

# How Brinkmanship Saved Chadbourne: Credibility and the International Sugar Agreement of 1931

Alan Dye  
Barnard College,  
Columbia University  
[ad245@columbia.edu](mailto:ad245@columbia.edu)

Richard Sicotte  
University of Vermont  
[rsicotte@zoo.uvm.edu](mailto:rsicotte@zoo.uvm.edu)

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## Abstract

Theories of cartel stability assume detection is unambiguous. If full information is available, defection is known. Recent empirical findings suggest that cartel agreements are contractually incomplete, which implies identification of a violation is ambiguous. It is possible, with full information, for members of a cartel to disagree about whether an act constitutes a violation. This paper examines the question of strategy when cartel members disagree by studying an episode of near breakdown in the International Sugar Agreement of 1931. Cuba made its threat credible using a strategy with the game-theoretic characteristics of brinkmanship. Our findings support other recent empirical work on cartels. Genesove and Mullin (2001) find that such agreements are necessarily incomplete with the implication that enforcement rules may be less automatic than cartel theory implies. Bates (1997) finds that, when such agreements involve governments, outcomes depend not only on economic or state-level strategy, but also on domestic politics.

Recent empirical work on cartels questions the adequacy of the proposed detection and retaliation mechanisms of cartel enforcement to account for observed behavior. Since Stigler's (1964) insight that members had an incentive to design self-enforcing rules to detect and penalize defectors, theories of cartel stability have focused on sequences of detection and retaliation as the mechanisms of enforcement. Oliver Williamson (1996, p. 8) deduces from this that collusion is a contractual problem, which if there are nonzero transaction costs, will suffer from problems of incompleteness. Genesove and Mullin (2001) find evidence that the contracts underlying cartel agreements are incomplete, and that incompleteness significantly alters the design of agreements, the problems of detection, and the frequency and severity of retaliation for enforcement purposes, relative to the predictions of theories of cartel stability.<sup>1</sup> Particularly significant, contractual incompleteness introduces the possibility of disagreements about whether an act constitutes a violation, not accounted for in the theories, which sometimes treat detection as uncertain but not ambiguous. Contractual incompleteness implies the possibility of ambiguities that must be worked out in in-contract renegotiations. Empirical observations of disagreements leading to cartel breakdowns, sometimes diverted, raise the question: What possible responses or strategies exist when a disagreement arises?

This paper examines the question of strategy when cartel members disagree because of contractual incompleteness. We analyze an episode of near breakdown in the International Sugar Agreement of 1931, and conclude that breakdown was diverted, after excruciating renegotiations, only because a strong player played a strategy of brinkmanship. Brinkmanship, a strategy first introduced by Thomas Schelling (1966, 1980), is a high-risk strategy by which one party threatens an action that would result in mutual harm if an opponent refuses to take a desired action.

Our evidence are extensive office records of the International Sugar Council, the Cuban Sugar Stabilization Institute, the U.S. Department of State, and Czarnikow-Rionda, a prominent New York sugar brokerage, whose president was involved with and directly informed of Cuba's international negotiations to establish sugar controls. The records contain internal memoranda, letters and cables of correspondence between cartel members, officials and consultants. The types of documents include minutes and

transcripts of meetings, statistical tables, knowledge of behind-the-scenes negotiations, and perceptions and analyses from the executive offices of national sugar producers' associations, producers, and consultants.<sup>2</sup>

Our finding has several implications for the literature on international cartels. First, it is at variance with the usual predictions of cartel theory because, when detection is unambiguous, the optimal enforcement strategy typically involves joint retaliation of all nondefecting members. We find that members of the cartel rejected joint retaliation. Incompleteness in the cartel contract caused members to disagree about whether it had been violated. The most injured party, and largest member, then threatened to abandon the agreement in an attempt to force a reconsideration. Other cartel members did not treat the threat as credible until the strategy of brinkmanship was played. Like Levenstein (1997), we find that a distinction between in-contract retaliation and breakdowns is useful. Parallel to Genesove and Mullin (2001), we find that contractual incompleteness creates a need for communication and renegotiation in an ongoing cartel agreement. Finally, how the brinkmanship strategy was played reinforces Bates' (1997) finding that the structure and stability of international cartels or commodity agreements depend on the heterogeneous domestic politics of its member countries.

### *The Chadbourne Agreement*

After years of talk and months of direct negotiation, the agreement between the so-called Chadbourne countries was signed on May 9, 1931. The agreement had two main objectives: (i) to restrict production and exports in order to pull up prices, and (ii) to segregate and remove from the market large surplus stocks of sugar that had accumulated. At the time it was signed, the price of sugar on the world market was at a historic low (below average costs for even the lowest-cost countries). Figure 1 shows that the price of sugar in the two principal import markets fell precipitously in the late 1920s and remained below 2 cents per lb. in 1930 and 1931. In 1927, internal correspondence of a major sugar brokerage warned that a price less than 2 cents would be below the costs of the most efficient mills in Cuba, which was, with Java, the least-cost sugar producing country.<sup>3</sup>

Adding to the troubles, by the end of 1930, stocks held off the market exceeded a remarkable 4 million tons. Figure 2 shows the buildup and distribution of world surplus stocks of sugar, defined here as unsold visible stocks at the end of the crop year. Before 1929, a 4-million-ton surplus was unimaginable, physical stocks had never exceeded 1.5 million tons. In fact, 1925 was the first time they reached 1 million tons, and that event was received with great alarm (Rowe, 1930). The 4 million tons of unsold stocks in 1930 represented about one-third of the world export market.

Under these extraordinary conditions, exporters were beside themselves. Their expectation, expressed in numerous documents, was that, unless world demand for sugar recovered or something else was done, a further collapse in the price was probable, and it could be disastrous. Expectations of further price collapse could be self-fulfilling, because they might induce sugar holders to dump their stocks. As we explain below, many also believed that continued falling prices could stimulate endogenous tariff protection in the major sugar-importing countries.<sup>4</sup>

The Chadbourne Agreement formally created an international sugar cartel. The signatories were the national sugar producers' associations of nine important sugar exporters—Belgium, Cuba, Czechoslovakia, Germany, Hungary, Java, Peru, Poland, and Yugoslavia. The terms of the agreement are summarized in Table 1. As signatories, each agreed to enforce specified export quotas and to remove from the market all physical stocks of sugar held in the country and identified by the signatories as “excess stocks.”<sup>5</sup> Excess stocks were to be released in equal portions over the next four years and charged against the country's export quota. Each country agreed to reduce its production to avoid additional accumulation of stock; however, only export quotas, not production quotas, were specified in the agreement (a point that later became contentious when *ex post* adjustments were necessary). Independent firms in each country had incentives to defect, so to enforce the agreement, each signatory committed to obtain legislation to license and regulate exports.<sup>6</sup> Finally, an International Sugar Council (ISC), made up of delegates from each signatory, was set up to collect statistical information, administer procedures, monitor compliance, and adjudicate disputes. The agreement was to be terminated after five years, when the last release of segregated excess stocks was completed. Therefore, the primary motive of the Chadbourne Agreement was to coordinate a reduction in the

physical stocks of sugar hoping to fend off any further fall in the market price of sugar by signaling a commitment to buyers to withhold stocks from the market and release them in an orderly manner.

Yet a few months after May 1931 agreement, forecasts for end-of-year stocks of sugar in 1930-31 climbed from 4.2 to more than 5.5 million tons, and forecasts for the 1931-32 crop year exceeded 6 million tons. The agreement, based on underestimates of stock accumulations, would need adjustment to achieve its aim. (See Figure 2.)

### *The Dispute*

Frictions between Cuba and Java, the main contributors to the increased stocks, emerged almost immediately after the agreement was signed. The first real confrontation occurred at the annual planning meeting of the ISC for the 1932 crop, held at the Ritz Hotel in Paris, December 14-18, 1931. Concerned about the unanticipated accumulation of stocks, the Cuban Sugar Stabilization Institute (ICEA, or Instituto Cubano de Estabilización del Azúcar), represented by New York lawyer, Thomas L. Chadbourne, requested that the Java group restrict its crop in 1932 to 1.679 million tons, instead of the previously announced 2.5 million tons. Reciprocally, Cuba offered to reduce its crop in 1932 to 2.3 million tons, instead of the 3.4 million previously planned. The Javanese producers refused. To accept the offer, they would have to destroy existing cane plantings. They had insisted in the original negotiations that the members of the United Java Sugar Producers (VJSP, or Vereenigde Java Suiker Producenten) would not accept the destruction of cane.

Surprised by the refusal, the Cuban delegation accused the Javanese of violating the agreement. Each party had committed to make the appropriate production cuts to halt the accumulation of surpluses. The Javanese countered saying their actions were consistent with the agreement. They had no plans to exceed their export quota. As for the adjustment of production to stocks, the agreement required no specific action as to the manner or speed of adjustment. They would take appropriate action, but since the plantings for the 1932 crop was already completed, it could not take effect before the 1933 crop. The Cuban delegation proposed arbitration as provided in the agreement. The Council (ISC) opposed; arbitration could not be completed before decisions for the 1932

crop had to be made. As a compromise, the Cuban delegates agreed to accept a ruling by the Council if its decision (except for Cuba and Java) was unanimous. The Council decided unanimously in favor of Java. They gave two reasons: (i) the contractual agreement did not specify when production adjustments had to be made, and (ii) all had agreed to accommodate the special needs of each member in production adjustments. Requiring destruction of cane in Java could threaten the political viability of the agreement there.<sup>7</sup>

The ISC's ruling was not well received in Cuba. The home office of the ICEA in Havana almost repudiated their delegates' decision to accept it. Instead, ICEA cabled instructions to the delegation in Paris to announce that Cuba would "adjust its quota using the same method that Java does." If Java is conservative, Cuba will be; but if Java overstates its expected sales in Asia, Cuba will overstate its expected sales in the U.S. The Javanese delegation responded by offering to negotiate voluntary (extralegal) production cuts with the individual members of the VJSP, but they argued it would take time. The Cuban delegation reminded that Cuba's deadline for making a decision about the crop restriction was approaching in mid-January, when Cuba's grinding season would commence. They demanded that Java had to announce its crop reduction plans by January 10. On December 18, Java committed to provide those figures by January 5; yet by December 31, it announced it could not provide them until the end of January. For Cuban regulators this created a problem. They needed to announce the amount of the crop restriction before commencement of grinding, scheduled for January 15, so that producers could make production plans.<sup>8</sup> ICEA officials in Havana suspected Java of engaging in a delay tactic to force Cuba to move first and commit to a crop figure before Java did.

