agreement. One could envisage a shock that would result in reduced payoffs to all parties lest some technical fix were implemented, but no state would object and reform would be the inevitable outcome.

The second condition is the existence of scale economies that are steep enough to deter the creation of two or more rival institutions. High scale economies ensure that a rival creation takes the specific form of a succession. Commodity agreements are perfect candidates, for there is room for only one cartel at a time. Scale economies are also present in most regulatory agencies, such as the various BASEL committees. In contrast, trade and most of the

“trade-related” issues offer lower scale economies, making viable bilateral bypass such as Bilateral Trade Agreements (BITs) and regional Preferential Trade Areas (PTAs).

Last, we selected two cases that both display the outcome of greatest interest, namely succession—rival in the case of sugar, controlled in the case of wine. Overtly selecting on the dependent variable is justified insofar as both institutions also underwent periods of stasis and several reform attempts prior to succession, thus ensuring important within-case variation in outcomes. Each case thus effectively constitutes several cases (Gerring 2004), allowing us to illustrate other predictions of the model.

Our main independent variables are the severity of unexpected shocks, the potential harm inflicted by renegeing, transaction costs of reform, relative capacity for coalition-building/organization, and future uncertainty. Some of these have a straightforward empirical meaning while others a more difficult to code. For example, while they depend on objective factors such as formal voting rules or environmental volatility, variables like reform costs and future uncertainty also have subjective dimensions that are best gauged through careful empirical analysis to establish the perceptions of key players.

5 A case of rival succession: Sugar

In 1937, 20 states joined Britain and the United States in London to negotiate an international agreement regulating production and trade in sugar—a

commodity of growing economic importance during the interwar years. The International Sugar Agreement (ISA) of 1937 instituted production quotas and export controls to stabilize the global production and pricing of sugar. It created an International Sugar Council (ISC) to oversee implementation. In the following decades, the 1937 agreement was revised several times to cope with changing market conditions: votes were redistributed in favor of emerging producers, production ceilings were adjusted to restrain output in developed countries, and joint stock-management was introduced. However, by 1968, the ISC was replaced by a rival, the International Sugar Organization, in which Britain controlled fewer votes than the USSR while the U.S. chose to watch from the sidelines.

The 1937 agreement divided power among two groups: importing countries (a total of 4 parties) and exporting countries (18 parties). No major importer or exporter remained outside the agreement. As the largest importers, Britain and the U.S. each controlled 17 out of 45 importers' votes (a combined share of 76% of importer votes, and 34% of total votes), reflecting their dominant position as agenda setters within the institution. The remaining two importers, China and India, each held a small vote share (6 and 5). As the largest global producer Cuba held 10 out of 55 exporters' votes. The second largest producer—Holland—held 9 votes, and the U.S.S.R., 5 votes. The remaining 15 exporters were small players. Decisions of the Council were taken by simple majority.

Though ostensibly representing different sets of interests, the divide between the two groups was actually blurred. For both Britain and the U.S., sugar im-

ports served as an important tool to promote political stability and economic development within their international spheres of influence. Each top dog granted special privileges to select producing countries whereby their exports (to either Britain or the U.S.) were not counted against export quotas to the global "free market." Thus, London gave preferential treatment to imports from Commonwealth countries, while London privileged Cuba and other Latin American countries (Swerling 1954; Mahler 1984; Viton 2004).

5.1 1937-1945: Stasis amidst growing demand for change

The first decade of the Sugar Council's existence is best described as one of stasis despite rapid exogenous change, what historical institutionalists refer to as 'drift'- when institutions are deliberately held in place while their context shifts in ways that alter their effects (Hacker et al. 2015). Like many commodity agreements (Koremenos 2002), the 1937 ISA was agreed for a period of 5 years, after which it would be subject to review. However, WWII soon intervened to make review and reform of the agreement impractical. In 1942, a wartime protocol was added prolonging the 1937 ISA unaltered until August 1944. In the presence of substantial yet expected future uncertainty, the existing agreement provided an element of insurance for importers (high p in Proposition 1).

As WWII drew to an end, demand for increased agricultural output and the introduction of new welfare state policies throughout Europe placed sugar high on the global agenda and led to a radical change in Britain's colonial policy (Viton 2004:6). The labor-intensive sugar industries of the colonies, where low

prices and outdated production methods kept workers in perpetual poverty, offered an ideal instrument to implement the socioeconomic development targets of the British Government (Viton 2004). London thus set out to negotiate a Commonwealth Sugar Agreement (CSA) designed to replace British imports from the global free market with greater imports from Commonwealth countries (Moynagh 1977; Mahler 1984). Furthermore, Britain threatened to terminate the 1937 ISA altogether and to replace it by "an international committee with limited advisory powers."

The British move sent a negative shock throughout the exporting world outside of the Commonwealth. For a country like Cuba, which derived 80% of its foreign exchange earnings from sugar exports, expanding production and gaining wider access to global markets was vital for post-economic recovery (Viton 2004:270). However, the new UK policy meant Cuba would see demand for its exports reduced. Washington's strong ties to Cuba meant the two dominant agenda setters were unable to form a viable sub-group to initiate change. U.S. Secretary of State, Hull, argued, "...termination would be viewed with great apprehension by the sugar exporting countries of this Hemisphere unless they had some assurance that their pre-war position in the international trade in sugar will be maintained". Under strong U.S. pressure, London agreed to a compromise: extend the 1937 agreement for another year provided that existing treaty-provisions for stocks and export quotas to the free market were rendered inoperative pending a review of the treaty after the war (Art.2, ISA Protocol, 1944). This compromise was accepted in Washington as "the best we

can achieve" since it at least ensures the "maintenance of existing machinery".

Our model is not designed to explain the rift among agenda setters, but to make sense of the absence of institutional change. Reform of the 1937 agreement was blocked by the British veto (high reform cost, c , in Proposition 2). Second, the US could not overcome this veto by initiating a controlled succession, because British participation was critical to any global scheme (low capacity for organization by core group—low N —Proposition 3). Last, sugar exporters at the time could not pursue a rival organization, as they were themselves divided between those who, like Cuba, wanted to take advantage of the temporary suspension of quotas to expand production in anticipation of future negotiations, and those who, like Holland and Poland, had seen a decline in wartime production and wanted to "freeze" prewar market shares in light of their reduced bargaining power (low capacity for organization by underdogs—low S —Proposition 4).

5.2 1945-1958—Unsuccessful Push for Reform

The situation remained unresolved for another thirteen years. Following the 1944 protocol, which extended the 1937 ISA until 1945 with a temporary suspension of export quotas against a promise of future review, the existing agreement was extended yearly by protocol until 1958.

As earlier, institutional stasis during this period was less a reflection of broad satisfaction with the status quo than of internal deadlock and the unavailability of outside options. The status quo which involved a temporary suspension of

the operative parts of 1937 ISA left Britain free to import exclusively from Commonwealth producers, leaving other producers increasingly dissatisfied. Leading the group of exporting countries, Cuba pursued a two-pronged strategy of renegeing and demanding renegotiation. On the one hand, Cuba sought to compensate for the loss of the British market by over-producing and selling more. On the other hand, Cuban over-production aimed to pressure Britain to renegotiate the 1937 agreement by bringing world prices down and thereby hurting all sugar exporters, including Commonwealth producers, whom the UK's refusal to renegotiate the 1937 ISA was meant to help. Cuba calculated that as global prices kept plummeting, Britain would eventually consent to a renegotiation.

This point was almost reached in 1951. By then, further expansion of Cuba's sugar production to more than 30% of total global production had suppressed prices to less than 1/3 of the pre-1950 level (Mahler 1984:716). However, the successful conclusion in 1951 of the Commonwealth Sugar Agreement committed Britain to buy a large quantity of raw sugar at a fixed price from Commonwealth producers (Moynagh 1977:10), thereby insuring those producers against drops in world prices. Although the 1951 Review Conference led to a reinstatement of controls on export to the "free market" along lines similar to the 1937 agreement, on the question of production ceilings, no agreement could be reached as Cuba made any reduction of output conditional on a decrease in UK protectionist measures, which London refused (IBRD 1968; Viton 2004:270). The 1951 agreement thus effectively returned the 1937 status quo ante with the exception that UK imports were no longer part of the global "free market" (Mahler

1984:716; Swerling 1954). Indeed, the global market was now largely residual, as British and American preferential agreements accounted for more than 50% of global sugar trade (Mahler 1984).

The failure to reach a renegotiation did not lead to an institutional fix. Instead the review conference leading to the 1958 ISA largely reiterated the terms of the 1951, 1953 and 1956 deals before it. Exporters could not initiate a rival succession because they were divided not just between Commonwealth and Latin American producers, but also among the latter, between countries like Cuba, which enjoyed privileged access to the US market, and others like Brazil who did not and were hurt by falling prices (low S in Proposition 4). Importers could not reform the 1937 agreement because reform costs were high: $\frac{3}{4}$ of both importers and exporters votes were needed to amend the existing agreement (high c , Proposition 2). Importers could not proceed with a controlled succession either because of divide between UK and US preferences (low N , Proposition 3). In sum, protracted renegeing during this period is explained by a combination of high reform costs (c) and an inability to organize effectively on the part of both top-dogs and underdogs (low S , low N).

5.3 1959-1968: Unexpected Shock and Rival Succession

This situation changed in 1959, just as Castro came to power. Strained relations between Washington and revolutionary Cuba prompted Eisenhower in July 1960 to cancel Cuba's sugar quota and redistribute it to other Western Hemisphere countries, effectively suspending the operative clauses of the ISA (Berman and

Heineman 1963; IBRD 1968). The effect of this shock can hardly be overstated. Unlike prior shocks, it was totally unexpected, and as such, was uninsured, sending Cuba scrambling for an alternative, which it found in the Soviet Union. An alliance was formed between Moscow and Havana, whereby a large part of Cuba's sugar production was imported by the USSR from where it was re-exported to the global market, causing significant downward pressure on global prices (IBRD 1968). While this made limited economic sense for Moscow, since the USSR had turned from being an importer of sugar to becoming a producer and exporter, the Cold War gave Cuba a paramount importance. It also meant that, from now on, the Havana-Moscow axis could wreak havoc in the sugar market.

Despite facing hurtful reneging from Cuba and the USSR, Britain and the United States rebuffed Havana's demands for the reallocation of existing quotas. Washington's anti-Castro stand prevailed over the goal of stabilizing world prices. With neither reform (high c in proposition 2) nor controlled succession (low N , Proposition 3) being feasible, the logjam was eventually broken by the creation of a rival organization.

Indeed, from the mid-1960s several geopolitical developments strengthened the hand of Cuba and other developing producers. In 1964, the UN Conference on Trade and Development (UNCTAD) was created to address trade and development issues, amidst growing calls for a New International Economic Order. Major developing producers (Cuba and Brazil) supported by Moscow now pursued a strategy of regime-shifting by seeking to vest initiative on future sugar

cooperation in UNCTAD where a stronger developing country vote existed to support their agenda (high \blacksquare and high S , Proposition 4). Commonwealth exporters and "top dog" importers, by contrast, wanted to retain control in the International Sugar Council and derided UNCTAD's approach to political economy as "utopian" (Fakhri 2014:186).

Between 1965 and 1968, some fourteen meetings were held under the auspices of the ISC and UNCTAD to resolve the deadlock (Australia FCO 1968; Fakhri 2014). Finally, in December 1968, a new Sugar Agreement was concluded at the UNCTAD, establishing a new International Sugar Organization (ISO) to replace the Sugar Council. Export restrictions would once again be the chief device for stabilizing global prices, reinforced more strongly than before by banning imports from non-members (Art.28,1968-ISA; IBRD 1968). The new agreement also entailed measures to ensure access to developed importers' markets (Art.51) and introduced a special fund for developing countries plus an inclusive program aimed to stimulate broader economic development (Art.1).

The new agreement would come into force when ratified by governments holding 60% of exporting and 50% of importing countries' votes (against the $\frac{3}{4}$ of both votes required to reform the existing agreement). By lowering the threshold for acceptance, the treaty thus effectively removed the veto of developed importers and presented them with a *fait accompli*: either join the new ISO or be left out of an agreement. The US, still bent on undermining Cuba, refused to join the new organization. However, the UK, on account of its continued interest in facilitating Commonwealth sugar production and exports, joined.

Some 30 new developing member states also joined as either exporters or importers. In total the new ISO had 46 exporting and 30 importing members with votes split 50/50 between the two groups. The UK share of importers votes was reduced to about 15% whereas the USSR controlled 20%. Thus, the underdogs of the International Sugar Council became top dogs in the new International Sugar Organization.