José López Oña, a member of ICEA's Executive Committee, commented that "he suffered the disagreeable impression that we might be Java's *juguete* (toy)."<sup>9</sup> An escalation of threats, rhetoric, and public displays of outrage followed. Cuba threatened to abandon the agreement, but Java and the European delegates ignored the threats and privately chastised Cuban officials for disagreeable behavior until ICEA played a strategy of brinkmanship.<sup>10</sup>

*The Strategy of Brinkmanship*

The term “brinkmanship” conveys the strategy of threatening to take one’s opponent and one’s self to the brink of mutual demise (Schelling, 1966, 1980; Dixit and Nalebuff, 1991; Nalebuff, 1986). One would only engage in such a threat, which risks harm to one’s self, if no simple credible threat were available to induce an opponent’s compliance without harming one’s self. The threat of mutual harm also needs to be credible, which usually is achieved by setting in motion a process that causes the escalation of that threat. The textbook example is the face-off between President John F. Kennedy and Premier Nikita Khrushchev in the 1962 Cuban missile crisis. The drama of that incident highlights the extremes to which threats of brinkmanship can go. Game theory shows that the apparently irrational threat of nuclear annihilation can be explained as a rational strategic response. It is risky, but it can work. Besides nuclear face-offs, the strategy is also observed when the stakes are not so high, such as in marital or labor-management disputes. We observe it as the strategy played by a dominant producer in an incompletely contracted international cartel.


Why would a threat of mutual demise be credible? It cannot be, if the discretion to carry out the threat is in the hands of the threatening party. If  $A$  threatens  $B$  with mutual demise, in the last hour, when it is time to execute,  $A$  will not carry it out because she will also be harmed. Therefore, to engage in brinkmanship,  $A$  must threaten a loss of control over the execution of the threat. This can be done, in principle, by rendering the decision either to a automated process or giving control over to another person who would prefer to carry it out. Naturally,  $A$  will want to temper the loss of control because the aim of the threat is to obtain compliance and abandon the action before either  $A$  or  $B$  is harmed. The play of brinkmanship, then, involves an attempt at a “controlled lack of control” (Dixit and Skeath 1999, p. 451). In practice, one may set in motion a stochastic process by which the threatening party slowly loses control of the decision and the risk of mutual harm slowly escalates. In the Cuban missile crisis, Kennedy made his threat credible by initiating a military blockade of Soviet ships headed for Cuba. It was credible because he could not be fully in control of events that might lead to military engagement. As tension escalated, decisions made in the heat of the moment by military officers, some of whom were more in favor of engagement than he was, might be impossible to reverse.

The process of escalation is an important element in the strategy. For the threat to be credible,  $B$  must expect a high probability of execution if she does not comply, but a low (or zero) probability if she does. Naturally,  $A$  wants to choose the minimum effective threat because she wants to minimize the risk of damage to herself, but precision may not be possible. She will not know the threshold that will make  $B$  comply, so there is reason for her to initiate a process that starts with a lower probability of execution but permits escalation to a higher probability. Such mechanisms that introduce uncertainty will likely also cause her to lose control of the risk. If permitted to escalate too far, she may not be able to recover control of the threat. When that point is reached is also uncertain and adds to the risk of the threat.

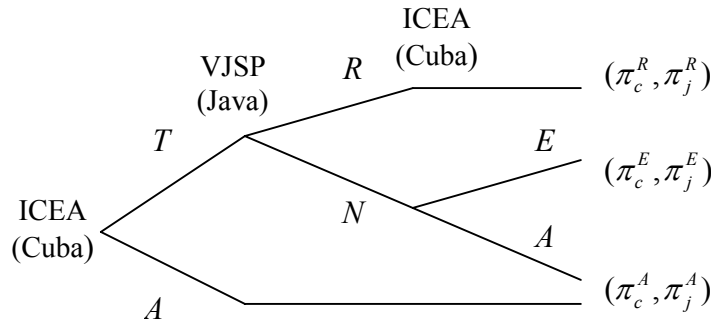
We observe brinkmanship in the disagreement between Cuba and Java over how Java should, within provisions of the cartel agreement, adjust its production to stocks. Before further discussion of the details of the dispute, it is useful to sketch out an analytical framework for interpreting their actions.

It is important, when analyzing brinkmanship, to identify exactly who the players are because the play (often) involves introducing a threat that control could be given over to another player, who values the act of carrying out the threat differently. The two players are Cuba's ICEA and Java's VJSP, the rival organizations representing the two sugar industries. The actions that the leaders of each association take after the December 1931 ISC meeting can be summarized in a sequential game.

After the ISC's decision to back Java's position, ICEA could choose either to acquiesce to the Council's decision or try to force the VJSP to renegotiate its position. A third possibility was that it could abandon the agreement unconditionally. ICEA officials considered the latter an inferior strategy, although some other producers did not (see below). Ignoring, for the moment, unconditional abandonment, consider the game tree below. Suppose  $\pi_i^s$  is the payoff. The index  $i = c, j$  identifies the payoff as either Cuba's or Java's, and  $s$  identifies the strategy. Cuba could acquiesce,  $A$ , or threaten,  $T$ . If Cuba threatens, Java may renegotiate,  $R$ , or not renegotiate,  $N$ . If Java does not renegotiate, Cuba may execute the threat,  $E$ , or acquiesce.



**Figure 3**  
**The Brinkmanship Game Tree**



As for the payoffs, we know that, for Cuba,  $T$  leading to  $R$  dominates  $A$ , but for Java,  $A$  dominates  $R$ . That is,  $\pi_c^R > \pi_c^A$ , and  $\pi_j^R < \pi_j^A$ . If a simple threat,  $T$ , is deemed non-credible in Java, the Javanese producers estimate Cuba's perceived payoff of the threat plus its execution as  $\pi_c^E < \pi_c^A$ . Java anticipates that Cuba will respond at the  $N$  node by choosing,  $A$ , not to execute, rather than  $E$ . The equilibrium outcome is  $(\pi_c^A, \pi_j^A)$ , the same outcome that would have occurred if Cuba had originally played  $A$ .<sup>11</sup> Java would play  $N$  if Cuba played a simple, non-credible threat. (By "simple," we mean that ICEA controls the decisions to threaten and execute the threat.)

To alter Java's response, ICEA had to make its threat credible. The strategy of brinkmanship accomplishes this by introducing the possibility that the execution of the threat be taken out of ICEA's control. Suppose, for now, that ICEA can signal that Java's refusal to renegotiate,  $N$ , would result in the removal from ICEA's control of the decision to execute,  $E$ , or not,  $A$ , and that execution,  $E$ , would occur with a probability  $q > 0$ . Java's expected payoff from playing  $N$  becomes  $E(\pi_j^N) = q\pi_j^E + (1 - q)\pi_j^A$ . The Javanese VJSP will renegotiate only if  $E(\pi_j^N) < \pi_j^R$ , assuming they are risk neutral. That is true only if  $\pi_j^E$  is sufficiently small and  $q$  is sufficiently large, since  $\pi_j^R < \pi_j^A$ .

The Cuban ICEA also wants to limit the risk of harm to its own members by choosing the minimum effective threat. The expected payoff for Cuba, if Java refuses to renegotiate, is  $E(\pi_c^N) = q\pi_c^E + (1 - q)\pi_c^A$ . If the loss of control resulted in a probability of

execution,  $q$ , that was too high, ICEA would not be willing to make the threat. If ICEA can set a process in motion that starts with a small loss of control, such that  $q$  starts out small, but the loss of control escalates over time, that process constitutes an effective algorithm for identifying the minimum effective threat.

A final element involves Java's expected response. Cuban officials in ICEA, when deciding whether brinkmanship was a desired strategy, could not be certain how Java would respond to the threat. The VJSP claimed that the agreement, and especially any further concessions to Cuba, faced serious internal political opposition in Java. The current majority faction in the VJSP supported the agreement, but a growing minority faction within the VJSP disagreed. Furthermore, a smaller group of sugar producers in Java, not members of the VJSP and mostly of Chinese ethnicity, were opposed to the agreement. The Dutch East Indies parliament had accommodated the majority of the Dutch members of the VJSP with enforcement legislation, but further concessions would meet much opposition and were unlikely.<sup>12</sup> This implies varying expectations about the consequences of provoking Cuba to execute its threat. An aggressive faction,  $a$ , expects the outcome from competition to be superior to further concessions, and a nonaggressive faction,  $\tilde{a}$ , expects competition to yield a worse outcome. That is, two Javanese factions have opposite relative expectations regarding plays of  $E$  relative to  $R$ :

$$\pi_j^E(a) > \pi_j^R > \pi_j^E(\tilde{a}). \text{ (More below.)}$$

To make a rational decision about whether to threaten, ICEA had to form an expectation about which faction was likely to control Java's response. If  $p$  is ICEA's estimated probability that the aggressive faction would control the decision, then ICEA estimates that the VJSP expects its payoff from playing  $N$  to be:

$$E_c(\pi_j^N) = p[q\pi_j^E(a) + (1-q)\pi_j^A] + (1-p)[q\pi_j^E(\tilde{a}) + (1-q)\pi_j^A]$$

The expected outcome of a threat from Cuba depends on ICEA officials' belief about  $p$  and their ability to manipulate  $q$ . To invoke an expected response of  $R$  from Java, ICEA must set  $q$  such that  $E_c(\pi_j^N) < \pi_j^R$ .  $E_c(\pi_j^N)$  is increasing in  $q$  as long as  $p$  is sufficiently large. If ICEA sets  $q$  too low,  $E_c(\pi_j^N) > \pi_j^R$ , and the threat is ineffective.