In sum, rival succession was triggered by the major, yet unexpected, shock caused by the communist victory in Cuba, which served to further fracture an already-fractured group of agenda-setters and open the stage to a shift of the negotiations to the pro-LDC forum of UNCTAD, where developing exporters were able to regroup and propose a rival organization, whose agenda they promptly seized while the UK surrendered some control and the US chose to watch from the sidelines.

6 A case of controlled succession: Wine

Faced with widespread overproduction and falling prices, in 1924 France and seven European wine-producing countries signed an agreement to create an Office International du Vin (OIV) (Simpson 2011:68). Dominated by "old world" wine countries—Spain, Italy, Germany, and France—the organization was tasked with formulating common standards for the production and trade in wine based on the French AOC system, which narrowly specified the geographic area ("terroir") in which a wine must be manufactured, the choice of grape

varieties, and the production standards it must meet in order to trade under a designated name (Hannin et al. 2006:75; Simpson 2011:70).

For most of the 20th century, the OIV worked to the broad satisfaction of its members despite rapid exogenous changes. As new wine producing countries emerged within and outside Europe, the OIV had to adjust to changing production technologies, a doubling of global wine production, and an expansion of international trade—from 10-20% of all wine produced during the 1920s, to 70% by the 1990s (Hannin et al. 2006:79, Silverman et al. 1999). The OIV adapted to changing market conditions by expanding its membership (from 8 in 1924 to 47 in 1990), by adjusting regulations of production methods, and through flexible application of existing rules. For example, the U.S. was allowed to join the organization in 1984 with a reservation on the issue of "appellations of origin". Nevertheless, by 2000 the rapid accumulation of market shocks proved too much for the organization to adjust (high α and low p in Proposition 1). In 2001 a majority of members decided to dissolve the OIV and replace it with a new organization, the International Organization of Vine & Wine.

As with the Sugar Council, a major source of growing dissatisfaction with the OIV was a shift in the balance of market power to which the organization failed to adapt (Hannin et al. 2006:79). By the 1980s, members filed into two camps: on one side were the "old world" wine countries, represented mostly by European producers; on the other side were the "new-world" producers, chiefly South Africa, Australia, New Zealand, Chile, Argentina, Canada and the United States. Starting in the 1980s, Europe, which had traditionally accounted for

two-thirds to three-quarters of global wine production, began to lose market power to new world wine producers, which, through the adoption of modern production methods, were able to produce more consistently high quality wines at lower cost (wwtg; Meloni and Swinnen 2013).

This changing balance of market power failed to be reflected within the OIV, whose voting structure and operating procedures kept favoring old world producers (New Zealand 2001). Beginning in the 1990s, new world producers grew increasingly dissatisfied with the organization's insistence on "terroir" as the basis for wine classification, which played to the strength of old world producers; they demanded a reform (New Zealand 2001; Hannin et al. 2006:78). A series of minor reforms were agreed in the late 1980s but failed to satisfy the demand for change. By the mid-1990s, following U.S. leadership, "new world" members exploited the antiregulatory spirit of the Uruguay Round by shifting negotiations to the GATT/WTO regime. Their position was significantly strengthened by the Uruguay Round Final Act of 1994 which undermined the legitimacy of several core OIV standards. For instance, the OIV's ban on the use of oak chips, popular in the new world, and the strict requirements regarding the geographic origins of grapes would not be permitted under new WTO rules which sought to crack down on "technical trade barriers" (Hannin et al. 2006:85).

In 1997 a Review Conference of the OIV was called to ensure compliance with new WTO practices. New world producers, backed by major wine importing countries such as the UK and U.S., pushed for wide-ranging reforms that would abolish existing restrictions on production and marketing of wine, whereas Eu-

European producers sought the minimum adjustments necessary. Preliminary negotiations ended inconclusively because of a combination of high distributional conflict and inflexible reform structures. Distributional conflict reflected the fact that wine-production is dominated by small family vineyards and cooperatives in Europe, but by large, concentrated and vertically integrated corporations in the new world (Simpson 2011). For example, 10% of wine in France, Italy, or Spain is produced by the top five national wine companies, compared to 70% in the U.S. and Australia (Simpson 2011). Scale economies allow producers in the latter countries to embrace high-tech production technologies which make them highly competitive in a less regulated market (Hannin et al. 2006:81), thus making it costly for old world producers to consent to deregulation.

Institutionally, the OIV's voting structure made it easy for European producers to block proposed reforms (high c in Proposition 2). Reform was further made difficult by the fact that most European wine countries were part of the EU, and thus subject to more than 2000 regulations, directives, and decisions published since 1962, regulating quantity, price, and quality through market intervention (Council Regulation No. 479/2008; Meloni and Swinnen 2013).

Given these stumbling blocks, reform failed, opening the route to succession, starting with a failed attempt at rival succession. In 1998 seven new world countries (Argentina, Australia, Canada, Chile, New Zealand, South Africa, U.S.) formed the World Wine Trade Group (WWTG) to promote "unsubsidized wine production and free export markets" and to "enhance the international acceptability of wine produced in WWTG countries" (wwtg.org). The group,

which was soon joined by Georgia and Uruguay, accounted for about 1/3 of global wine production and exports. However, it did not reach the critical mass that would have allowed its members to eclipse the OIV and turn it into a rival successor (low S in Proposition 4). Instead, the WWTG dedicated itself to lobbying the WTO and the OIV to adopt policies favorable to new world producers (New Zealand 2001) and to serving as a new forum for its members to sign bilateral trade agreements among each other (wwtg.org; Smith 2016:77).

In the end, deadlock was overcome through a controlled succession. On 3 April 2001, 35 countries signed an international agreement creating the International Organization of Vine & Wine (also referred to with the French acronym "OIV") to replace the old OIV. In a typical succession move, the new OIV founding treaty stipulated that consent to terminate the 1924 Treaty was a precondition for new OIV membership. Countries failing to ratify the new treaty would be granted only observer status (OIV Resolution Comex 2/2002).

The new treaty reflected a compromise between old and new wine countries. On the one hand, the treaty enacted a major rebalancing of power in favour of non-European members by giving each state a roughly equal vote-share plus the ability to veto actions not in their national interests by shifting from majority rule to consensus on most matters (New Zealand 2001). On the other hand, the new OIV remained wedded to protecting geographical indications, including "appellations of origin" standards, "insofar as they do not call into question international agreements relating to trade and intellectual property" (OIV Treaty 2001, Art.2.2.b.ii).

The thirty-one ratifications required for the new OIV to enter into force were easily obtained. However, twelve old OIV members (Argentina, Bolivia, Brazil, Canada, Chile, Georgia, Lebanon, the Netherlands, Tunisia, Turkey, the UK, and the U.S.) initially declined to join the new agreement, possibly gambling that it would not succeed in attracting a critical mass. Many of these "hold-outs" have since joined the new OIV, but a small group of former members have remained aloof—most importantly Canada, the UK and the U.S.

We have no formal explanation for why a country like the United States would remain outside the successor organization. It could be that "old world" producers made only enough concessions to attract the new wine countries that—like Chile or Australia—are highly dependent on European markets. In contrast to these countries the U.S. sells only 15% of its considerable wine production abroad (Silverman et al. 1999) while the UK is exclusively an importer, leading both players to be less willing to trade concessions for access to European markets. Or it could be that the US, as both a major wine producer and the world's largest importer (Baker 2016), felt confident enough to bypass the new organization and directly deal with Europe. Indeed, two years after the new OIV began operating, the US and the EC signed a bilateral agreement in which they recognized each other's existing winemaking practices and mutually exempted each other's products from certification requirements. With this deal, the US (re)gained access to European markets in exchange for respecting certain traditional "names of origin" such as "Champagne" for wines originating in the Community.

7 Mixed succession

Historical reality is often more complex than theory makes it to be. Some cases combine both types of succession. We offer two illustrations of this phenomenon.

The first is the best-known transition from the GATT to the WTO. While this case has been previously explained as an exercise of ‘go-it-alone’ power or an ‘outside option’, we show that it fits within our specific theorization of institutional succession (Steinberg 2002, McKibben 2015). Monumental in the dollar-amount of transactions covered by the regime, this succession was also exceptional in another way: it combined the two forms of succession—controlled and rival. With respect to trade issues, developed industrial member-states (the "North") implemented a classic case of formal controlled succession. Powerless to reform the GATT dispute settlement mechanism, they engineered a replacement; the WTO was declared the official successor to the GATT. Enough carrots were offered to less-developed countries (the "South") for them to individually break ranks and join the WTO. Top dogs under the GATT, the North, remained top dogs under the new WTO.

But with respect to "trade-related" issues, the Uruguay Round saw a multi-pronged rival succession, in which non-trade issues were wrenched out of their "regimes of origin"—all of which UN-based and thus controlled by "the South"—and collected in the WTO whose agenda the North controlled. The issues in question and their respective "Steinberg of origin" were copyrights (UNESCO), intellectual property (WIPO), competition and foreign investment (UNCTAD), and food standards (FAO). The WTO became the de facto, if not the de jure,

successor to these organizations in regard to the issues in question. Although this rival succession was informal in the sense that no legal transfer of mandates took place, every existing trade-related organization at some point had to acknowledge the existence of the WTO and redraw the formal boundaries between theirs and the WTO's mandate.

Our second example of mixed succession is the creation of the WIPO in 1967. Long before WIPO lost its exclusivity over intellectual property to the WTO, it had supplanted not one, but two organizations: it took over both the parent organization (controlled succession) and its rival (rival succession). The parent organization was the United International Bureaux for the Protection of Intellectual Property (BIRPI). The rival organization was the Universal Copyright Convention (UCC), established under UNESCO in 1952 as an alternative to the existing Paris (1883) and Berne (1886) conventions (both administered by BIRPI since 1893), which privileged European copyright-exporting nations at the expense of developing, copyright-importing countries (Bannerman 2011, 2012; Olian 1943). Since it established lower levels of copyright protection, the UCC was attractive to developing countries and it quickly gained a broad membership, including, most prominently, the United States who, citing its European bias, had refused to join the Berne Convention.

In a series of conferences held during the 1960s, the European agenda setters sought to reform the BIRPI to meet developing country demands and prevent the break-up of the international copyright system (Olian 1943:89, 102; Bannerman 2011). All ended in deadlock until 1967, when, fearful that the US

and other UCC states would ‘pick off’ Berne members one by one and draw them to the UCC, Europeans initiated a successful controlled succession in defense of the Berne system. Among the concessions they offered to developing states and the U.S. were amendments authorizing developing members to enter reservations to copyright protection for a 10-year period and even restrict it for educational material. As a further concession, agenda-setters agreed that WIPO would become a Special Agency of the UN, thereby ensuring developing countries a greater say in future policy-making. The establishment of WIPO and the revision of existing copyright conventions along with the termination of the UCC were negotiated as a single undertaking—neither could be realized without the other.

8 Conclusion

Given growing dissatisfaction by a subset of members of an IO, we ask what are the paths of change that they are likely to pursue. Drawing from the extant literature, our list includes stasis, regime-shifting, and reform, to which we add succession, a recurrent feature of international cooperation that has attracted little scholarly attention, being generally subsumed under other forms of institutional change, such as reform or creation.

Rather than looking at these paths individually or pairwise, we include them in a single model, trusting member governments to choose their mutual best replies. This approach has the advantage of not privileging one institutional

strategy over another and to take into account the feedback loops that too often defeat simple *ceteris paribus* arguments.

Reform and regime-shifting involve negotiations between established coalitions and are thus vulnerable to blackmail by veto players. Succession allows governments to bypass veto players by moving negotiations out of the collective format of an established IO to an informal setting, where decisions are individual. This superiority is offset by a weakness, the inability to exploit the scale economies (assuming any) that pertain to large groups, making succession akin to a tipping game, in which everyone sticks to the old organization or joins the new one.

The internal logics of reform and succession inform our analytical findings: (1) like reform, succession requires a severe and unpredictable shock that was not insured against, and/or substantial renegeing power on the losers' part; (2) unlike reform, succession is not subject to institutional deadlock; (3) unlike reform, succession may not be able to reach a scale that makes it efficient; (4) unlike reform, succession may reverse the balance of power between top dogs and underdogs (with the former defined as agenda setters and the latter as agenda takers) depending on each group's relative capacity to self-organize outside the existing institution.

Our model allowed us to code key changes in the respective history of the sugar and wine commodity regimes. We attributed the creation of the ISO to a classic case of rival succession, in which the secular split between the two key founders, the U.S. and the UK, led to the demise and replacement of the old

regime with one dominated by Cuba, Brazil and the Soviet Union. In contrast, the creation of the new OIV in relation to wine was a typical case of controlled succession, where the initial founders managed to stay the course through the violent deregulatory currents of the 1990s and relaunch an organization that had become incapable of internal reform. We further illustrated the external validity of our model through a brief application to the successions leading to the creation of WIPO and the WTO.