It is not rational for ICEA to maximize  $q$  so that  $E_c(\pi_j^N) < \pi_j^R$ . Cuba's expected payoff from playing brinkmanship,  $E_c(\pi_c^N)$ , is a decreasing function of  $q$ . There is a chance that the strategy could fail, so ICEA prefers the minimum effective  $q$ . In practice, of course, ICEA officials could only guess how high  $q$  had to be to invoke the desired response. A problem for ICEA—common to brinkmanship strategies—was that, by releasing control of the final implementation decision, it also lost control over the magnitude of  $q$ . As  $q$  was increased, the decision would depend less on what ICEA advised, and more on the growing influence of the political opposition, but ICEA had to be willing to take that risk to establish credibility.

### *Enforcement and Contractual Incompleteness*

Theories of cartel stability focus on sequences of detection and retaliation (Green and Porter, 1984; Ellison, 1994; Rothschild, 1999). They may treat detection as uncertain because of incomplete information, but if the facts are known, violations are unambiguous. In this confrontation between Cuba and Java, the facts were not in dispute; the dispute was over whether the facts constituted a violation. The evidence is conclusive that the written agreement was incomplete. The signatories had consciously stopped short of accounting for all contingencies and expected to rely on subsequent data collection and communication to fill in gaps, when necessary (cf. Genesove and Mullin 2001). An administrative body, the ISC, was created to perform these functions.

The dispute arose primarily from divergent interpretations of an ambiguity of the clause that required Java to adjust its production. It stated that, if there was an increase in Java's stocks above the current estimate, "... Java will take measures purposing to adjust its production accordingly when planting its next year's crop; the intent being that the production of Java will not ... be so increased that additional surplus stocks will be accumulated." (Chadbourne Agreement, Art. I). Java claimed that the adjustment requirement referred only to the act of planting; and in Java, where the growing period was relatively long, the plantings for the 1932 crop were already completed. Cubans argued that the language "next crop" referred to the next harvest. The Spanish translation replaced the word "crop" with "*zafra*," which means both "crop" and "harvest." As noted, the Cuban delegation at the planning meeting in December 1931 declared Cuba

would submit to the ISC's ruling, but when the ruling was unfavorable to Cuba, ICEA officials in Havana did not let the matter rest.

The ambiguity is explained by a difference in sugar technology and politics that raised the costs of negotiation. Accumulated stocks depended both on exports and production levels. Cuba had already enacted legal measures to restrict both in 1930 and had sought specific provisions for both in the original agreement. But Java held fast to a position of no production quotas. It had a long history of sugar production regulation with the different aim of self-sufficiency in staple production. The colonial government required rotations such that village land dedicated to cane had to be given over to rice paddy in the next crop. Therefore, unlike Cuba, where cane unused in the intended grinding season could be left standing and harvested the next grinding season, in Java, an unharvested cane planting, by regulation, had to be destroyed to release the land for paddy. The costs of reversing production decisions after planting were therefore higher for Javanese producers than for Cuban producers because planting costs were sunk in Java but not in Cuba.<sup>13</sup>

The main reason for incompleteness was the usual one—it was too costly to anticipate and provide for all contingencies.<sup>14</sup> But in this case, besides private contracting costs, political costs contributed to incompleteness. Enforcement depended on political action at the national level, consequently, the signatory producers' associations did not have the full autonomy of private firms to comply or make *ex post* adjustments. For example, the Javanese association represented about 145 out of 195 estates. The Cuban association was by fiat the official representative of all 160 or so active mills.<sup>15</sup> The archives show that signatories' foremost concerns about enforcement were the legal controls in each country committed to obtain legislation to license and control exports and prohibit defection by individual companies. Without such controls, incentives existed for individual companies to violate the agreement. In fact, the first obstacle that had to be overcome in the original negotiation of the agreement was the absolution of doubts about whether the signatory associations could secure the necessary legislation from their national governments.<sup>16</sup> Monitoring the completion of those commitments was the first item of business in the meetings following the agreement's signing.

Parallel to our conclusion, Bates (1997) finds a similar dependence of the structure of the international coffee cartel on domestic politics. But to our knowledge, no theoretical work has looked specifically at the constraints on contractual completeness that reliance on legislative action imposed on international cartel agreements. The record suggests ISC officials believed that detailed enumeration of contingencies, which might have been efficient in a purely private agreement, could jeopardize domestic political support for export licensing laws that signatories were seeking from their respective national legislatures. First, spelling out worst-case scenarios as contingencies might fuel the political opposition. Second, informational asymmetries enjoyed by sugar producers would be lost to the extent that they were revealed in contingencies enumerated in the formal agreement. Consistent with the implied enumeration bias, the agreement incorporated specific provisions to adjust quotas upward, if forecasted demand were too low; but it did not incorporate provisions for downward adjustments to the quotas, if forecasts were too optimistic.

The political challenges varied among the signatory countries and depended on the branch of government that had jurisdiction. There were three main patterns. The European signatory countries, except the Netherlands, had well-established precedents to provide legal support for international cartels in many industries (Hexner 1946, Gupta 2001). The Netherlands East Indies did not share the central European corporatist tradition of institutionalization of cartels. Export licensing legislation had to be obtained from the Colonial Council in Batavia, a representative local governing body where opposition to a sugar cartel was not insignificant. First, support for it among Javanese sugar producers was mixed. The VJSP represented only about three-quarters of the sugar producers in Java, and its membership began to fall at the end of 1931.<sup>17</sup> The remaining quarter, mostly ethnic Chinese, were against it. Colonial officials were not enthusiastic about further export restriction when a growing segment of the industry opposed it.

The signatories perceived Cuba as having the strongest political commitment to the agreement. Since 1927 Cuban producers had invested much time and expense pursuing such an agreement. They had signed a similar agreement with U.S. domestic producers in 1930, which included a commitment on Cuba's part to pursue an international agreement.<sup>18</sup> The program had the full backing of President Machado and

the Cuban Congress. The sugar industry's representatives in ICEA were in the inner circles of Machado's regime. Constitutionally, the Cuban president had strong powers to enact legislation, but beyond that, Machado in 1929 had seized control of the government and had adopted heavy-handed measures to impose a cronyist legislative agenda that gave priority to sugar and U.S. relations. Machado continued to have the support of the United States' government; most observers of Cuban politics considered that endorsement the litmus test of Cuban political viability, since under the Platt Amendment, the United States had the right to intervene to suppress political instability.

However, since the signing of the agreement, several outcomes and events weakened the political support for it in Cuba. First, many sugar producers and other constituent groups that had supported the principle of an agreement viewed the negotiated outcome as unfair to Cuba. Table 2, column iii, compares average 1931-35 quotas to pre-agreement exports as an indicator of the relative burden. Of the nine signatory countries, only three quotas were less than 90 percent of pre-crisis average exports from 1925-29—Belgium, Cuba and Czechoslovakia. Four quotas exceeded their 1925-29 average exports—Germany, Java, Poland and Peru. Space precludes a complete analysis of the relative bargaining outcomes. Briefly, the relatively homogeneous European group leveraged their positions by acting in coalition and having larger domestic markets relative to production levels (cf. Libecap, 1989).<sup>19</sup> Belgium, the only significant raw sugar importer among them (because of its large refining industry), was a pivotal member of the coalition. Germany had additional leverage because it faced lower opportunity costs of an isolationist policy.

Table 2, columns iv-vi, show that only Cuba's and Java's sugar industries depended primarily on sugar exports. In the other signatory countries, sugar production did not contribute much to national income, and most of the sugar produced (except in Czechoslovakia and Peru) was consumed domestically. Therefore, Cuba and Java had the largest stakes in the agreement. As one might expect, Cuba accepted a larger share of the export reduction in the agreement. But Java did not. The VJSP argued that their quota represented a significant cut from expected future exports because they were reestablishing former cane capacity with a new disease-resistant cane variety after recovering from the devastating *sereh* disease (Boomgaard, 1988). While Cuba had been

pursuing an international agreement since 1927, Java had been the holdout. The Europeans supported it from the beginning, but only if Java participated.<sup>20</sup> Cuba's national economy was much more dependent on sugar than Java's. Almost 80 percent of Cuba's export earnings were from sugar exports whereas in Java, only about 20 percent was from sugar exports. Cuba was one of the most monocultural countries in the world; rough estimates show the ratio of sugar export earnings to national income to be nearly 40 percent (Zanetti, 1989, Alienes Urosa 1950).

Cuba and Java also carried the largest surplus stocks. Shocks to international markets in 1931 made forecasts, on which export quotas were based, too high and caused the unanticipated accumulation of stocks. Java had forecasted sugar export growth in India, Japan and China, where it had transportation-cost advantages; yet in 1931 those markets were respectively at 60, 48 and 77 percent of 1929 levels (ISC Statistical Tables, 1937). Cuba's 1930 agreement with U.S. sugar producers gave a quota of 2.8 million tons in the 1931 U.S. market, but actual sales there did not reach 2.3 million tons (U.S. House Committee on Agriculture, 1962). There were two reasons. Demand fell more than expected; but also, U.S. mainland producers violated the spirit if not the letter of the agreement, by accelerating sales of their 1931 crop and, then, forward selling the 1932 crop at the end of 1931. Java's refusal to cooperate raised doubts in Cuba about whether Java's commitment to the agreement was genuine.

Only in Cuba were the prospects of national recovery so closely tied to the sugar market. Sugar export earnings fell by 70 percent between 1929 and 1932 and accounted directly for about half of the 30 percent decline in national income (Zanetti, 1989, Alienes Urosa, 1950). Falling real wages and shortened seasonal employment caused expected real income in 1932 for sugar workers, under the proposed crop restrictions, to drop to somewhere between  $\frac{1}{3}$  and  $\frac{1}{4}$  of 1929 incomes.<sup>21</sup> Other prices and wages were correlated with sugar-industry incomes.

Labor unrest and violent opposition to the Machado government intensified. The United States embassy in Havana linked the political troubles to the price of sugar and told Washington that most Cubans believed a higher sugar price would pacify the situation.<sup>22</sup> Machado suppressed a coup d'état in 1931, but terrorist acts against the government continued in 1932 (Smith, 1960, pp. 130-31; Gellman, 1973, p. 9).