As warned in the introduction, we only covered a selected set of institutional strategies, omitting change that is incremental, or initiated by the organization staff themselves, or terminal. By bringing attention to an understudied empirical phenomenon, and by anchoring our model within existing literature on contested multilateralism we hope to have opened new avenues for research on competing mechanisms of institutional change. A logical next step in this research agenda would be to further test and refine the model through application to a wider set of cases including both institutional stasis, reform, renegeing, rival regime creation and succession.

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Online Appendix

for "To Reform or to Replace? Institutional Succession in International Organizations".

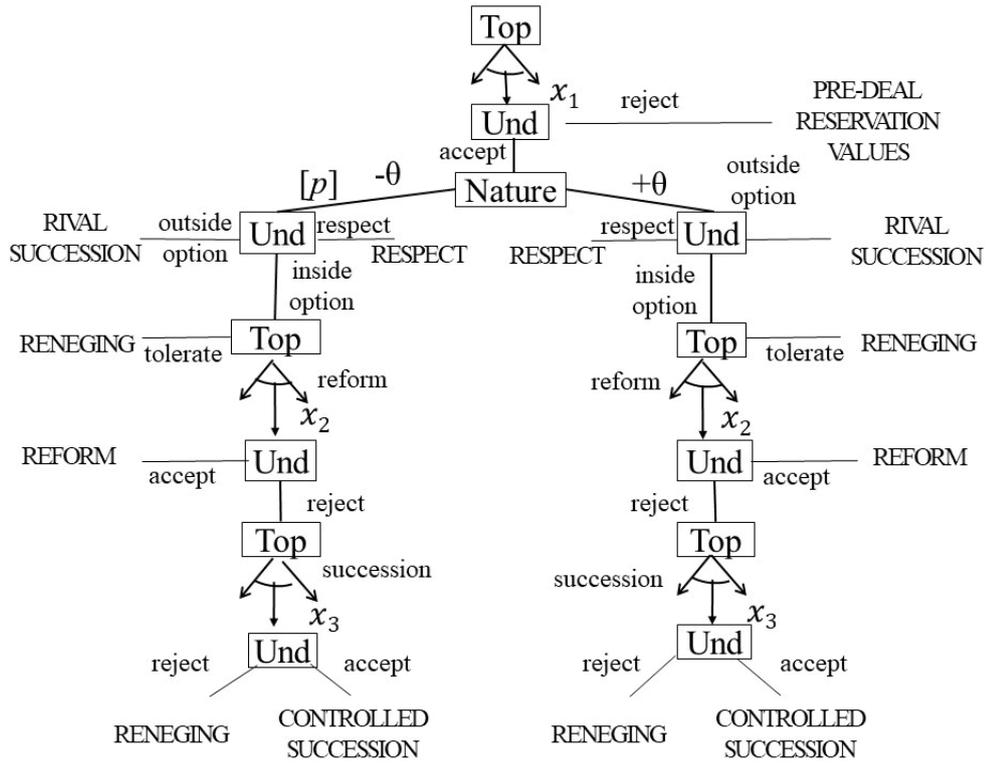


Figure 1A: The Reform and Succession Game

Table 1A: list of individual payoffs		
	underdog	top dog
Prior to Nature's Move		
– pre-deal reservation value	0	0
Left Branch $\theta < 0$		
– respect [Resp]	$x_1 \frac{k}{n} - \theta$	$(1 - x_1) \frac{k}{n} + \theta$
– outside option (rival succession) [Riva]	$y \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$	$(1 - y) \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$
– inside option (reneging) [Rene]	$(x_1 \frac{k}{n} - \theta) (1 - \delta)$	$((1 - x_1) \frac{k}{n} + \theta) (1 - \delta)$
– reform [Refo]	$x_2 \frac{k}{n} - \theta - c$	$(1 - x_2) \frac{k}{n} + \theta - c$
– controlled succession [Cont]	$x_3 \frac{N+1}{n} - \theta$	$(1 - x_3) \frac{N+1}{n} + \theta$
Right Branch $\theta > 0$		
– respect [Resp]	$x_1 \frac{k}{n} + \theta$	$(1 - x_1) \frac{k}{n} - \theta$
– outside option (rival succession) [Riva]	$y \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$	$(1 - y) \left(\frac{1}{2} - \frac{\beta(n-(S+1))}{n} \right)$
– inside option (reneging) [Rene]	$(x_1 \frac{k}{n} + \theta) (1 - \delta)$	$((1 - x_1) \frac{k}{n} - \theta) (1 - \delta)$
– reform [Refo]	$x_2 \frac{k}{n} + \theta - c$	$(1 - x_2) \frac{k}{n} - \theta - c$
– controlled succession [Cont]	$x_3 \frac{N+1}{n} + \theta$	$(1 - x_3) \frac{N+1}{n} - \theta$

1 Terminology

1.0.1 variables:

x_1 : share of pie offered by top dogs to underdogs during initial negotiation,

$0 \leq x_1 \leq 1$;

p : probability that Nature chooses bad circumstances for underdogs (good for top dogs), $0 \leq p \leq 1$;

θ : incremental payoff added or subtracted by Nature to the players' payoffs, $0 < \theta < 1$;

δ : index of degradation, $0 < \delta < 1$;

x_2 : share of pie offered by top dogs to underdogs in reformed incumbent organization, $0 \leq x_2 \leq 1$.

c : cost of reform.

x_3 : share of pie offered by top dogs to underdogs in controlled successor organization, $0 \leq x_3 \leq 1$.

y : share of pie kept by Underdogs in rival successor organization, $0 \leq y \leq 1$.

β : parameter capturing the relative inefficiency of the rival organization.

n : number of countries.

k : number of countries joining the incumbent organization.

N : number of top dogs (also the size of top dog's core group)

S : underdogs' core subset.

1.0.2 abbreviations:

Und : the underdogs (also referred to in the proof as Underdogs)

Top : the top dogs (also referred to as Top dogs)

Resp : respect

Rene : reneging

Refo : reform

Riva : rival succession

Cont : controlled succession

2 Simplification

To simplify the analysis, we assume that $y = 1$; Underdogs appropriate the entire pie generated by the outside option.

3 Solution concept

The game calls for subgame perfection. In light of the large number of possible equilibria, backward induction is impractical. Instead, we follow the spirit of the mechanism design approach, which consists in first identifying the equilibria that the top dogs—the agenda setter—could possibly favor, then identifying the incentive constraints that each of these equilibria must meet, and finally have the top dogs choose among them the equilibria that deliver the highest payoffs, one for every plausible parametric configuration. But firstly, two lemmas help reduce the number of possible equilibria.

Lemma 1 *The underdogs always respect in the case of good circumstances for values of $S < \bar{S}$, with $\bar{S} \equiv \frac{n}{\beta} \left(\theta + \frac{1}{n} \beta (n - 1) - \frac{1}{2} \right)$.*

Proof. At the bottom of the right branch, Underdogs accept the x_3 offer if $x_3 \frac{(N+1)}{n} + \theta \geq (x_1 + \theta)(1 - \delta) \Rightarrow x_3 \geq -n \frac{\theta + (\delta-1)(\theta + x_1)}{N+1}$. After verifying that the right-hand expression is always positive, it follows that Top dog's maximization yields the simple result $x_3^* = -n \frac{\theta + (\delta-1)(\theta + x_1)}{N+1}$. Substituting x_3^* in Underdogs' utility for controlled succession in the case of good circumstances yields payoff $u_U(Cont) = x_3^* \frac{N+1}{n} + \theta = (x_1 + \theta)(1 - \delta)$, which is strictly inferior to their respect payoff $(x_1 + \theta)$.

Still on the right branch, Underdogs accept the x_2 offer if $x_2 - c - \theta \geq x_3 \frac{N+1}{n} - \theta$, which after substitution yields $x_2 \geq c + \theta + (\theta - x_1)(\delta - 1)$. After verifying that the right-hand side is always positive, Top dogs' maximization yields $x_2^* = c + \theta + (\theta - x_1)(\delta - 1)$. Substituting that value in Underdogs' utility for reform in the case of good circumstances yields payoff $u_U(Refo) = x_2^* + \theta - c = (\theta + x_1)(1 - \delta)$, which is strictly inferior to their respect payoff.

Last, Underdogs' payoff for "respect" is higher than that for "rival organization" if $u_U(Resp) \geq u_U(Riva) \Rightarrow x_1 + \theta \geq \frac{1}{2} - \frac{\beta}{n}(n - S - 1) \Rightarrow x_1 < \frac{1}{n}\beta(S - n + 1) - \theta + \frac{1}{2}$. A solution exists for values of $S > \frac{n}{\beta}(\theta + \frac{1}{n}\beta(n - 1) - \frac{1}{2}) \equiv \bar{S} \geq \bar{S}$. It is always binding. ■

Lemma 2 For values of $S > \bar{S}$, there are only two possible equilibria, respect and rival succession, with $\bar{S} \equiv -\frac{1}{2\beta}(n + 2\beta - 2n\beta)$.

Proof. Respect obtains for values of $x_1 \geq \theta$. This is because, in the case of bad circumstances, Underdogs will not respect the initial offer unless they are fully insured against the circumstantial loss of θ . For low values of x_1 , therefore, respect, in the eyes of Underdogs, is less competitive than the three internal

change strategies (reneging, reform, controlled succession). However, as the value of x_1 rises in response to a more attractive outside option—say S gets higher—respect offers an advantage over the other three internal change strategies: it is not afflicted by deadweight losses. Therefore, for equilibrium values of $x_1 \geq \theta$, the only strategy left to compete with rival succession is respect. The actual value \bar{S} at which the flip occurs is left to further determination. ■

The two preceding lemmas help us partition the solution space into three sub-spaces. For $S < \bar{S}$, there are four possible equilibria: (1) the *regime-shifting equilibrium*, having for path "inside option-renegotiate-accept" on the left side of the tree, "respect" on the right side, and "accept" at the top; (2) the *respect equilibrium*, having for path "respect" on both sides and "accept" at the top; (3) the rival succession equilibrium, having for path "outside option" on the left side, "respect" on the right side, and "accept" at the top; and (4) the *no-deal equilibrium* with for path "reject" at the top. North choose the equilibrium that delivers the highest payoff. We analyze each one sequentially.

For $\bar{S} < S < \vec{S}$, there are only two possible equilibria: (1) the *respect equilibrium* that has for path "respect" on both branches and "accept" at the top; and (2) the *rival-succession equilibrium* that has for path "outside option" on the left branch, "respect" on the right branch, and "accept" at the top.

For $S > \vec{S}$, there are also two possible equilibria: (1) the *respect equilibrium* that has for path "respect" on the left branch, "outside option" on the right branch, and "accept" at the top; and (2) the *rival-succession equilibrium* that has for path "outside option" on both branches and "accept" at the top.

Except otherwise mentioned (section 6), what follows bears on sub-space:
 $S < \bar{S}$.

4 North's offering of x_1^* , x_2^* , and x_3^*

In this section, we derive North's equilibrium values of x_1 , x_2 and x_3 for each of the five possible strategic outcomes, starting with the three internal change strategies. Throughout, color-coding is used to ease the later tracking of the relevant parametric values of θ , δ and c .

4.1 The renegeing, reform, and controlled succession equilibria

The four successive lemmas build up to proposition 7.

Lemma 3 $x_3^* = n \frac{\theta + (\theta - x_1)(\delta - 1)}{N + 1}$ for

$$\theta < \frac{1}{n\delta} (1 + N) \equiv \widehat{\theta}, \quad (\text{cyan})$$

does not exist otherwise.

Proof. x_3^* is calculated to make controlled succession at least as good as renegeing for Underdogs: $x_3^* \frac{N+1}{n} - \theta \geq (x_1 - \theta)(1 - \delta)$. Existence requires $x_1 \leq \frac{1}{n - n\delta} (1 + N - n\theta\delta)$, which, in turn, only exists for $\theta < \widehat{\theta}$. ■

Lemma 4 $x_2^* = c + \theta + (\theta - x_1)(\delta - 1)$ for

$$\theta < -\frac{1}{\delta}(c - 1) \equiv \underbrace{\theta}, \quad (\text{magenta})$$

does not exist otherwise.

Proof. x_2^* is calculated to make reform at least as good as controlled succession for Underdogs: $x_2^* - c - \theta \geq x_3^* \frac{N+1}{n} - \theta$. Existence requires $x_1 < -\frac{1}{1-\delta}(c - 1 + \theta\delta)$, which, in turn, only exists for $\theta < \underbrace{\theta}$. ■

Lemma 5 x_2^* and x_3^* make reneging as good as either reform or controlled succession for Underdogs.

Proof. If x_2^* and x_3^* make controlled succession as good as reneging and reform for Underdogs, they also make reneging as good as reform for the same Underdogs. ■

Lemma 6 For each of the three equilibrium outcomes known as reneging, re-

form, and controlled succession, x_1^* can take one of three values: $x_1^* = \left\{ 0, \theta \frac{-2p+p\delta+1}{p\delta-1}, -\frac{\frac{1}{n}\beta(S-n+1)+\frac{1}{2}-\theta(\delta-1)}{\delta-1} \right\}$.

(We shall refer to $x_1^* = 0$ as *Rene*₀, *Refo*₀, or *Cont*₀ depending on which strategy generates the value $x_1^* = 0$, and similarly to $x_1^* = \theta \frac{-2p+p\delta+1}{p\delta-1}$ as *Rene*₁, *Refo*₁, or *Cont*₁, and to $x_1^* = -\frac{\frac{1}{n}\beta(S-n+1)+\frac{1}{2}-\theta(\delta-1)}{\delta-1}$ as *Rene*₂, *Refo*₂, or *Cont*₂.)

Proof. The value of x_1 is anchored by the two outside options: (1) rival succession and (2) the reservation value of zero.

(1) For Underdogs to prefer controlled succession to rival succession, one must have $x_3^* \frac{N+1}{n} - \theta \geq -\frac{\beta(n-S-1)}{n} \Rightarrow x_1 \geq Cont_2$. While the constraint exists for all authorized variable and parameter values, it is binding for values of

$$\theta > \frac{y}{\delta - 1} \left(\frac{1}{n} \beta (S - n + 1) + \frac{1}{2} \right) \equiv \overleftarrow{\theta}, \quad (\text{light green})$$

otherwise x_1 is equal to zero. What is true of controlled succession also applies to renegeing and reform.

(2) For Underdogs to prefer controlled succession to the reservation value of zero, one must have $p \left(x_3 \frac{\alpha(N+1)}{n} - \theta \right) + (1-p) \left(x_1 \frac{\alpha(n)}{n} + \theta \right) \geq 0 \Rightarrow x_1 \geq Cont_1$. While the constraint exists for all authorized variable and parameter values, it is binding only for values of

$$\delta < \frac{1}{p} (2p - 1) \equiv \bar{\delta},$$

otherwise x_1 is equal to zero. What is true of controlled succession also applies to renegeing and reform.

Moreover, $Cont_2 > Cont_1$ (likewise $Rene_2 > Rene_1$ and $Refo_2 > Refo_1$) for

$$\theta \geq \frac{1}{4} (p\delta - 1) \frac{n + 2\beta + 2S\beta - 2n\beta}{(\delta - 1)n(p - 1)} \equiv \overleftarrow{\theta}, \quad (\text{sienna})$$

an expression that is positive given assumption $S < \bar{S}$. Hence,

$$\left\{ \begin{array}{l} \text{if} \\ \theta < \underline{\theta} \quad \text{Rene}_1 = \text{Refo}_1 = \text{Cont}_1 > \text{Rene}_2 = \text{Refo}_2 = \text{Cont}_2 \\ \theta > \underline{\theta} \quad \text{Rene}_2 = \text{Refo}_2 = \text{Cont}_2 > \text{Rene}_1 = \text{Refo}_1 = \text{Cont}_1 \end{array} \right. \quad \text{then}$$

Note also that the two θ constraints— $\overleftrightarrow{\theta}$ and $\underline{\theta}$ —intersect at $\bar{\delta}$ with $\underline{\theta} < \overleftrightarrow{\theta}$

on the right side of the intersection, and $\overleftrightarrow{\theta} < \underline{\theta}$ on the left.

Last, $\text{Rene}_1 > 0$ (likewise $\text{Refo}_1 > 0$ and $\text{Cont}_1 > 0$) for $\delta < \bar{\delta}$. ■

Lemma 7 *The underdogs never turn down the initial x_1 .*

Proof. *Being the residual claimants, the top dogs never have an interest in making an initial offer that would be turned down and yield them their zero reservation value.* ■

Lemmas 3-7 together yield the generic result for the three internal change strategies—reneging, reform and controlled succession:

Proposition 8 *In the reneging, reform, and controlled succession equilibria, x_1^**

is equal to:

$$\left\{ \begin{array}{llll} \text{IF} & \mathcal{E} & \mathcal{E} & \text{OR} & \text{THEN } x_1^* = \\ \theta < \ddot{\theta}, \widehat{\theta}, \underline{\theta}, \ddot{\Theta}, \dot{\Theta} & \dot{\delta} < \bar{\delta} < \bar{\delta} & \underline{\theta} < \theta & & -\frac{\frac{1}{n}\beta(S-n+1)+\frac{1}{2}-\theta(\delta-1)}{\delta-1} \equiv \text{Rene}_2, \text{Refo}_2, \text{Cont}_2 \\ " & " & \theta < \underline{\theta} & & \frac{\theta-2p+p\delta+1}{p\delta-1} \equiv \text{Rene}_1, \text{Refo}_1, \text{Cont}_1 \\ " & \dot{\delta}, \bar{\delta} < \delta & & \overleftrightarrow{\theta} < \theta & -\frac{\frac{1}{n}\beta(S-n+1)+\frac{1}{2}-\theta(\delta-1)}{\delta-1} \equiv \text{Rene}_2, \text{Refo}_2, \text{Cont}_2 \\ " & " & & \theta < \overleftrightarrow{\theta} & 0 \equiv \text{Rene}_0, \text{Refo}_0, \text{Cont}_0 \end{array} \right.$$

with the constraint involving $\underline{\theta}$ and $\dot{\delta}$ only applying to reform and those involving $\widehat{\theta}$, $\ddot{\theta}$, $\ddot{\Theta}$ and $\dot{\Theta}$ only applying to controlled succession.

Proof. Most parts were proven in prior lemmas. There are two novelties: (i)

$\ddot{\theta}$ was derived from the condition $x_1 \leq \frac{1}{n-n\delta}(1+N-n\theta\delta)$ encountered in the

proof of lemma 3 (controlled succession), leading to the potentially new binding constraint: $Conto_2 \leq \frac{1}{n-n\delta} (1 + N - n\theta\delta) \Rightarrow$

$$\theta \leq \frac{1}{2} \frac{2N - 2y\beta - ny - 2Sy\beta + 2ny\beta + 2}{n} \equiv \ddot{\theta}. \quad (\text{cyan dash})$$

(ii) $\ddot{\theta}$ and $\dot{\theta}$ were derived from the condition $x_1 \leq -\frac{1}{1-\delta} (c - 1 + \theta\delta)$ encountered in the proof of lemma 4 (reform), leading to the potentially new binding constraints $Ref_o_2 \leq -\frac{1}{1-\delta} (c - 1 + \theta\delta) \Rightarrow$

$$\theta \leq -\frac{1}{2} \frac{-2n\alpha + 2y\beta + 2cn + ny + 2Sy\beta - 2ny\beta}{n} \equiv \ddot{\theta} \quad (\text{magenta dash})$$

and $Ref_o_1 \leq -\frac{1}{1-\delta} (c - 1 + \theta\delta) \Rightarrow$

$$\theta \leq (p\delta - 1) \frac{c - 1}{2p + 2\delta - 3p\delta - 1} \equiv \dot{\theta}. \quad (\text{magenta dots})$$

■

4.2 The rival succession equilibrium

We already showed that Underdogs choose to pursue their outside option when it is more interesting than renegeing, reform, or controlled succession, which formally is the case when $x_1 \leq -\frac{\frac{1}{n}\beta(S-n+1) + \frac{1}{2} - \theta(\delta-1)}{\delta-1}$, with existence condition $\theta > \frac{1}{2} \frac{n+2\beta+2S\beta-2n\beta}{(\delta-1)n} \equiv \overleftrightarrow{\theta}$.

The outside option must also beat respect, yielding $x_1 \leq \theta + \frac{1}{n}\beta(S-n+1) + \frac{1}{2}$ and requiring $\theta > -\frac{1}{2} \frac{n+2\beta+2S\beta-2n\beta}{n}$ for existence.

Last, Underdogs must prefer the outside option to their zero reservation value: $p\left(\frac{1}{2} - \frac{\beta(n-S-1)}{n}\right) + (1-p)(x_1 + \theta) \geq 0$, yielding $x_1 \geq -\frac{\theta(p-1) - p\left(\frac{1}{n}\beta(S-n+1) + \frac{1}{2}\right)}{p-1}$. This last condition exists for $\theta \geq p\frac{\frac{1}{n}\beta(S-n+1) + \frac{1}{2}}{p-1} - 1$ and is only binding for

$$\theta < p\frac{\frac{1}{n}\beta(S-n+1) + \frac{1}{2}}{p-1} \equiv \underline{\theta}. \quad (\text{light blue})$$

We now reconcile these various constraints. First, it is easily shown that only one of the two upper bounds on the value of x_1 that is acceptable to Underdogs could potentially be binding: $-\frac{\frac{1}{n}\beta(S-n+1) + \frac{1}{2} - \theta(\delta-1)}{\delta-1} \leq \theta + \frac{1}{n}\beta(S-n+1) + \frac{1}{2}$. Second, for x_1 to exist, one must have $-\frac{\theta(p-1) - p\left(\frac{1}{n}\beta(S-n+1) + \frac{1}{2}\right)}{p-1} \leq x_1 \leq -\frac{\frac{1}{n}\beta(S-n+1) + \frac{1}{2} - \theta(\delta-1)}{\delta-1}$, implying $\theta > \frac{1}{4}(p\delta - 1)\frac{n+2\beta+2S\beta-2n\beta}{n(\delta-1)(p-1)} \equiv \underline{\theta}$. Within that range, $x_1 = 0$ requires either that $n + 2\beta + 2S\beta - 2n\beta$ be positive, which is the case whenever $S > \bar{S}$, or, if $S < \bar{S}$, that $\overleftarrow{\theta} > \underline{\theta}$, that is, $-\frac{1}{2}(-2p + p\delta + 1)\frac{n+2\beta+2S\beta-2n\beta}{n(\delta-1)(p-1)} > 0$ or $\delta > \bar{\delta}$. Putting it all together:

Proposition 9 *In the rival succession equilibrium, x_1^* is equal to:*

$$\left\{ \begin{array}{llll} \text{IF} & \mathcal{E} & \mathcal{E} & \text{THEN } x_1^* = \\ S > \bar{S} & & & 0 \equiv Riva_0 \\ S < \bar{S} & \delta < \bar{\delta} & \underline{\theta} < \theta & Riva_0 \\ " & " & \overleftarrow{\theta} < \theta < \underline{\theta} & -\frac{\theta(p-1) - p\left(\frac{1}{n}\beta(S-n+1) + \frac{1}{2}\right)}{p-1} \equiv Riva_2 \\ " & \delta > \bar{\delta} & \overleftarrow{\theta} < \theta & Riva_0 \end{array} \right.$$

We did not take into account the $\theta \geq p\frac{\frac{1}{n}\beta(S-n+1) + \frac{1}{2}}{p-1} - 1$ existence condition for it is unlikely to be binding; Top dogs are unlikely to make an initial offer that is turned down.

4.3 The respect equilibrium

Top dogs can steer the outcome toward a respect outcome if they make the Underdogs prefer respect to other possible outcomes. It was already shown that Underdogs prefer respect to reneging, reform, or controlled succession when $x_1 \geq \theta$. We still have to find the conditions for which respect is preferred to taking the outside option and to rejecting the initial deal. For the outside option, we established earlier that respect beats it if $x_1 \geq \theta + \frac{1}{n}\beta(S - n + 1) + \frac{1}{2}$, a condition that is binding when $\theta \geq -\frac{1}{2n}(2\beta + n + 2S\beta - 2n\beta)$, otherwise $x_1 = 0$. As for rejecting the initial deal, respect prevails if $p(x_1 - \theta) + (1 - p)(x_1 + \theta) \geq 0$, implying $x_1 \geq \theta(2p - 1)$, with existence condition $\theta < \frac{1}{2p-1}$ and binding condition $p > \frac{1}{2}$.