Machado's power to support ICEA's policies without regard to popular sentiment was therefore diminishing. And his government had fewer resources to withstand a worsening of economic conditions. In the three years after the 1929 New York Stock Exchange crash, seventeen Latin American countries' governments were overthrown. Machado lasted until August 1933 (Véliz, 1980, p. 279).

The outcome of the dispute between ICEA and the VJSP, therefore, had economic consequences in Cuba of national scope at a critical time. Chadbourne and members of ICEA warned that Cuba was in an "inflamed state of mind" over this dispute, popular "repulsion" to the agreement was spreading, and its success did not turn on "contractual obligation" alone. It turned on political conditions in Cuba.<sup>23</sup>

### *Credibility and Escalation*

ICEA officials uttered their first threats to abandon the agreement in the week after Java announced on December 31 that its figures would not be ready until the end of January. ICEA had demanded the figures by January 10. The deadline was determined by legal and planning constraints on Cuban crop restriction. The law required that the President set the crop size each year the preceding November. That date had already passed, but sugar mill owners were pressuring for an announcement so that plans could be made before the official commencement of grinding on January 15.<sup>24</sup>

The original threat was not received as credible. After repeating the threat several times, on January 6, just before their return to Havana, the Cuban delegates received specific instructions from ICEA to restate it. The delegates "begged and insisted" not to be required to repeat it because it could "interrupt," rather than benefit, progress, as the Javanese delegation used Cuba's "unnecessary" threats to justify intransigence. After the Cuban delegates' departure, the record contains repeated cables sent between various European members of the ISC and ICEA in which the European members were trying to do damage control. Giving no explicit acknowledgement of the threat, even as the President of ICEA continued to restate it by cable, they expressed anger at the exaggerated rhetoric and argued that it did nothing to improve matters. Well into February the record shows that Cuba's threat was not being taken seriously.

To turn the tables, ICEA took two important steps that set a process in motion by which it would surrender control of the decision whether to abandon the agreement to popular politics. The two steps constituted a strategy of brinkmanship. The first involved the intentional release of cables between ICEA and the ISC that revealed the tenor of the dispute. Many of these cables were published in the Cuban press. One such cable, a January 27<sup>th</sup> cablegram from the President of the ISC to ICEA, stated the ISC's view that Java was not obligated to release its figures under the agreement. Viriato Gutierrez, President of ICEA, replied in a cable to the Chairman of the ISC, Francis Powell, that "[Cuba] is seething with conviction that giving of Java's figures is purposefully being delayed beyond a date when Cuba can still control her crop, a conviction which we think justified . . . ." It irritated the Javanese and the others, but Chadbourne claimed "the moment had arrived to satisfy the public opinion in Cuba, which feels very alarmed, and that the United States be made aware of the state of the negotiations."<sup>25</sup> The political opposition to the tighter crop restriction grew significantly afterward.

The second important step was the decision of Machado, upon ICEA's recommendation, to decree the commencement of the *zafra* (grinding season) on January 15 but to delay restriction of the crop until Java provided its restriction figures.<sup>26</sup> How did this decree set in the process motion that would gradually lead Cuba to abandon crop restriction, if Java delayed too long? The law authorized, but did not require the President to restrict the crop. Machado, ICEA and the largest, most powerful sugar producers remained in favor of crop restriction. But from experience with earlier dissention over crop restrictions, and with current political unrest, Machado was unwilling to go out on a limb. Once grinding commenced, the longer it proceeded without fixing a limit to the crop, the more likely internal interest-group politics would compel him to abandon crop restriction. If the matter were settled quickly, ICEA still had the backing of the President to fix the size of the crop. If, in the other extreme, the Javanese delayed indefinitely, the crop would *de facto* be unrestricted. But more significant, each day that Java delayed, the political pressure to abandon crop restriction would build.

The mechanism to increase  $q$  was quite obvious to sugar producers in Cuba. The enabling legislation authorized the President of the Republic to set internal production quotas for all mills and cane growers. Control was instrumented by assigning each bag of

sugar a “certificate of identity” that designated where it could be sold: the home market, the U.S. market, or the Chadbourne-governed world market. Individual mills were assigned quotas pro rata by cane availability, determined by ownership or long-term contract, which was not perfectly correlated with daily milling capacity. Because of labor and fuel costs, each mill ground its crop as fast as possible.<sup>27</sup> The longer the grinding season progressed without announcing individual mills’ quotas, the more mills with small cane-to-capacity ratios would reach levels of production that surpassed their quotas. The more time passed, the more the burden of the restriction would have to be reallocated to mills with more cane. Under the regulations, companies that owned more than one mill could legally transfer cane internally from one mill to another, but transfers between companies were not permitted. Some larger, multi-mill companies therefore had a speed advantage (cf. Chandler, 1977). Virtually all single-mill companies were Cuban-owned, and most large multi-mill companies were American-owned (Santamaría, 2002). The unequal distribution of quotas would permeate local markets for cane and labor, so that the populations in areas with more cane and small, independent mills would be the most damaged. As more mills approached their prospective quotas, growing disproportionality of the burden of restriction to the benefit of foreign-owned mills would intensify the political opposition to a point Machado could not afford to ignore. Rising unrest, fueled by severe economic distress already threatened his longevity.

Not comprehending the political situation in Cuba, Java attempted several times to get ICEA to preannounce its crop restriction figure, but then Java finally acceded, on February 6, to submit a proposal of no reduction in 1932 and a 1.75 to 1.5 million ton reduction in 1933.<sup>28</sup> Enforcement was not guaranteed; the VJSP was unable to obtain enforcement legislation, so the reduction would be strictly voluntary on the part of individual producers in Java. The proposed figure incorporated production forecasts of the non-cooperating producers. ICEA declared Java’s proposal unsatisfactory, and announced a crop restriction of 3.061 tons – a high figure, but not as high as some of the suggestions circulating in Cuba at the time.<sup>29</sup>

In February and March, threats and accusations were hurled through the cable wires in both directions. On February 18, Java offered a lower figure, 1.35 million tons, for the 1933 crop, but Cuba refused it. The President of the ICEA, Gutierrez, cabled a

reply expressing remorse over Cuba's five-year effort to stabilize the markets, restating that they felt obligated to pull out of the agreement unless Java also reduces its 1932 plantings to a point that would insure no further accumulation of stocks. The Cubans added an additional condition – that the parties agree to re-open the agreement and discuss revising the export quotas downward to make them more consistent with the worsened market conditions. ICEA proposed that Java reduce its 1932 export quota to 1.5 million tons, and restrict its 1933 production to 1.35 million.<sup>30</sup>

Up to that point, Java and the other members of the ISC did not have a good estimate of how vulnerable Cuba's compliance was – the probability  $q$ . In an ISC meeting in March, ICEA made extra effort to bring them up to date. First, they tried to educate them on the political circumstances in Cuba. The majority of *hacendados* had come to view the agreement as ineffective, and ICEA had to “make private arrangements among producers” to maintain official support for the agreement. On March 18, the Asociación de Hacendados was scheduled to vote on whether to support the agreement or not, and the vote would be close. Second, for the first time Cuba failed to send a delegation to an ISC meeting. Cuba was represented only by a non-ICEA diplomat who acted as a spokesperson but had no decision-making powers. Sending members of ICEA to Europe at that time, they argued, would only reduce their ability to fend off political attacks at home. On March 17, ICEA announced rhetorically that it was “pulling out of the agreement.” On March 19, Gutierrez reminded the Council that grinding was proceeding 40,000 tons a day, a reference to the ticking time bomb of the unrestricted *zafra*. The standoff broke on March 20, the VJSP committed to the principle of further export restriction for 1932, the European ISC members and Peru offered to guarantee Java's 1932 export reduction to 1.5 million tons. If Java failed to meet that amount, the other members committed to reduce their quotas in 1932 and 1933 to make up the difference. ICEA offered a conditional acceptance, given that the terms on the table were fulfilled and that an ISC meeting would be held as soon as possible to “revisit [revise] the quota question to adjust [the agreement]” to the new market conditions.<sup>31</sup>

That meeting was scheduled for June 1932 in Ostend, Belgium. The Cuban delegation was sent with specific instructions that, given the turn of political conditions and unanticipated fall in the US market since May 1931, Cuba must receive an increase

in its quota to 1 million tons in order to stay in the agreement.<sup>32</sup> It was also given instructions to accept no compromise below 1 million. After protracted negotiations, the Cuban delegates reported a compromise offer from Java, which they recommended and endorsed as the best possible, but did not meet preconditions given them by ICEA. The ICEA offices reply that Gutiérrez, the President of the Institute, was on vacation in Cienfuegos and could not be located. Without the President present, ICEA was not authorized to alter the delegation's instructions. Why would the President of ICEA have gone on vacation at precisely the time when the ISC meeting to revise the quotas was scheduled? ICEA recalled its delegation, and an angered Javanese delegation withdrew its offer, but by October, Cuba received a revised quota of 1 million tons for 1933 and 957,000 tons for the remaining three years of the agreement.

As the theory predicts, the actions of the Cuban delegation produced a deliberate loss of control that initially was slight, yet it set in motion a process by which the loss of control escalated gradually and reached a climax. In this case, the process set in motion was tangible and had a well-defined limit. Brinkmanship was a qualified success in Cuba, depending on one's point of view. The ploy caused Europe and Peru to bear some of the responsibility for Java's political uncertainty, and it gave Cuba a larger export quota. The agreement then ran its course. It was successful at eliminating a large quantity of surplus stocks without throwing the market into turmoil, but its ability to support the price of sugar was weakened.

### *The Incentives for Cooperation*

It would have been irrational for the Chadbourne representatives to pursue the collusive agreement if they did not expect to benefit from it. According to their own statements of intention, the organizers believed that uncontrolled production of sugar would result in continued accumulation of surpluses. Even if they remained unsold, the overhang would depress prices because refiner and middlemen buyers would minimize inventories, and even slight improvements in the price would drive holders of sugar to sell.<sup>33</sup> With world net exports at 9 million tons, the 5.5 million tons of unsold stocks at the end of 1931 was a large overhang. (See Figure 2.)

Was it large enough to cause the Chadbourne countries to prefer the even more restrictive renegotiated agreement to a reversion to competition? That depended on the price elasticity of demand for sugar. Estimates of the short-run price elasticity using econometric techniques and data from the 1960s and 1970s place at 0.16 or lower—probably too low for 1932 (Schmitz and Christian, 1993, p. 74). If we observe and accept the statements of contemporaries, there was much disagreement and controversy among producers over its expected magnitude. Naturally, it would be difficult for contemporary experts to predict price movements when the price was well below historical levels and the countries constituting the bulk of the market were radically revising policies of trade protection and currency controls. Nonetheless, rational actors had to form expectations from whatever information they had. Optimal strategies depended on the beliefs players formed about the expected behavior of the market and the other participants in the agreement.

We have some information about the estimates ICEA officials were using. Manuel Rionda, eminent New York sugar broker and consultant to ICEA during these negotiations, circulated an analysis of price forecasts in late December 1931 giving two scenarios: he compared (i) the proposed more restrictive renegotiated agreement in which Cuba produced 2.1 million tons and Java produced 1.7 million to (ii) an unrenegotiated agreement in which Cuba restricted its crop to 2.5 million tons (less than the originally planned 3.4 million) and acquiesced to Java's unwillingness to adjust its crop to accumulated stocks. Both scenarios assumed the export quotas would be honored so that the additional production would be added to stocks. His analysis implies, conservatively, a price elasticity of demand of 0.36—not the usual definition, however, because it is derived from forecasted price responses to increases in *unsold* stocks. Our counterfactual contemplates releases of stocks; therefore, Rionda's forecasts imply an upper bound to the price elasticity for increased production cum stock releases, and  $-1/0.36 = -2.78$  understates the expected absolute price response to released stocks.<sup>34</sup>

What would have happened to the price in a counterfactual reversion to competition? If the 6.4 million tons of unsold stocks in 1932 reported by Willett and Gray were suddenly released, a constant elasticity of 0.36 gives a negative sugar price of  $-0.97$  cents—unrealistic for two reasons. First, under competition, the crops would have

become unrestricted. Second, not all the unsold stocks would be released under competitive conditions. Stock holding implied future price optimism, which reversion to competition would have challenged such that one would expect substantial quantities to be released. No information on how much would have been released is available. To be conservative, we assume a release of 10 percent of stocks equally spread among holders of stocks. Using the elasticity estimate described in the preceding paragraph, this would have produced a 20 percent fall in the price of sugar and a 4 percent decline in world sugar export revenues. Its effect on profits was greater. A simple calculation of producers' profits using Cuban cost information, described in the Appendix, estimates that increased losses would have ranged between 40 and 60 percent, and as one increases the percentage of stocks assumed to be released, losses climb quickly.

The executives of Cuba's ICEA and Java's VJSP both expressed support for the agreement not only in communications with each other but also in confidential communications within their respective organizations. Both organizations revealed a preference for the revised agreement by incurring additional negotiation costs, resisting domestic political opposition, and enduring each other's insults to preserve it.

Differences of opinion that produced the political opposition may have come from different estimates of the price elasticity, but they also came from differences in mistrust about Java's future cooperative behavior and heterogeneous distributional consequences of competition. Surprisingly, after giving the above market outlook, having supported pursuit of the agreement since 1927, Rionda came out in favor of abandoning the Chadbourne Agreement by March of 1932. From his analysis (above), one might expect him to prefer the agreement, but Rionda reversed his support because he began to expect continued shenanigans from Java and doubted that ICEA was up to the challenge of the shrewd Dutch negotiators in the international bargaining game.<sup>35</sup> The political opposition also divided along expected distributional gains. North American refiners that owned sugar mills in Cuba opposed the agreement because, without crop restriction, they would have priority in selling their crops to the affiliated refiners. North American banks, which owned virtually all the liens on the current stocks, but not on the anticipated additional production, favored the agreement because it maximized the value of their liens.<sup>36</sup> Cuban national mill owners (*hacendados*) were mixed. Initially, a majority had favored the

agreement, anticipating that their access to short-term credit from banks was linked to it. But if it malfunctioned, credit prospects would vanish. So *hacendado* opposition came to depend on varying expectations of the agreement's malfunctioning and subjective models of who could survive the shake out (cf. North, 1990). Under normal credit conditions, the North-American-owned mills were thought to have advantages; but Rionda argued that, in the current market conditions, the smaller, less efficient mills, few of which were owned by foreigners, would be at an advantage because of lower overhead costs.<sup>37</sup> Their analyses explicitly state, though, that production efficiency was not what would determine survival; instead, it was the ability to avoid or to survive through bankruptcy.

Preferences for the agreement depended on its viability. An important question is whether the Chadbourne signatories represented enough export volume to withstand erosion of its market share by outsiders. Table 3 gives information about pre-agreement market shares, using 1929 and 1931 as benchmarks. Relative to total world exports, the Chadbourne countries, excluding Cuba's exports to the United States, held around 50 percent of the market. That market share, however, does not account for world sugar market segmentation and the Chadbourne countries' cost advantages in unprotected markets. The largest sugar-consuming countries gave preferential treatment to high-cost domestic producers, colonies, or overseas possessions. Except for domestic sales and special agreements with neighboring countries, the Chadbourne countries exported sugar to what they called the "free" or "world" market, which was (as it is now) a residual market. Table 3 separates world exports in 1929 by the major trading blocs. Domestic producers in Europe or colonial territories had near prohibitive protection from non-preferential imports. The United States protected its domestic industry and insular possessions, and gave preferential treatment to Cuba sufficient to exclude all other foreign imports. Of the trading blocs listed, only the UK was a significant buyer in the residual market. The 1.2 million tons of imperial sugar sold to UK destinations accounted only for one-third of UK imports, the rest came from the Chadbourne countries and the Dominican Republic. The Chadbourne countries, thus, controlled about 90 percent of the residual market.

The Chadbourne countries did not expect an erosion of their share of the residual market for three reasons. First, the price objective was modest; they did not aim to raise

the price above historic, pre-control levels. The agreement called for automatic increases in quotas if the price rose to 2 cents U.S. per lb., and again, if the price reached 2.5 cents. And if the price was sustained above 2.5 cents, it called for consideration of further relaxation of restraints. Producers in the protected areas were uncompetitive at those prices. Second, the agreement was to terminate after five years, yet entrants would not build new capacity without consideration beyond the five-year horizon. At current prices, investment was unattractive. Third, the agreement provided for joint retaliation by the Chadbourne group against non-signatory countries that tried to free-ride on the agreement.<sup>38</sup>

Of greater concern, industry experts expressed concern that failure to halt a further decline in the sugar price would have the adverse effect of provoking endogenous protection in importing countries. Two examples illustrate. In Java's principal market, the Indian Tariff Board submitted sugar duty recommendations as a function of the price of sugar purchased from Java. From 1931 to 1937, tariffs on sugar imports into India reduced imports from Java from 1 million to 100,000 tons.<sup>39</sup> The U.S. Tariff Commission was established with a similar mandate. In 1932, U.S. refiners approached President Hoover with a demand for an increase in the tariff on refined sugar. And in 1933, U.S. domestic sugar producers approached President Roosevelt demanding a new increase in the raw sugar tariff, claiming that new market conditions made the recent sugar tariff increase in 1930 (under the Smoot-Hawley Tariff) inadequate.

Therefore, we find strong evidence that the expected relative payoffs of the strategies outlined were as depicted in Figure 3 and the accompanying discussion. As observed, for Cuba, a renegotiated agreement,  $\pi_c^R$ , was better than an unrenegotiated agreement that held Cuba to the May 9<sup>th</sup> agreement and acquiesced to Java's additional accumulation of surplus stocks,  $\pi_c^A$ . But it was worse for Java; that is,  $\pi_j^A > \pi_j^R$ . Brinkmanship took advantage of differences of opinion about payoff expectations. The decision to participate in the international agreement, underpinned by national legislation, was a collective decision. ICEA's play of brinkmanship assumes that ICEA preferred  $\pi_c^A$  to  $\pi_c^E$ , but it required that an opposition group in Cuba consider  $\pi_c^A$  worse than  $\pi_c^E$ . It also required that the VJSP consider abandonment of the agreement,  $\pi_j^E(\tilde{a})$ , as worse

than renegotiation,  $\pi_j^R$ , but permits the existence of another group that disagreed. This array of preferences is unquestionably present in the historical record; the intensity of these differences matters, but is unobservable.

### *Conclusion*

To solve its dispute with Java, the Cuban representation in the Chadbourne negotiations adopted the risky strategy of brinkmanship. The root cause was incompleteness of the contractual agreement. When unanticipated accumulation of surplus stocks called for an adjustment of production, ambiguity in the contractual provisions led to a disagreement among signatories about whether Java's actions constituted a violation. The controversy was not over detection but over interpretation; the facts were not in dispute. Dissatisfied with the joint decision, Cuba's ICEA tried to enforce its interpretation by unilaterally threatening a reversion to competition. Initially, neither Java nor the other Chadbourne countries considered the threat credible. ICEA made it credible by setting a process in motion that exposed the decision to implement to the growing domestic political division in Cuba over optimal sugar control policy.

The brinkmanship episode highlights features of the cartel enforcement for which theory has illuminated at best in limited form. The detection/retaliation sequence outlined by Stigler (1971) and forming the basis of cartel enforcement mechanisms since Green and Porter (1984) fails to account for the contractual incompleteness of cartel agreements. Empirically, our finding parallels that of Genesove and Mullin's (2001) study of the U.S. sugar refiners' cartel, showing that contractual incompleteness and information asymmetry affected the form of the agreement and enforcement mechanisms.

Theories in the spirit of the Green-Porter model depict retaliation as an equilibrium-path phenomenon, in which a trigger mechanism in the agreement can unambiguously set off joint retaliation. Genesove and Mullin (2001) find that contractual incompleteness made in-contract renegotiations desirable, and communication of private information becomes important for enforcement and adaptation of cartel rules. Agreements established notification procedures used to alert and justify actions that might be misconstrued as violations. We similarly observe similar procedures to deliberate facts, determine whether a violation was committed, and decide what actions

should be taken, but they worked imperfectly, not always working to resolve differences. Communication also encounters imperfections. ICEA's initial attempts to communicate political threats to its continued participation suffered from lack of credibility, and actions ICEA took to establish credibility increased the risk of a breakdown in the agreement.