Between the three potential binding participation constraints, the binding one depends on S . If $S < \bar{S}$, it is $x_1 \geq \theta$. Indeed, $\frac{1}{2}\frac{2n\theta+2\beta+n+2S\beta-2n\beta}{n} \leq \theta$ implies $S < \bar{S}$, while $x_1 \geq \theta$ necessarily implies $x_1 \geq \theta(2p - 1)$. Therefore the respect equilibrium value is $x_1^* = \theta \equiv Resp_\theta$. However, if $S > \bar{S}$, the binding incentive constraint is $x_1 \geq \frac{1}{2}\frac{n+2\beta+2S\beta+2n\theta-2n\beta}{n}$. In sum,

Proposition 10 *In the respect equilibrium, x_1^* is equal to:*

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN } x_1^* = \\ S > \bar{S} & \frac{1}{2}\frac{n+2\beta+2S\beta+2n\theta-2n\beta}{n} \equiv Resp_3 \\ S < \bar{S} & \theta \equiv Resp_\theta \end{array} \right. .$$

5 North's choice of outcome

In this section, we calculate which of the five strategic outcomes North prefer. From the preceding section, we know that the pool of strategies from which North choose varies according to parameters δ and θ . With respect to δ , four partitions are possible:

$$\bar{\delta}, \dot{\delta} < \delta \text{ (area 1)}$$

$$\dot{\delta} < \delta < \bar{\delta} \text{ (area 2)}$$

$$\delta < \bar{\delta}, \dot{\delta} \text{ (area 3)}$$

$$\bar{\delta} < \delta < \dot{\delta} \text{ (area 4)}$$

We further partition each area into sub-areas to obtain parametrically-defined domains with their respective subset of relevant strategies (for instance, see Figure A2 for area 1). For each sub-area, we determine the conditions for which Top dogs prefer one strategy over another. The number of pairwise comparisons required to determine the winning equilibrium within a sub-area is a direct function of the number k of equilibria that are in competition for this sub-area according to the formula $\frac{k(k-1)}{2}$. For instance, $k = 5$ requires 10 pairwise comparisons. We try to define all parametric conditions as a function of θ if possible or, if not possible, of δ , or if still not possible, of c . As before, color- (and shape-)coding are used to ease the visual tracking of the relevant parametric values of θ , δ and c .

5.1 area 1: $\bar{\delta}, \dot{\delta} < \delta$

Area 1 is simulated for the following parameter values: $n = 10$, $\beta = 1.5$, $c = .1$,

$p = .4$, $N = 6$, $S = 4$. As a result, $\bar{\delta} = -0.5$ and $\dot{\delta} = 0.2$.

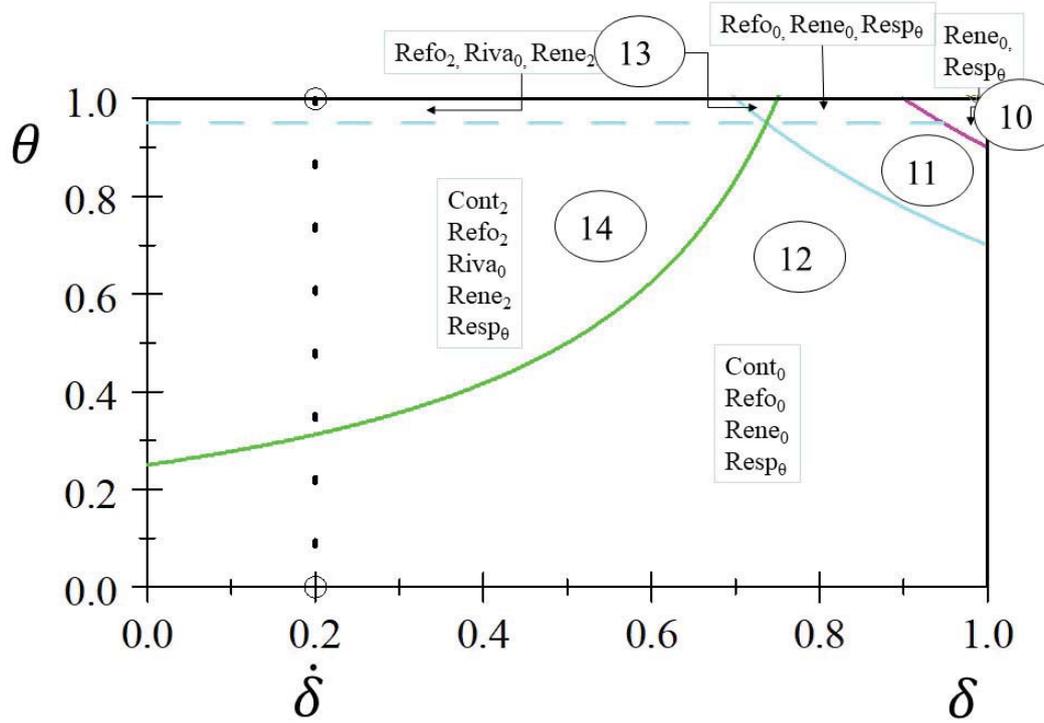


Fig A2: Area 1

5.1.1 sub-area 10 ($Rene_0, Resp_\theta$)

$$U_T(Resp_\theta) > U_T(Rene_0) \Rightarrow -2\theta + 1 + 2p\theta > -(\theta - 1 - 2p\theta + p\theta\delta + p\delta) \Rightarrow$$

$$\theta < -p\frac{\delta}{p\delta-1} \equiv \varrho \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta < \varrho & U_T(Resp_\theta) > U_T(Rene_0) \cdot \\ \theta > \varrho & U_T(Rene_0) > U_T(Resp_\theta) \end{array} \right. \quad (\text{light green thick})$$

5.1.2 sub-area 11: ($Ref_0, Rene_0, Resp_\theta$)

Prior results apply.

$$U_T(Ref_0) > U_T(Rene_0) \Rightarrow -(\theta - 1 - 2p\theta + 2cp + p\theta\delta) > -(\theta - 1 - 2p\theta + p\theta\delta + p\delta)$$

$$\Rightarrow 2c - \delta < 0 \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \delta > \dot{\delta} & U_T(Ref_0) > U_T(Rene_0) \cdot \\ \delta < \dot{\delta} & U_T(Rene_0) > U_T(Ref_0) \end{array} \right.$$

$$U_N(Resp_\theta) > U_N(Ref_0) \Rightarrow -2\theta + 1 + 2p\theta > -(\theta - 1 - 2p\theta + 2cp + p\theta\delta)$$

$$\Rightarrow \theta < -2c\frac{p}{p\delta-1} \equiv \bar{\varrho} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta < \bar{\varrho} & U_T(Resp_\theta) > U_T(Ref_0) \cdot \\ \theta > \bar{\varrho} & U_T(Ref_0) > U_T(Resp_\theta) \end{array} \right. \quad (\text{red thick})$$

5.1.3 sub-area 12: $(Cont_0, Ref_0, Rene_0, Resp_\theta)$

Prior results apply.

$$U_N(Cont_0) > U_N(Ref_0) \Rightarrow \frac{n+p-n\theta+Np-np+2np\theta-np\theta\delta}{n} > -(\theta-1-2p\theta+2cp+p\theta\delta)$$

$$\Rightarrow c > -\frac{1}{2n}(1+N-n) \equiv \dot{c} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ c > \dot{c} & U_T(Cont_0) > U_T(Ref_0) \cdot \\ c < \dot{c} & U_T(Ref_0) > U_T(Cont_0) \end{array} \right.$$

$$U_T(Cont_0) > U_T(Rene_0) \Rightarrow \frac{n+p-n\theta+Np-np+2np\theta-np\theta\delta}{n} > -(\theta-1-2p\theta+p\theta\delta+p\delta)$$

$$\Rightarrow \delta > -\frac{1}{n}(N-n+1) \equiv \ddot{\delta} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \delta > \ddot{\delta} & U_T(Cont_0) > U_T(Rene_0) \cdot \quad \text{(black)} \\ \delta < \ddot{\delta} & U_T(Rene_0) > U_T(Cont_0) \end{array} \right.$$

$$U_T(Cont_0) > U_T(Resp_\theta) \Rightarrow \frac{n+p-n\theta+Np-np+2np\theta-np\theta\delta}{n} > -2\theta+1+2p\theta$$

$$\Rightarrow \theta > p \frac{N-n+1}{n(p\delta-1)} \equiv \widehat{\varrho} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta > \widehat{\varrho} & U_N(Cont_0) > U_N(Resp_\theta) \cdot \quad \text{(magenta dots)} \\ \theta < \widehat{\varrho} & U_N(Resp_\theta) > U_N(Cont_0) \end{array} \right.$$

5.1.4 sub-area 13: ($Ref_{o_2}, Riva_0, Rene_2, Resp_\theta$)

$$U_T(Riva_0) > U_T(Rene_2) \Rightarrow (\theta - 1)(p - 1) > -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta-np\delta+4n\theta\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow \theta >$$

$$\frac{1}{2} \frac{-n-2\beta-2S\beta+2n\beta+2np-3np\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-2np\beta\delta}{n(\delta-1)(p-1)} \equiv \acute{\theta} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta < \acute{\theta} & U_T(Rene_2) > U_T(Riva_0) \cdot \\ \theta > \acute{\theta} & U_T(Riva_0) > U_T(Rene_2) \end{array} \right. \quad (\text{dark red})$$

$$U_T(Riva_0) > U_T(Resp_\theta) \Rightarrow (\theta - 1)(p - 1) > -2\theta + 1 + 2p\theta \Rightarrow \theta > -\frac{p}{p-1}$$

$$\equiv \vec{\theta} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta > \vec{\theta} & U_T(Riva_0) > U_T(Resp_\theta) \cdot \\ \theta < \vec{\theta} & U_T(Resp_\theta) > U_T(Riva_0) \end{array} \right. \quad (\text{yellow dots})$$

$$U_T(Rene_2) > U_T(Resp_\theta) \Rightarrow -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta-np\delta+4n\theta\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} >$$

$$-2\theta+1+2p\theta \Rightarrow 2np\delta^2+(2p\beta-2np+np+2Sp\beta-2np\beta)\delta+(2n\beta-n-2S\beta-2\beta) >$$

0. Assuming χ and ω the two solutions for δ on the left-hand side of the inequality, we have

$$\left\{ \begin{array}{ll} IF & THEN \\ \delta < \chi \text{ or } \delta > \omega & U_T(Rene_2) > U_T(Resp_\theta) \\ \chi < \delta < \omega & U_T(Resp_\theta) > U_T(Rene_2) \\ \chi \&\omega \ddagger & U_T(Rene_2) > U_T(Resp_\theta) \end{array} \right. \quad (\chi \text{ (green dots)}, \omega \text{ (dark green dots)})$$

$$\begin{aligned}
U_T(Riva_0) &> U_T(Ref_0_2) \Rightarrow (\theta - 1)(p - 1) > \\
&-\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow \\
\theta > \frac{1}{2} \frac{-n-2\beta-2S\beta+2n\beta+2np-np\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-2np\beta\delta}{n(\delta-1)(p-1)} \equiv \tilde{\Theta} \Rightarrow
\end{aligned}$$

$$\left\{ \begin{array}{ll}
IF & THEN \\
\theta < \tilde{\Theta} & U_T(Ref_0_2) > U_T(Riva_0) \cdot \quad (\text{alice blue dash}) \\
\theta > \tilde{\Theta} & U_T(Riva_0) > U_T(Ref_0_2)
\end{array} \right.$$

$$\begin{aligned}
U_T(Rene_2) > U_T(Ref_0_2) &\Rightarrow -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta-np\delta+4n\theta\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} > \\
&-\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow \\
p(2c - \delta) > 0, &\text{ which is not true for area 1 where } \delta > \dot{\delta}. \text{ Hence,}
\end{aligned}$$

$$\left\{ U_T(Ref_0_2) > U_T(Rene_2) \cdot \right.$$

$$\begin{aligned}
U_T(Resp_\theta) &> U_T(Ref_0_2) \Rightarrow -2\theta + 1 + 2p\theta > \\
&-\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow
\end{aligned}$$

$$\delta < \frac{n + 2\beta + 2S\beta - 2n\beta + 4cnp}{p(n + 2\beta + 2S\beta - 2n\beta + 4cn)} \equiv \tilde{\delta}. \quad (\text{blue dots})$$

More precisely,

$$\left\{ \begin{array}{ll} \text{IF} & \& \text{THEN} \\ c < \ddot{c} & \delta < \tilde{\delta} \quad U_T(\text{Resp}_\theta) > U_T(\text{Ref}o_2) \\ \text{''} & \delta > \tilde{\delta} \quad U_T(\text{Ref}o_2) > U_T(\text{Resp}_\theta) \\ \ddot{c} < c < \square & U_T(\text{Ref}o_2) > U_T(\text{Resp}_\theta) \\ \square < c & \delta < \tilde{\delta} \quad U_T(\text{Resp}_\theta) > U_T(\text{Ref}o_2) \\ \text{''} & \delta > \tilde{\delta} \quad U_T(\text{Ref}o_2) > U_T(\text{Resp}_\theta) \end{array} \right. ,$$

with $\square \equiv -\frac{1}{4np}(2\beta + n + 2S\beta - 2n\beta)$ and $\ddot{c} \equiv -\frac{1}{4n}(2\beta + n + 2S\beta - 2n\beta)$.

5.1.5 sub-area 14: ($\text{Cont}_2, \text{Ref}o_2, \text{Riva}_0, \text{Rene}_2, \text{Resp}_\theta$)

Prior results apply.

$$\begin{aligned} U_T(\text{Cont}_2) &> U_T(\text{Ref}o_2) \Rightarrow \\ \frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)} &> \\ -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} &\Rightarrow \\ p^{\frac{1+N-n+2cn}{n}} > 0 &\Rightarrow \end{aligned}$$

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ c > \dot{c} & U_T(\text{Cont}_2) > U_T(\text{Ref}o_2) \\ c < \dot{c} & U_T(\text{Ref}o_2) > U_T(\text{Cont}_2) \end{array} \right. .$$

$$\begin{aligned} U_T(\text{Cont}_2) &> U_T(\text{Riva}_0) \Rightarrow \\ \frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)} &> \end{aligned}$$

$$\Rightarrow \theta < -\frac{1}{2} \frac{n-2p+2\beta+2S\beta-2n\beta+2p\delta-2Np+2Np\delta-np\delta-2p\beta\delta-2Sp\beta\delta+2np\beta\delta}{n(\delta-1)(p-1)} \equiv \underline{\Theta} \Rightarrow$$

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \theta < \underline{\Theta} & U_T(\text{Cont}_2) > U_T(\text{Riva}_0) \cdot \quad (\text{purple}) \\ \theta > \underline{\Theta} & U_T(\text{Riva}_0) > U_T(\text{Cont}_2) \end{array} \right.$$

$$\begin{aligned} U_T(\text{Cont}_2) &> U_T(\text{Rene}_2) \Rightarrow \\ \frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)} &> \\ \frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)} &> \\ \Rightarrow p \frac{N-n+n\delta+1}{n} > 0 &\Rightarrow \end{aligned}$$

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \delta > \ddot{\delta} & U_T(\text{Cont}_2) > U_T(\text{Rene}_2) \cdot \quad (\text{black}) \\ \delta < \ddot{\delta} & U_T(\text{Rene}_2) > U_T(\text{Cont}_2) \end{array} \right.$$

$$\begin{aligned} U_T(\text{Cont}_2) &> U_T(\text{Resp}_\theta) \Rightarrow \\ \frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)} &> \\ -2\theta + 1 + 2p\theta \Rightarrow \delta < \frac{-n+2p-2\beta-2S\beta+2n\beta+2Np-2np}{p(2N-3n-2\beta-2S\beta+2n\beta+2)} \equiv \underbrace{\delta} &\Rightarrow \end{aligned}$$

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \delta < \underbrace{\delta} & U_N(\text{Cont}_2) > U_N(\text{Resp}_\theta) \cdot \quad (\text{magenta}) \\ \delta > \underbrace{\delta} & U_N(\text{Resp}_\theta) > U_N(\text{Cont}_2) \end{array} \right.$$

5.2 area 2: $\dot{\delta} < \delta < \bar{\delta}$

Area 2 is simulated for the following parameter values: $n = 10$, $\beta = 1.5$, $c = .1$, $p = .8$, $N = 5$, $S = 4$. As a result, $\bar{\delta} = 0.75$ and $\dot{\delta} = 0.2$.

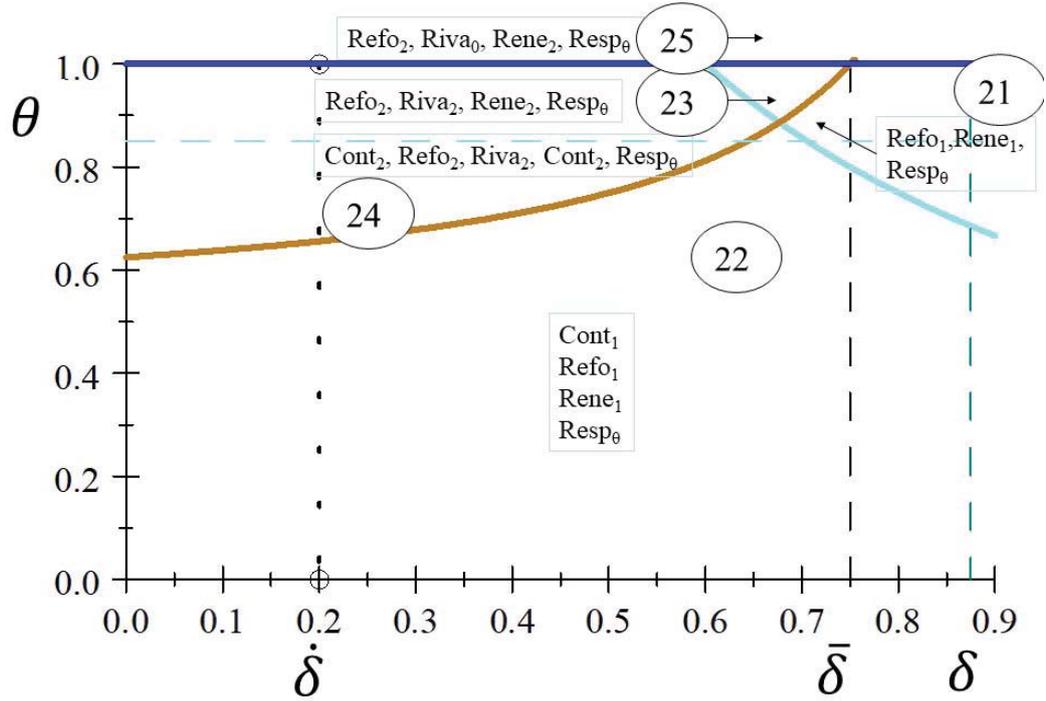


Fig A3: Area 2

5.2.1 sub-area 21: $(Refo_1, Rene_1, Resp_\theta)$

$U_T(Refo_1) > U_T(Rene_1) \Rightarrow 1 - 2cp > 1 - p\delta \Rightarrow \delta > 2c \equiv \dot{\delta}$, which is the case for area 2. Therefore,

$$U_T(Refo_1) > U_T(Rene_1).$$

$$U_T(\text{Resp}_\theta) > U_T(\text{Ref}_1) \Rightarrow -2\theta + 1 + 2p\theta > -(2cp - 1) \Rightarrow \theta < -p \frac{c}{p-1} \equiv \ddot{\varrho}$$

$$\Rightarrow \left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \theta < \ddot{\varrho} & U_T(\text{Resp}_\theta) > U_T(\text{Ref}_1) \cdot \\ \theta > \ddot{\varrho} & U_T(\text{Ref}_1) > U_T(\text{Resp}_\theta) \end{array} \right. \quad (\text{red dash})$$

$$U_T(\text{Resp}_\theta) > U_T(\text{Rene}_1) \Rightarrow -2\theta + 1 + 2p\theta > -(p\delta - 1) \Rightarrow \theta < -\frac{1}{2}p \frac{\delta}{p-1} \equiv$$

$$\overleftarrow{\varrho} \Rightarrow \left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \theta < \overleftarrow{\varrho} & U_T(\text{Resp}_\theta) > U_T(\text{Rene}_1) \cdot \\ \theta > \overleftarrow{\varrho} & U_T(\text{Rene}_1) > U_T(\text{Resp}_\theta) \end{array} \right. \quad (\text{alice blue thick})$$

5.2.2 sub-area 22: ($\text{Cont}_1, \text{Ref}_1, \text{Rene}_1, \text{Resp}_\theta$)

Prior results apply.

$$U_T(\text{Cont}_1) > U_T(\text{Rene}_1) \Rightarrow \frac{n+p+Np-np}{n} > 1 - p\delta \Rightarrow \delta > \ddot{\delta} \Rightarrow$$

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \delta > \ddot{\delta} & U_T(\text{Cont}_1) > U_T(\text{Rene}_1) \cdot \\ \delta < \ddot{\delta} & U_T(\text{Rene}_1) > U_T(\text{Cont}_1) \end{array} \right.$$

$$U_T(\text{Cont}_1) > U_T(\text{Resp}_\theta) \Rightarrow \frac{n+p+Np-np}{n} > -2\theta + 1 + 2p\theta \Rightarrow \theta > \frac{1}{2}p \frac{N-n+1}{(p-1)n} =$$

$$\overleftarrow{\varrho} \Rightarrow \left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \theta > \overleftarrow{\varrho} & U_T(\text{Cont}_1) > U_T(\text{Resp}_\theta) \cdot \\ \theta < \overleftarrow{\varrho} & U_T(\text{Resp}_\theta) > U_T(\text{Cont}_1) \end{array} \right. \quad (\text{light blue thick})$$

$$U_T(Cont_1) > U_T(Ref_{o_1}) \Rightarrow \frac{n+p+Np-np}{n} > 1 - 2cp \Rightarrow c \geq \dot{c} \Rightarrow$$

$$\left\{ \begin{array}{l} IF \quad \quad \quad \text{then} \\ c \geq \dot{c} \quad U_T(Cont_1) > U_T(Ref_{o_1}) \quad \cdot \\ c < \dot{c} \quad U_T(Ref_{o_1}) > U_T(Cont_1) \end{array} \right.$$

5.2.3 sub-area 23: (Ref_{o_2} , $Riva_2$, $Rene_2$, $Resp_\theta$)

$$U_T(Ref_{o_2}) > U_T(Resp_\theta) \Rightarrow -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)}$$

$$> -2\theta + 1 + 2p\theta \Rightarrow \delta < \frac{n+2\beta+2S\beta-2n\beta+4cnp}{p(n+2\beta+2S\beta-2n\beta+4cn)} \equiv \tilde{\delta} \Rightarrow$$

$$\left\{ \begin{array}{l} IF \quad \quad \quad \text{THEN} \\ \delta < \tilde{\delta} \quad U_T(Ref_{o_2}) > U_T(Resp_\theta) \quad \cdot \\ \delta > \tilde{\delta} \quad U_T(Resp_\theta) > U_T(Ref_{o_2}) \end{array} \right.$$

$$U_T(Riva_2) > U_T(Rene_2) \Rightarrow \frac{1}{2} \frac{2n+2p\beta-np+2Sp\beta-2np\beta}{n} >$$

$$-\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta-np\delta+4n\theta\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow$$

$$\theta > \frac{1}{4} \frac{-n-2\beta-2S\beta+2n\beta-2p\beta+np-2Sp\beta+2np\beta-2np\delta+4p\beta\delta+2np\delta^2+4Sp\beta\delta-4np\beta\delta}{n(\delta-1)(p-1)} \equiv \widehat{\Theta}$$

\Rightarrow

$$\left\{ \begin{array}{l} IF \quad \quad \quad \text{THEN} \\ \theta > \widehat{\Theta} \quad U_T(Riva_2) > U_T(Rene_2) \quad \cdot \quad \quad \quad \text{(pink dash)} \\ \theta < \widehat{\Theta} \quad U_T(Rene_2) > U_T(Riva_2) \end{array} \right.$$

$$U_T(Riva_2) > U_T(Ref_{o_2}) \Rightarrow \frac{1}{2} \frac{2n+2p\beta-np+2Sp\beta-2np\beta}{n} >$$

$$-\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)}$$

$$\Rightarrow \theta > \frac{1}{4} \frac{-n-2\beta-2S\beta+2n\beta-2p\beta+np-2Sp\beta+2np\beta+4p\beta\delta-4cnp+4cnp\delta+4Sp\beta\delta-4np\beta\delta}{n(\delta-1)(p-1)} \equiv \widehat{\Theta}$$

$$\Rightarrow \left\{ \begin{array}{ll} IF & THEN \\ \theta > \underbrace{\Theta} & U_T(Riva_2) > U_T(Ref_{o_2}) \cdot \quad \text{(pink thick)} \\ \theta < \underbrace{\Theta} & U_T(Ref_{o_2}) > U_T(Riva_2) \end{array} \right.$$

$$U_T(Riva_2) > U_T(Resp_\theta) \Rightarrow \frac{1}{2} \frac{2n+2p\beta-np+2Sp\beta-2np\beta}{n} > -2\theta+1+2p\theta \Rightarrow \theta > \frac{1}{4} p \frac{n+2\beta+2S\beta-2n-2n\beta}{n(p-1)} \equiv \hat{\varrho} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta > \hat{\varrho} & U_T(Riva_2) > U_T(Resp_\theta) \cdot \quad \text{(cyan dots)} \\ \theta < \hat{\varrho} & U_T(Resp_\theta) > U_T(Riva_2) \end{array} \right.$$

$$U_T(Ref_{o_2}) > U_T(Rene_2) \Rightarrow -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} > -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta-np\delta+4n\theta\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow \delta >$$

$$\dot{\delta} \Rightarrow \left\{ \begin{array}{ll} IF & THEN \\ \delta > \dot{\delta} & U_T(Ref_{o_2}) > U_T(Rene_2) \cdot \\ \delta < \dot{\delta} & U_T(Rene_2) > U_T(Ref_{o_2}) \end{array} \right.$$

$$U_N(Rene_2) > U_N(Resp_\theta) \Rightarrow -n-2\beta-2S\beta+2n\beta-np\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-2np\beta\delta > 0. \text{ Assuming } \chi \text{ and } \omega \text{ the two solutions for } \delta \text{ on the left-hand}$$

side of the inequality, we have

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \delta < \chi \text{ or } \delta > \omega & U_T(\text{Rene}_2) > U_T(\text{Resp}_\theta) \\ \chi < \delta < \omega & U_T(\text{Resp}_\theta) > U_T(\text{Rene}_2) \\ \chi \&\omega \ddagger & U_T(\text{Rene}_2) > U_T(\text{Resp}_\theta) \end{array} \right. .$$