Using the trigger-mechanism metaphor, Cuba's unilateral threat of retaliation constituted a breakdown in the agreement because differences of viewpoint persisted over whether the trigger had been tripped. The dissonance between crispness of the trigger mechanism in theory and observation is paralleled in other empirical studies. Levenstein (1997) and Genesove and Mullin (2001) find strong retaliation only in response to massive cheating. Occasional cheating is often not punished, and violations are usually met in degree and in kind.<sup>40</sup> Cartel breakdowns may disagreements because contracts are incomplete. The international sugar cartel had good information about what actions had been taken, but they disagreed about what actions constituted violations. Heterogeneity appears to be crucial element in players' incentive to announce and act upon perceived disagreement. Regardless of Cuba's perception of bearing a greater share of the burden, ICEA's incentive to play brinkmanship depended on Cuba's relatively large position in physical stocks, high supply elasticity, and cost efficiency. The reluctance of the other players to retaliate jointly might also be explained by differences in their optimal responses to Java's deviation caused by differences in costs, exposure to unprotected markets or other structural heterogeneities (e.g. see Rothshild 1997).

Finally, our findings underline Bates' (1997) study of the International Coffee Organization, which concludes that domestic politics affected national strategies in international agreements, such as commodity control schemes. Bates shows that institutional design sensitive to heterogeneous domestic politics can enhance cooperation.<sup>41</sup> We find that domestic politics, and its differences in Cuba and Java contributed to the difficulties of communication, but it also gave Cuba the edge it needed to force the cartel effectively to adopt its interpretation of the agreement.

**Appendix.**  
**Counterfactual Estimate of the Price Effect of Abandoning the Agreement**

Our estimation of export earnings under the counterfactual assumption that the agreement was abandoned is admittedly crude, so to strengthen its reliability, we deliberately bias all its components against our result. We estimate the sugar price response, predicated by a counterfactual release of stocks of sugar onto the market, by  $\Delta p = -(1/\eta)\Delta x$ , where  $\eta$  is the price elasticity of demand for sugar. We estimate an overstated  $\eta = 0.36$ , as described on p. 20, from contingent price forecasts made by one of the leading sugar forecasting teams of the day, Manuel Rionda and Bernardo Braga Rionda, of Czarnikow-Rionda, who produced contingent price forecasts by varying the assumptions about the yet unknown 1932 Cuban crop size. There is no need to suspect misrepresentation, since these forecasts were found in private communications for internal use. As explained in the text, this estimate understates the price response to an actual release of sugar stocks.

With abandonment of the agreement, quantity of new exports released onto the market from stocks would not necessarily equal the actual stocks of 6.4 million metric tons reported by Willett and Gray's, *Weekly Statistical Sugar Trade Journal*. Offsetting forces would have affected that quantity. (i) Abandonment of crop restriction would have increased sugar production as countries lifted crop restrictions. Cuba had the highest supply elasticity. Contemporaries estimated that Cuba could increase its crop by another 1 million tons. (ii) Accumulation of stocks before the agreement suggests that not all unsold stocks would be released even under competitive conditions. However, if stocks were held because of future price optimism, a price war would undermine price optimism and holders would increase their preferred release of stocks. Information about how producers and owners of sugar would have responded is unavailable. To get a sense of the effect of releases on market magnitudes, we assume, conservatively, that 10 percent of the 6.4 million tons of existing stocks would have been released under competition. This figure ignores possible increases in production, which if accounted for would strengthen our finding. These magnitudes imply a fall in world sugar price by about 20 percent, which implies a fall in world export revenues of about 4 percent, and in Cuba by 10 percent. How did this affect sugar producer profits? To obtain a simple baseline, we calculate ex ante and ex post profits as  $\pi_t = (p_t - c_t)x_t$ , where  $p_t$  is the raw price of sugar (current US cts./lb.) and  $c_t$  is the unit cost of raw sugar production at time  $t$ , and  $x_t$  are exports of sugar (metric tons). The unit cost of production  $c_t$  would have fallen because wages were correlated with sugar prices. Wages were most sensitive in Cuba, where the sugar industry employed a larger share of the labor force. Mill records show that wages constituted about 1/3 of unit costs. Contemporaries in Cuba cited the unit cost in 1929 at about 2 cents per lb. Using actual price movements, deflated by the U.S. BLS Wholesale Price Index, Rionda's forecasted production increase, and allowing from 1/3 to 2/3 of unit costs to vary in equal proportion with the sugar price, implies increased losses ranging between 40 and 60 percent. Higher releases of stocks causes losses to rise quickly.

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**Table 1****The Chadbourne Agreement Quotas and Surplus Stocks**

Original Agreement, Brussels, May 9, 1931.

(000s tons)

Signatory	Segregated Surplus Stocks	Export quotas				
		1931	1932	1933	1934	1935
Cuba	1321	665	818	869	869	869
Java	500	2300	2400	2500	2600	2700
Germany	84	500	350	300	300	300
Poland	80	309	309	309	309	309
Hungary	16	84	84	84	84	84
Belgium	29	30	30	30	30	30
Czechoslovakia	9	571	571	571	571	571
Yugoslavia	--	15	15	15	15	15
Peru	--	360	374	374	374	374
<b>TOTAL</b>	1758	4824	4938	5038	5138	5238

Notes: The units used to measure quotas in the agreement are those preferred by each signatory country. All quotas listed above are in metric tons (2205 lbs.) except Cuba's quota, which is in long tons of 2240 lbs. Quotas for Peru and Yugoslavia were negotiated after the original agreement was signed.

Source: Swerling, Boris C. *International Control of Sugar, 1918-41*. Stanford University Press, 1949, pp. 44-7.



**Table 2**  
**Comparison of Quotas**

Country	Comparison pre-1930 sugar exports and post-1930 sugar export quotas			Importance of Sugar Industry in National Economy		
	(i) Average Pre-agreement sugar exports 1925-29 000s metric tons	(ii) Average Sugar export quotas 1931-35	(iii) Ratio avg. quota 1931-35 to average exports 1925-29	(iv) Domestic sugar sales 1931 relative to sugar exports 1925-29	(v) Ratio of sugar exports to total exports 1925-29 Percent	(vi) Ratio of sugar exports to national income 1925-29
<b>US Sugar Program</b>						
Cuba (US)	3492	1731 <sup>a</sup>	0.50			38.7 <sup>b</sup>
<b>Chadbourne Agreement</b>				3.6 <sup>b</sup>	78.8 <sup>b</sup>	
Cuba (non-US)	1013	818	0.81			
Java	2177	2500	1.15	18.2	20.8	--
Germany	198	350	1.76	835.0	0.5	0.1
Poland	268	309	1.15	138.8	5.0	--
Hungary	88	84	0.95	128.9	3.4	0.5
Belgium	78 <sup>c</sup>	30	0.39	293.2	1.0	0.1 <sup>d</sup>
Czechoslovakia	774	571	0.74	50.6	9.6	2.9
Yugoslavia	0	15	--	--	--	--
Peru	327	371	1.13	18.4	1.8 <sup>e</sup>	--
Total Chadbourne	8010	5035	0.63	--	--	--

*Data sources:*

Chadbourne export quotas are taken from Swerling, Boris C. *International Control of Sugar, 1918-41*. Stanford University Press, 1949, pp. 44-7. Exports of sugar for 1925-1930 are from BB RG2S10cB98 "Sugar 1932 Chadbourne Committee corresp with Aurelio Portuondo"; except exports from Cuba to the United States are USDA data in U.S. House of Representatives, Committee on Agriculture, "History and Operations of the U.S. Sugar Program," Washington, DC, GPO, 1962. Exports and domestic consumption of sugar for 1931-1937 International Sugar Conference, Statistical Tables. Confidential. London, April 5, 1937; International Sugar Council. Statistical Bulletin. Vol. 1, no. 3, Nov. 1937, taken from USNA R.G. 59 Central files, 561.35 E1/510; supplemented by UN, FAO, *The World Sugar Economy in Figures 1880-1959*. Commodity Reference Series No. 1. 1961, Table 6, pp. 39-51. Sugar export earnings for European and Peruvian sources

were calculated using raw-value equivalent tons from the ISC and the annual price of sugar in London from League of Nations, Economic Organization, *The World Sugar Situation*, Report by the Economic Committee of the League of Nations. Official No: C.303.M.104.1929.II.[B]. II. Economic and Financial 1929.II.30. Indonesian total exports and sugar export earnings from *Changing Economy in Indonesia*, Volume 12A (General Trade Statistics), Royal Tropical Institute, Amsterdam, 1991. Cuban total exports are from Oscar Zanetti, *Cautivos de la reciprocidad*, Havana, Ediciones ENPES, 1989. Cuban sugar export earnings were from Cuba Económica y Financiera, *Anuario azucarero 1959*. Total exports and national income estimates of European countries are from B.R. Mitchell, *International Historical Statistics, Europe 1750-1993*, Fourth Edition, B.R. Mitchell, Stockton Press, 1998; for Peru, B.R. Mitchell, *International Historical Statistics, The Americas 1750-1993*, 4<sup>th</sup>, 1998. Cuban national income estimates are from Alienes Urosa, *Características Fundamentales de la economía cubana*, 1950.

<sup>a</sup> Actual exports.

<sup>b</sup> The figures for Cuba in this panel combine average exports of sugar 1925-29 to US plus non-US destinations, and domestic consumption for Cuba is for 1932 (1931 unavailable).

<sup>c</sup> The figure for Belgium substitutes net exports from FAO (1961) for figures given by the ISC to account for Belgium's large sugar refining capacity. Except for this, the ISC data are more reliable than FAO data. The results are not sensitive to the choice of data.

<sup>d</sup> Belgian national income estimate available only for 1927.

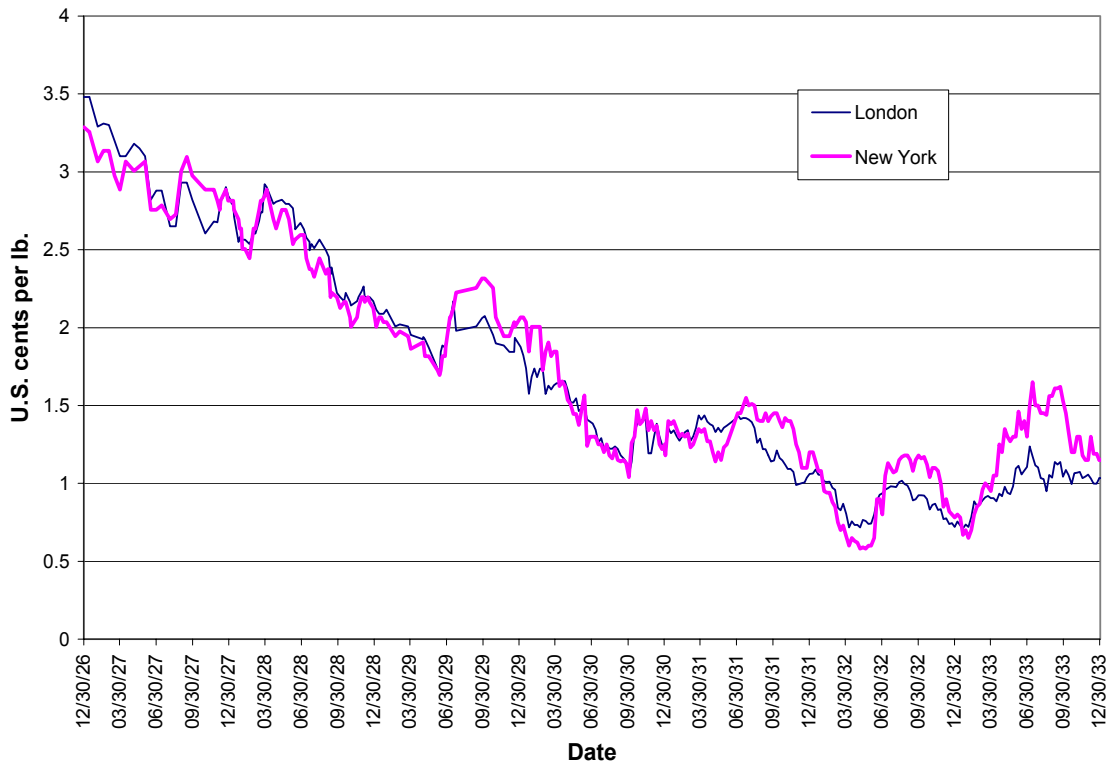
<sup>e</sup> Peruvian average exports are for 1926-29.

**Table 3**  
**World Sugar Market and Preferential Blocs, 1929 and 1931**

Country	World market		Share of world market		Share of residual free market	
	1929	1931	1929	1931	1929	1931
Chadbourne countries	6.03	4.85	49.3	53.2	92.7	88.3
Remainder of residual free market	0.47	0.64	3.9	7.0	7.3	11.7
Total residual free market	6.50	5.50	53.2	60.2	100.0	100.0
US preferential bloc	4.21	2.25	34.5	24.7	--	--
British Imperial bloc	1.20	1.07	9.8	11.7	--	--
French territorial bloc	0.31	0.31	2.5	3.3	--	--
Total world market	12.22	9.12	100.0	100.0	--	--

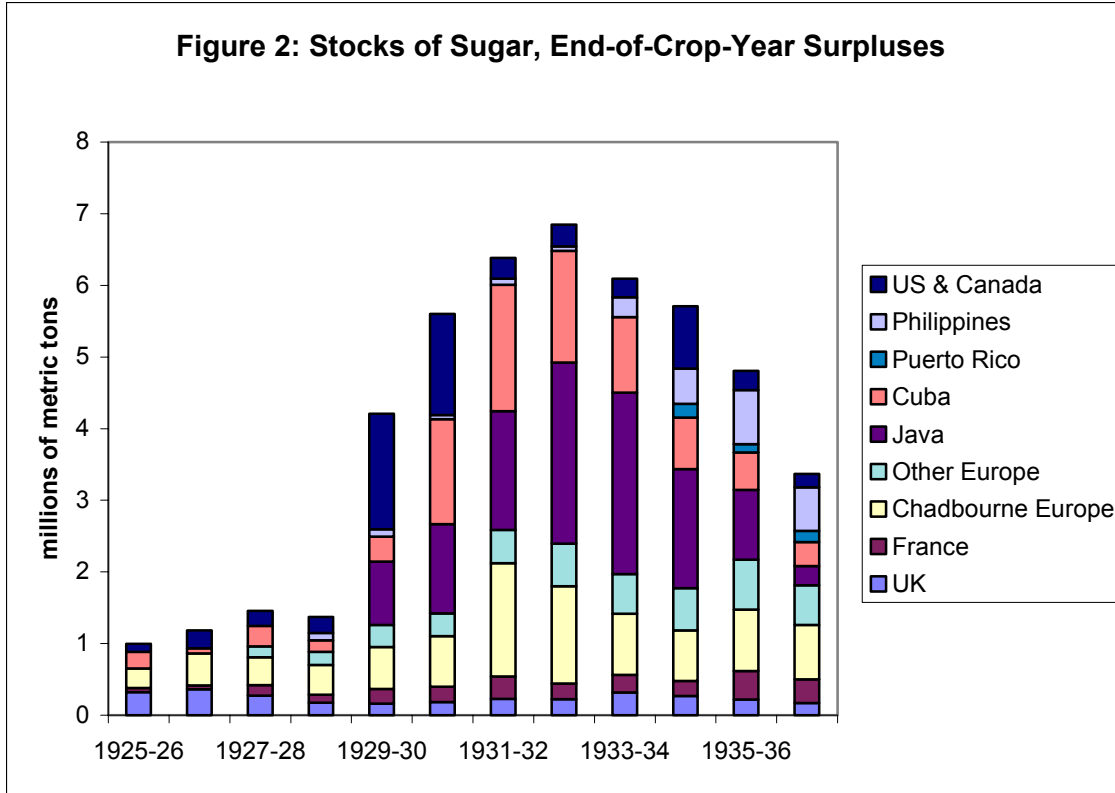
Sources: BB RG II Ser. 10c box 98 f. "Sugar 1932 Chadbourne Committee corresp w/ A. Portuondo"; International Sugar Conference, *Statistical Tables*, Confidential Bulletin of the International Sugar Conference, London, April 5, 1937; International Sugar Council. *Statistical Bulletin of the ISC*, vol. 1, no. 3, Nov. 1937; Swerling, Boris C. *International Control of Sugar*, pp. 44-7; supplemented by data from UN, FAO, by UN, FAO, *The World Sugar Economy in Figures 1880-1959*. Commodity Reference Series No. 1. 1961, Table 6, pp. 39-51.

**Figure 1: Sugar Prices in New York and London, 1927-1933**



*Data sources:* London prices are from: December 30 1926-September 29 1927: USNA, R.G.59, 837.61351/463, Attached memorandum to a letter from Secretary of Commerce Herbert Hoover to Secretary of State, unauthored; October 31 1927-December 17 1929: *Commercial and Financial Chronicle*; December 19 1929-October 30 1936: *The Times* (London). New York prices are from *Willett and Gray's Weekly Statistical Sugar Trade Journal*.

*Note:* London prices through September 29 1927 were given in U.S. cents per pound; from October 31 1927-December 17 1927, London prices were converted to U.S. cents per pound at par; from December 19 1929-October 30 1936 London prices were converted to U.S. cents per pound at the closing exchange rate for that day as reported in *The Times* (London).



Data source: Willett and Gray, *Weekly Statistical Sugar Trade Journal*, 1925-1938.

Notes: The figures given are for the end-of-crop-year date for each county, which varied geographically. Crop years were: Cuba, Jan.-Dec.; Java, May-Apr.; Europe, Sept.-Aug.; except Czechoslovakia, Oct-Sept. Taking observations at the variable end-of-crop-year is superior to observation on a common calendar date. It minimizes observed physical stocks, because production occurred over 5 to 6 months of the year, but producers or distributors held stocks over the crop year to smooth sales and reduce sales price seasonality. The Chadbourne countries based the agreement on end-of-crop-year observations or forecasts. The figures discussed in the agreement differ from the above because the Chadbourne countries netted out a fixed amount of “normal stocks” determined by past marketing practices.

<sup>1</sup> Levenstein (1997) and Genesove and Mullin (2001) find that the formal theory overpredicts the severity of the threat of retaliation and underpredicts the incidence of cheating as a consequence. The theory predicts that all violations will be met with retaliation and, as a consequence, no cheating occurs in equilibrium. These empirical studies of cartels show that imperfect enforcement of the agreement can nonetheless be effective if profligate or continued violations are met with retaliation.

<sup>2</sup> The archives and collections consulted are: Archivo Nacional de Cuba, Havana, Fondos ICEA, and Sec. de la Presidencia (henceforth: ANC, ICEA, and ANC, Sec. Pres.); the Braga Brothers Collection, Record Group II, papers of Manuel Rionda, Pres. of Czarnikow-Rionda sugar brokerage, held in the University Archives, University of Florida at Gainesville (henceforth: BB R.G. II); and United States National Archives, Record Group 59, manuscript collection of the Department of State (henceforth: USNA, R.G. 59).

<sup>3</sup> Letter from Rionda to Tarafa, Oct. 3, 1927, BB R.G.II Letterbooks, Volume 64.

<sup>4</sup> See Eichengreen (1995) and Kindleberger (1973) for the general uncertainty of prices and trade volume.

<sup>5</sup> The original agreement included only seven. Yugoslavia and Peru joined a few months later.

<sup>6</sup> Copies of the legislation enacted in the respective countries are in Gustav Mikusch (1932).

<sup>7</sup> For a reprint of the Chadbourne Agreement, see Gutiérrez (1935). Documents for this episode are: Letter from Chadbourne to the "Java Group," December 14, 1931; Letter from Chadbourne to the delegates of the International Sugar Council, December 15, 1931; Letter from Chadbourne to Hartman, head of the Javanese delegation, Dec. 21, 1931; Letter from the Cuban delegation to ICEA, December 23, 1931, ANC ICEA Ljo 1857, no. 1. Cables of the Cuban delegation to ICEA, Dec. 14, 15, 16, 17, 18, and 31, 1931; ANC ICEA Ljo. 1746, no. 6.