5.2.4 sub-area 24: ($\text{Cont}_2, \text{Ref}_2, \text{Riva}_2, \text{Rene}_2, \text{Resp}_\theta$)

Prior results apply.

$$\begin{aligned} & U_T(\text{Cont}_2) > U_T(\text{Ref}_2) \\ & \Rightarrow \frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)} \\ & > -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta+np\delta+4n\theta\delta+2p\beta\delta-4cnp+4cnp\delta+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \\ & \Rightarrow \left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ c > \dot{c} & U_T(\text{Cont}_2) > U_T(\text{Ref}_2) \\ c < \dot{c} & U_T(\text{Ref}_2) > U_T(\text{Cont}_2) \end{array} \right. . \\ & U_T(\text{Cont}_2) > U_T(\text{Rene}_2) \\ & \Rightarrow \frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)} \\ & > -\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta-np\delta+4n\theta\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow \end{aligned}$$

$$\left\{ \begin{array}{ll} \text{IF} & \text{THEN} \\ \delta > \ddot{\delta} & U_T(\text{Cont}_2) > U_T(\text{Rene}_2) \\ \delta < \ddot{\delta} & U_T(\text{Rene}_2) > U_T(\text{Cont}_2) \end{array} \right. .$$

$$U_T(Cont_2) > U_T(Resp_\theta) \Rightarrow$$

$$\frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)}$$

$$> -2\theta + 1 + 2p\theta \Rightarrow \delta < \frac{-n+2p-2\beta-2S\beta+2n\beta+2Np-2np}{p(2N-3n-2\beta-2S\beta+2n\beta+2)} \equiv \underbrace{\delta}_{\delta} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \delta < \underbrace{\delta}_{\delta} & U_T(Cont_2) > U_T(Resp_\theta) \cdot \\ \delta > \underbrace{\delta}_{\delta} & U_T(Resp_\theta) > U_T(Cont_2) \end{array} \right.$$

$$U_T(Riva_2) > U_T(Cont_2) \Rightarrow \frac{1}{2} \frac{2n+2p\beta-np+2Sp\beta-2np\beta}{n} >$$

$$\frac{1}{2} \frac{-n-2p+2\beta+2S\beta+4n\theta-2n\beta+2n\delta+2p\delta-2Np+2np+2Np\delta-4np\theta-3np\delta-4n\theta\delta-2p\beta\delta-2Sp\beta\delta+4np\theta\delta+2np\beta\delta}{n(\delta-1)}$$

$$\Rightarrow \theta > -\frac{1}{4} \frac{n-2p+2\beta+2S\beta-2n\beta+2p\beta+2p\delta-2Np+np+2Np\delta+2Sp\beta-2np\beta-2np\delta-4p\beta\delta-4Sp\beta\delta+4np\beta\delta}{n(\delta-1)(p-1)}$$

$$\equiv \overleftarrow{\Theta} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta > \overleftarrow{\Theta} & U_T(Riva_2) > U_T(Cont_2) \cdot \quad (\text{pink}) \\ \theta < \overleftarrow{\Theta} & U_T(Cont_2) > U_T(Riva_2) \end{array} \right.$$

5.2.5 sub-area 25: (Refo₂, Riva₀, Rene₂, Resp_θ)

$$U_T(Riva_0) > U_T(Rene_2) \Rightarrow (\theta - 1)(p - 1) >$$

$$-\frac{1}{2} \frac{n-2\beta-2S\beta-4n\theta+2n\beta-2n\delta+4np\theta-np\delta+4n\theta\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-4np\theta\delta-2np\beta\delta}{n(\delta-1)} \Rightarrow$$

$$\theta > \frac{1}{2} \frac{-n-2\beta-2S\beta+2n\beta+2np-3np\delta+2p\beta\delta+2np\delta^2+2Sp\beta\delta-2np\beta\delta}{n(\delta-1)(p-1)} \equiv \acute{\Theta} \Rightarrow$$

$$\left\{ \begin{array}{ll} IF & THEN \\ \theta > \acute{\Theta} & U_T(Riva_0) > U_T(Rene_2) \cdot \quad (\text{dark red}) \\ \theta < \acute{\Theta} & U_T(Rene_2) > U_T(Riva_0) \end{array} \right.$$

$$\begin{aligned}
& U_T(Riva_0) > U_T(Ref_{o_2}) \Rightarrow (\theta - 1)(p - 1) > \\
& -\frac{1}{2} \frac{n - 2\beta - 2S\beta - 4n\theta + 2n\beta - 2n\delta + 4np\theta + np\delta + 4n\theta\delta + 2p\beta\delta - 4cnp + 4cnp\delta + 2Sp\beta\delta - 4np\theta\delta - 2np\beta\delta}{n(\delta - 1)} \\
\Rightarrow \theta > \frac{1}{2} \frac{-n - 2\beta - 2S\beta + 2n\beta + 2np - np\delta + 2p\beta\delta - 4cnp + 4cnp\delta + 2Sp\beta\delta - 2np\beta\delta}{n(\delta - 1)(p - 1)} \equiv \tilde{\Theta} \Rightarrow
\end{aligned}$$

$$\left\{ \begin{array}{ll}
IF & THEN \\
\theta > \tilde{\Theta} & U_T(Riva_0) > U_T(Ref_{o_2}) \quad \cdot \quad (alice \text{ blue dash}) \\
\theta < \tilde{\Theta} & U_T(Ref_{o_2}) > U_T(Riva_0)
\end{array} \right.$$

$$\begin{aligned}
& U_T(Riva_0) > U_T(Resp_\theta) \Rightarrow (\theta - 1)(p - 1) > -2\theta + 1 + 2p\theta \Rightarrow \theta > -\frac{p}{p-1} \\
\equiv \vec{\varrho} \Rightarrow & \left\{ \begin{array}{ll}
IF & THEN \\
\theta > \vec{\varrho} & U_T(Riva_0) > U_T(Resp_\theta) \quad \cdot \quad (\text{yellow dots}) \\
\theta < \vec{\varrho} & U_T(Resp_\theta) > U_T(Riva_0)
\end{array} \right.
\end{aligned}$$

5.3 area 3: $\delta < \bar{\delta}, \dot{\delta}$

Area 3 is simulated for the following parameter values: $n = 10$, $\beta = 1.5$, $c = .5$, $p = .9$, $N = 4$, $S = 5$. As a result, $\bar{\delta} = 0.89$ and $\dot{\delta} = 1$.

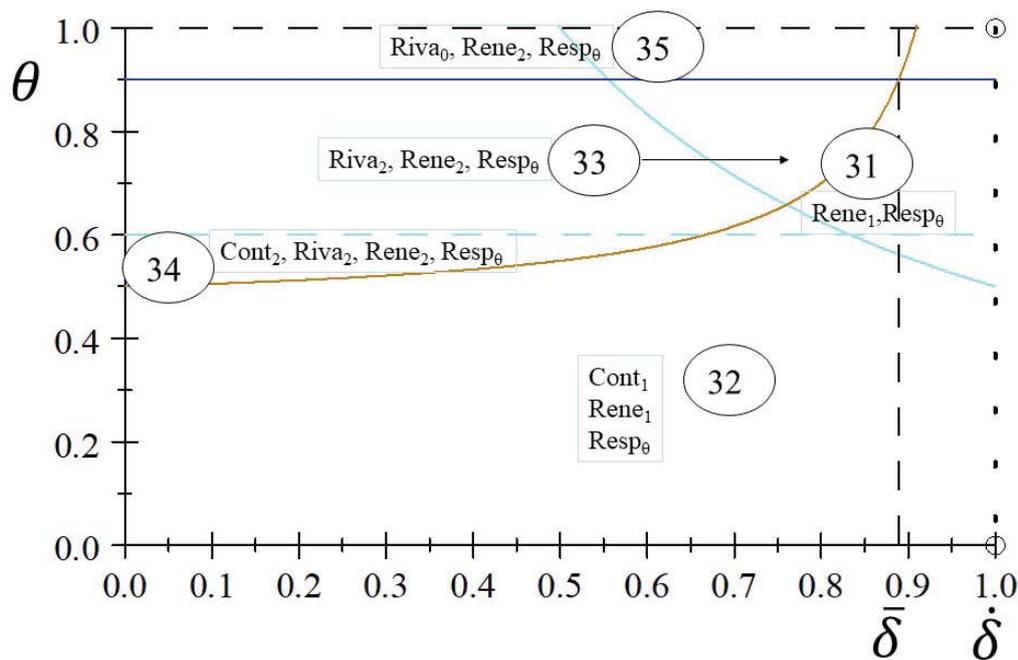


Fig A4: Area 3

All the calculations were already performed in the section on area 2. Indeed, the only difference between areas 2 and 3 is that the former includes the Reform outcomes $Refo_1$ and $Refo_2$ on account of $\delta > \hat{\delta}$, whereas the latter excludes them on account of $\delta < \hat{\delta}$.

5.4 area 4: $\bar{\delta} < \delta < \hat{\delta}$

Area 3 is simulated for the following parameter values: $n = 10$, $\beta = 1.5$, $c = .5$, $p = .52$, $N = 4$, $S = 5$. As a result, $\bar{\delta} = 0.08$ and $\hat{\delta} = 1$.

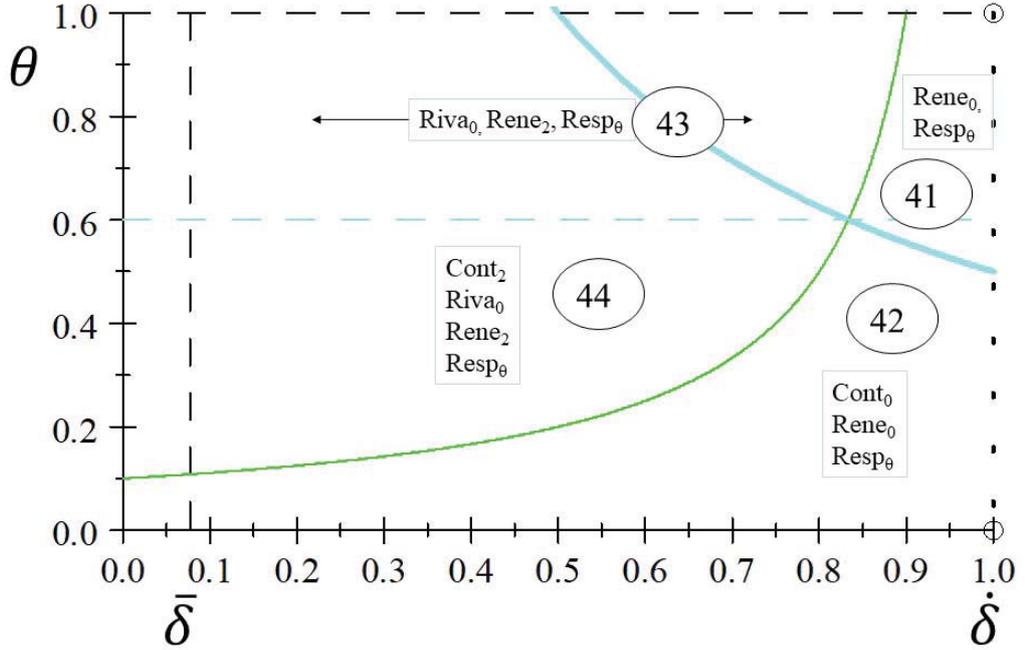


Fig A5: Area 4

All the calculations were performed in area 1 because the only difference between areas 1 and 4 is the presence of the Reform outcomes Ref_{o_0} and Ref_{o_2} in area 1 on account of $\delta > \hat{\delta}$ and their exclusion from area 4 on account of $\delta < \hat{\delta}$.

With all the background work now complete, we move to the text simulations.