<sup>8</sup> The law governing crop restriction required that the President give advanced notification of the crop size and distribution of internal quotas. Memorandum from ICEA to the Cuban delegation in Paris, n.d. (probably Dec. 21 or 22, 1931); and letter from the Cuban delegation to ICEA, Dec. 23, 1931; ANC ICEA Ljo 1857, no. 1. Cables of the Cuban delegation to ICEA, Dec. 18, 1931; ANC ICEA Ljo. 1746, no. 6.

<sup>9</sup> Letter from López Oña (ICEA) to V. Gutiérrez (ICEA), Jan. 3, 1932, ANC ICEA Ljo. 1746, no. 6.

<sup>10</sup> Cables from ICEA to the Cuban delegation, Jan. 6, 1932; from the ISC to ICEA, Jan. 16, 1932; from Powell (Chairman of the ISC) to Gutiérrez (President of ICEA), Jan. 23, 1932; from Gutiérrez to Powell, Jan. 27, 1932; Cable from Beauvuin (President of the ISC) to Gutiérrez, Jan. 29, 1932; ANC ICEA Ljo. 1746, no. 6.

<sup>11</sup> This assumes Cuba incurred no costs from threatening and backing down.

<sup>12</sup> *International Sugar Journal*, Nov. 1932, p. 415.

<sup>13</sup> Report on Java Sugar industry by Amsterdamsche Bank, Mar. 13, 1929, BB R.G.IISer.10c Box 60 f. Java Sugar; Maxwell (1927); Transcript of speech by Hartman of the Javanese delegation to the ISC on Dec. 17, 1931; and letter from Chadbourne to Hartman on Dec. 21, 1931. ANC ICEA Ljo. 1857, no. 1.

<sup>14</sup> There were forewarnings that quotas might exceed what the demand at desired prices; however, the time costs of postponing an agreement were high. How they would address each contingency was sometimes left deliberately vague or incomplete.

<sup>15</sup> Cuba. Secretaría de Agricultura. *Anuario azucarero* (1930-33); Dutch East Indies. Centraal Kantoor voor die Statistiek. (1933); Gutiérrez (1935), appendix.

<sup>16</sup> Letter from Rionda to Chadbourne, Feb. 27, 1931, BB R.G.IISer.10c Box 98 f. Sugar 1930 1931 Chadbourne Committee.

<sup>17</sup> *International Sugar Journal*, Nov. 1932, p. 415; *Diario de la Marina*, Feb. 9, 1932, p. 4.

<sup>18</sup> ANC Secretaria de la Presidencia, Caja 94, No. 50, Tarafa Chadbourne Beauvuin; BB R.G.IISer.10c Box 109 f. Curtailment 1927; Pérez-Cisneros (1957).

<sup>19</sup> The Chadbourne countries agreed to reserve home markets for domestic production.

<sup>20</sup> Letter from Tarafa to Vester, Dec. 4, 1927. BB R.G.IISer.10c Box 117 f. Tarafa, J.M. corresp. 1921-27; "Draft Minutes of the First Meeting of the International Sugar Committee, Brussels, August 7, 1935," BB R.G.IISer.10c Box 100 f. ISC 1935; Pérez-Cisneros (1957).

<sup>21</sup> This understates the decline because labor demand during the off-peak "dead season" was significantly lower in the depressed sugar industry. Cuban Foreign Policy Association (1935). Cost of living estimates are from obtained from Zanetti and García (1998), pp. 441-42, which gives food cost estimates for the sugar mills owned by the United Fruit Company. Report of Lee R. Blohm, American Consul at Havana,

October 15, 1932, reprinted in U.S. Department of Labor, Bureau of Labor Statistics, *Monthly Labor Review*, vol. 35, no. 6 (Dec. 1932): 1403-11. Letter of Chadbourne to “the Java Group,” Dec. 14, 1931, ANC ICEA Ljo 1857, no. 1.

<sup>22</sup> Comment of Chargé d’Affaires at American Embassy in Havana, Reed, Sept. 23, 1930. *Foreign Relations of the United States, 1930* (1945), vol. 1, pp. 657-58.

<sup>23</sup> Letter from Chadbourne to Hartman, Dec. 21, 1931, ANC ICEA Ljo. 1857, no. 1; cable from López Oña to Casanova, Dec. 31, 1931, Ljo. 1746, no. 6.

<sup>24</sup> The documentation for this episode is found principally in the exchanges of cables between ICEA-Havana, its delegates in Europe, and ISC officials in January and February 1932. ANC ICEA Ljo. 1746, no. 6. Some interpretation is also found in letters and cables from Aurelio Portuondo, a member of ICEA, to his business associate Manuel Rionda in New York. In particular, see the cables from Portuondo to Rionda, Dec. 16, 1931, Feb. 4 1932. BB R.G.IISer.10c Box 97 f. Sugar Chadbourne Committee Pool Sugar Stabilization Law Etc.; and the letter from Portuondo to Rionda, Jan. 30, 1932. BB R.G.IISer.10c Box 98 f. Sugar 1932 - Chadbourne Committee Correspondence with A. Portuondo. Finally, *Diario de la Marina*, a major Havana newspaper, covered the developments extensively.

<sup>25</sup> The Jan. 27 cable from Gutiérrez to Powell, and the Jan. 29 cable from Beauduin to Gutiérrez, in which Beauduin describes the reaction of the European and Dutch delegates, are from ANC ICEA Ljo. 1746, no. 6. Chadbourne is quoted by Portuondo in his letter to Rionda, Jan. 30, 1932, BB R.G.IISer.10c Box 98 f. Sugar 1932 -Chadbourne Committee Correspondence with A. Portuondo.

<sup>26</sup> This tactic was proposed to ICEA as early as January 3 by the Cuban ISC delegation while it was still in Europe. Cable from the Cuban delegation to the ICEA, Jan. 3, 1932, and cable from ICEA to the delegation on Jan. 6, 1932. ANC ICEA Ljo 1746 no. 6.

<sup>27</sup> The cane available to each mill under the crop restriction program was determined as all internal cane plus all cane grown by independent growers “attached” to the mill. About 85 percent of cane in Cuba at that time was produced by independent growers. They were assigned quotas and attached to mills based on their pre-restriction histories of supplying given mills by long-term contract. Dye (1998a, 1998b, 2000, 1994), CERP (1963).

<sup>28</sup> Cables from Beauduin to Gutiérrez, Jan. 30, 1932; Gutiérrez to Beauduin, Feb. 1, 1932; Beauduin to Gutiérrez, Feb. 6, 1932. ANC ICEA Ljo 1746 no. 6.

<sup>29</sup> Cable from Gutiérrez to Beauduin, Feb. 6, 1932. ANC ICEA Ljo 1746 no. 6.

<sup>30</sup> Cables from Beauduin and Powell to Gutiérrez, Feb. 18, 1932, Gutiérrez to Beauduin and Powell, Feb. 22, 1932, and Gutiérrez to Luis Marino Pérez, the Cuban delegate, Mar. 15, 1932. ANC ICEA Ljo 1746 no. 6.

<sup>31</sup> Cables from Gutiérrez to Marino Pérez, Mar. 16, 17, 19 and 21 1932; cable from Marino Pérez to Gutiérrez, Mar. 18, 1932; cable from the non-Cuban, non-Japanese members of the ISC to ICEA, Mar. 20, 1932. The European and Peruvian offer of guarantee was later limited to a maximum of 900,000 tons. ANC ICEA Ljo 1746 no. 6.

<sup>32</sup> Letters from Portuondo to Rionda, June 14, 1932, Oct. 29, 1932. BB R.G.IISer.10c Box 98 Sugar 1932. Also. from the same folder, Informe Oficial Sometido por la Delegación de Cuba al Instituto de Estabilización del Azúcar, de sus Trabajos en la V Conferencia Internacional del Azúcar, Celebrada en Ostende (Bélgica) del 7 al 16 de Julio de 1932. July 18, 1932. This official report contains a complete description of Ostende negotiations. The cables exchanged between ICEA and its delegates in Ostende are in ANC ICEA Ljo. 2169, no. 7 Ostende Conference 1932.

<sup>33</sup> Prior to the agreement, reports indicated that refiners were minimizing their inventories. The announcement of the agreement caused a temporary reversal of that position.

<sup>34</sup> Letter from Rionda to Portuondo, Jan. 13, 1932. BB R.G.IISer.10c Box 98 f. Sugar 1932: Chadbourne Committee, Corresp. with A. Portuondo.

<sup>35</sup> Cables from Rionda to Portuondo, Feb. 9, 1932, Mar. 25, 1932; BB R.G.IISer.10c Box 97 f. Sugar Chadbourne Committee Pool Sugar Stabilization Law Etc. Letter from Rionda to Portuondo, May 26 1932, BB R.G.IISer.10c Box 98 f. Sugar 1932 Chadbourne Committee Correspondence with A. Portuondo.

<sup>36</sup> *Diario de la Marina*, February 11, 1932, p. 2; Acta de la Asamblea de Hacendados, ANC ICEA Ljo. 2030 No12 Acta hacendados 1932; Guerra y Sánchez (1940).

<sup>37</sup> Letter from Rionda to Portuondo, May 26, 1932, BB R.G.IISer.10c Box 98 f. Sugar 1932 Chadbourne Committee Correspondence with A. Portuondo.

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<sup>38</sup> Initially, the Chadbourne countries saw two possible threats—the Dominican Republic and the Soviet Union. After 1931, the Soviet Union was not an important exporter. Minutes of the ISC, June 22-23, 1931; ANC ICEA Ljo. 2198, no. 5 ISC 1931.

<sup>39</sup> India. Tariff Board. (1931, 1933, 1938); Dutch East Indies. Centraal Kantoor voor de Statistiek (1938).

<sup>40</sup> Athey and Bagwell (2001), and Athey, Bagwell, and Sanchirico (1999) develop alternative models in which equilibrium-paths with no price wars are optimal, price wars represent off-path deviations, communication has a role in the determination of agreement rules, and deviations can fail to evoke retaliation.

<sup>41</sup> Bates, *Open-Economy Politics*, 1997, pp. 134, 155-58.