6 The cases where $S > \bar{S}$ and $S > \vec{S}$

From lemma 2, we know that there are only two strategies in competition on the right branch: respect ($Resp_3$) and rival secession ($Riva_0$). Moreover, the

value of \bar{S} satisfies the point at which the high x_1 values for renegeing, reform or controlled succession (which are all the same because determined in relation to the rival succession strategy) are equal to the low x_1 value for respect:

$$-\frac{\frac{1}{\alpha}\beta(S-n+1)+\frac{1}{2}-\theta(\delta-1)}{\delta-1} = \theta \Rightarrow \bar{S} = -\frac{1}{2\beta}(n+2\beta-2n\beta).$$

$$U_T(Riva_0) > U_T(Resp_3) \Rightarrow (\theta-1)(p-1) > -\frac{1}{2}\frac{-n+2\beta+2S\beta+4n\theta-2n\beta-4np\theta}{n} \Rightarrow$$

$$\theta > \frac{1}{2}\frac{n+2\beta+2S\beta-2n\beta-2np}{n(p-1)} \equiv \underline{\Gamma}$$

$$\left\{ \begin{array}{ll} \text{if} & \text{then} \\ \theta > \underline{\Gamma} & U_T(Riva_0) > U_T(Resp_3) \\ \theta < \underline{\Gamma} & U_T(Resp_3) > U_T(Riva_0) \end{array} \right. \quad (\text{dark green})$$

The result is the same irrespective of whether the strategy that is played on the right branch is respect ($S < \bar{S}$) or rival succession ($S > \bar{S}$).

7 Simulations

Given the large number of parametric constraints and conditions, we resort to a handful of simulations to express the results. All simulations assume $n = 10$ and $\beta = 1.5$ and thus $\bar{S} = 5.6667$.

7.1 Benchmark ($c = .5, p = .5, N = 5, S = 4$)

With $\bar{\delta} = 0$ and $\dot{\delta} = 1$, this case is identical to area 4. Respecting the shape- and color-coding scheme that was previously introduced, the next figure uses the parameters and cutpoints that fall within the relevant domain to partition the $\delta \times \theta$ space and infer the winning strategy within each part. In addition, the

benchmark simulation makes functions Θ and $\underline{\Theta}$ greater than unity and thus falling beyond the relevant domain, while point $\underbrace{\delta}_{\delta} < 0$ and χ and ω do not exist.

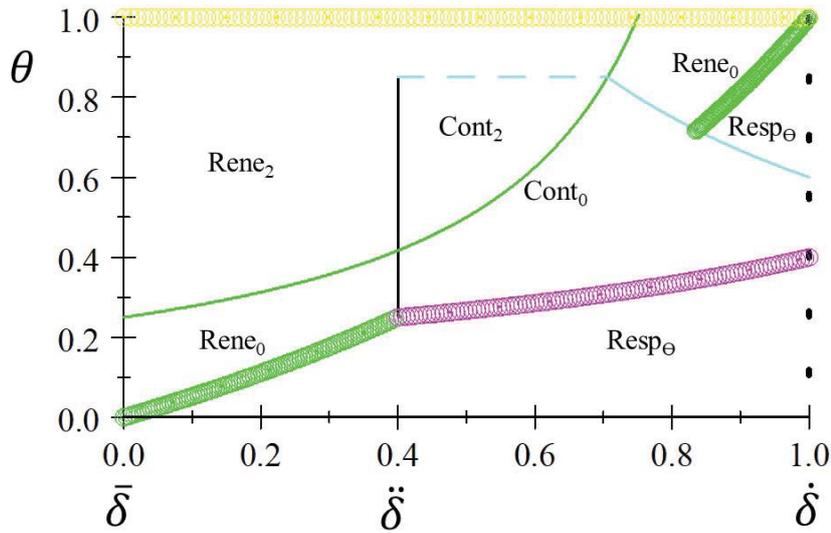


Fig A6: Benchmark

The next figures plot the benchmark case with a higher and lower probability of bad circumstances (p) respectively. Note that Figure 6bis combines area 3 and 4 results, whereas Figure 6ter is a replay of area 4.

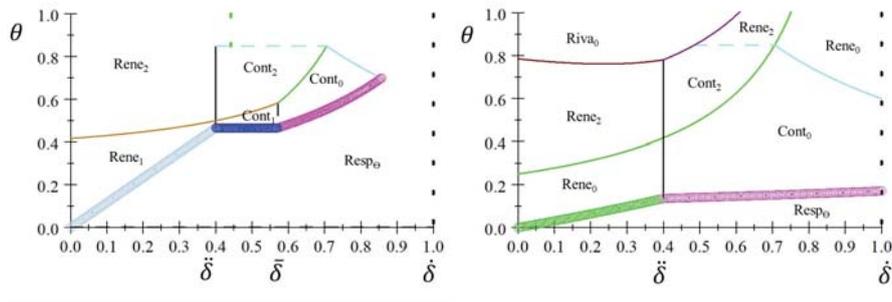


Fig A6bis: Benchmark higher p ($= .7$) Fig A6ter: Benchmark lower p ($= .3$)

7.2 Low c ($c = .2, p = .5, N = 5, S = 4$)

With $\bar{\delta} = 0$ and $\dot{\delta} = .4$, this case juxtaposes area 4 on the left with area 1 on the right.

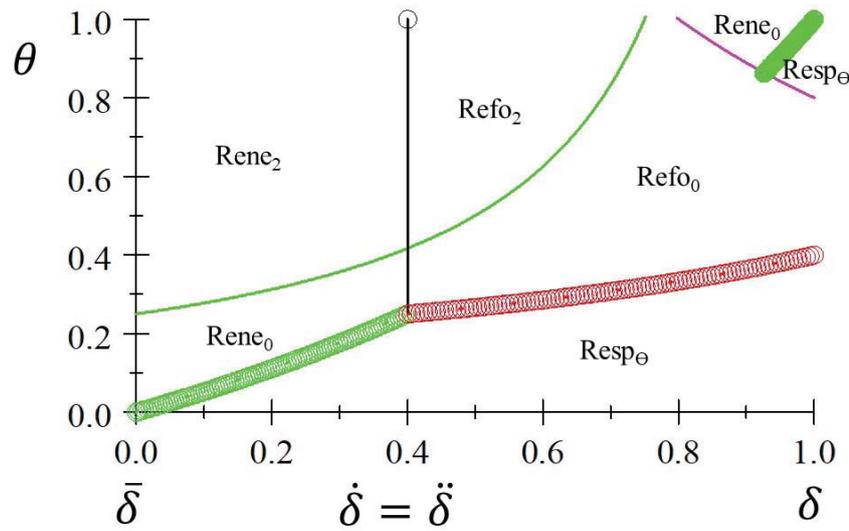


Figure A7: Low c

We then vary the value of p , with a higher probability of bad circumstances $p = .7$ in Figure A7bis and $p = .3$ in Figure A7ter. Figure A7bis combines, from left to right, results from areas 3, 2 and 1, while Figure A6ter combines, also from left to right, results from areas 4 and 1.

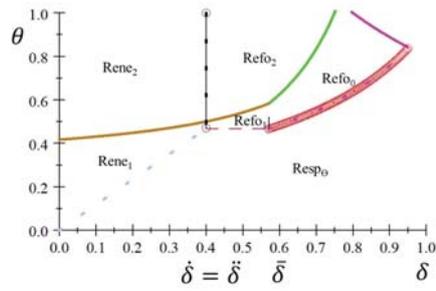


Fig A7bis: low c , high p

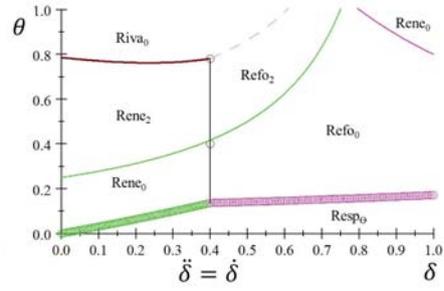


Fig A7ter: Low c , low p

7.3 High S ($c = .2, p = .5, N = 3, S = 5$)

With $\bar{\delta} = 0$ and $\hat{\delta} = 0.4$, this case juxtaposes area 4 on the left and area 1 on the right..

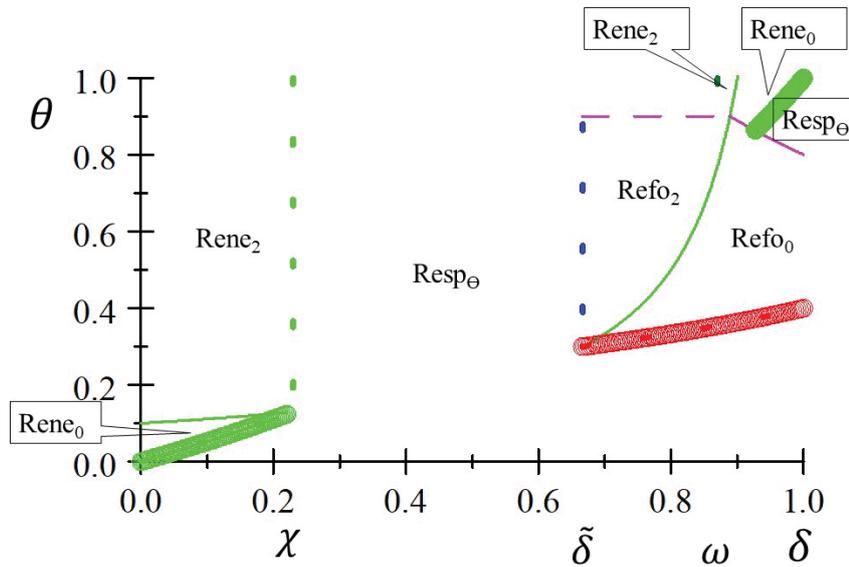


Fig A8: High S

7.4 Very high S ($c = .2, p = .5, N = 3, S = 7$)

This is the case where $S > \bar{S}$.

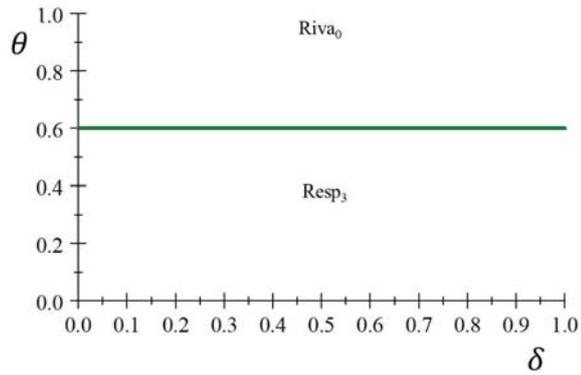


Fig A8bis: Very high S

7.5 High N ($c = .5, p = .5, N = 6, S = 2$)

With $\bar{\delta} = 0$ and $\dot{\delta} = 1$, this case reproduces area 4.

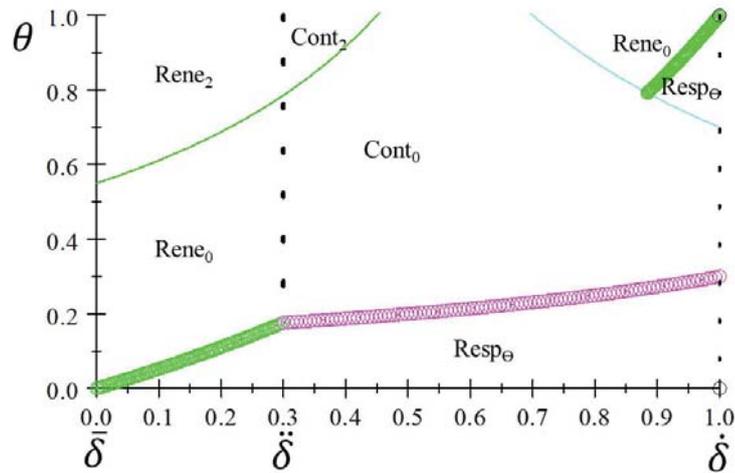


Fig A9: High N

Figure A9bis raises $p (= 0.7)$ and, with $\bar{\delta} = 0.57$ and $\dot{\delta} = 1$, juxtaposes area 3 with area 4. Figure A9ter drops $p (= 0.3)$ and, with $\bar{\delta} = -1.33$ and $\dot{\delta} = 1$, reproduces area 4.

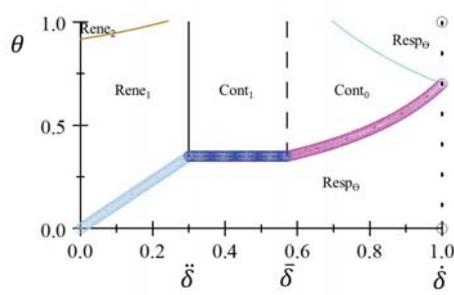


Fig A9bis: High N , high p

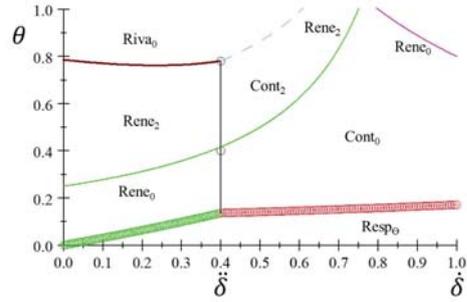


Fig A9ter: High N , low p

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