

**APPORTIONMENT AND SEQUENTIAL ALLOCATION:
Toward a Fair Division Method for the
Spratly Islands Dispute**

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Abstract:

In this paper, I examine the collective action problem surrounding the Spratly Islands dispute, particularly the distributional conflict dimension. Given the relative gains issue that underlies the lack of cooperation among the claimants, I present apportionment and sequential allocation as an approach to the fair division of sovereignty that accounts for the claims and interests of all parties and specifically adapt the Webster methods. Collectively referred to here as the “modified Webster method,” the resulting procedure involves two stages: a point allocation process that determines apportionment, and sequencing, which creates the order by which states select territory. The procedure is demonstrated through an example in which the goal of each state is to maximize its geographic security. The results confirm that the modified Webster method yields envy-free and efficient gains for players. I conclude that apportionment and sequential allocation are a constructive starting point for altering the noncooperative behavior among the claimants and reaching a fair political settlement on the Spratly Islands dispute.

I. Introduction

A potential security flashpoint in East Asian international relations is the dispute over the Spratly Islands in the South China Sea.¹ This archipelago, comprising

over 230 islands and reefs (Denoon and Brams 1997; Brams and Taylor 1999; Joyner 1999), possesses strategic value, politically and economically, for the claimants—primarily China, Taiwan, and

the Philippine Sea, for the purposes of consistency with the preponderance of literature, South China Sea will be used throughout this paper.

¹ Although this body of water is also referred to as

the four Association of Southeast Asian Nations (ASEAN) states Brunei-Darussalam, Malaysia, the Philippines, and Vietnam (Snyder 1996; Denoon and Brams 1997; Cui 2003).² Accordingly, the tension over the Spratly Island territories, manifested in mercurial diplomatic behavior, sporadic small-scale conflict, and a basic competition over resources, provides an impetus for reaching a political resolution in the near-term.

However, there is an absence of collective action toward addressing the fundamental issue of sovereignty. I posit relative gains as one explanation for the noncooperative behavior of the six claimant states and the consequent status quo, which is an inefficient and unstable outcome. The potential for mutually beneficial outcomes that could arise from cooperation is obstructed by the concern for relative gains. Overcoming such asymmetry while preserving the existing balance among the claimants is the task for any method aimed at settling the sovereignty issue of the Spratly Islands. I therefore contend that fair division could resolve the dispute over the territories. A procedure based on fairness guarantees to each party, conditional on the criteria, that the value of its share, at minimum, is equal to every other party's share.

In this paper I tackle the

² Note that Indonesia, Singapore, and Thailand presently do not have any claims on the Spratly Islands.

distributional problem of the Spratly Islands conflict. I address the following question: Is there an alternative process for the fair allocation of sovereignty that accounts for the claims and interests of all parties? I present apportionment and sequential allocation as an approach to the fair division of sovereignty and specifically adapt the Webster methods. Collectively referred to here as the "modified Webster method," the resulting procedure involves two stages: a point allocation process that determines apportionment, and sequencing, which creates the order by which states select territory. This method resolves the distributional problem by meeting "fair-division" criteria such that each state is satisfied with its share of sovereignty compared to the other parties' shares, while accounting for the states' divergent interests and competing claims. Through the modified Webster method I demonstrate the possibility of an outcome in which there are *envy-free* and *efficient* gains for all parties. Other division alternatives have been proposed, but there are limitations to their application. Through this research, I build on the methodology developed for the fair settlement of the dispute (Denoon and Brams 1997; Brams and Taylor 1999; Cui 2003). To simplify the analysis, I examine only China and three of the ASEAN members: Malaysia, the Philippines, and Vietnam.

This paper proceeds as follows. The next section provides a brief background to the dispute, discusses the effect of relative gains on efforts toward settlement, and

explains the limitations of existing regimes as long-term solutions. The third part reviews previously proposed schemes for dividing the Spratly Islands. The fourth section advances the adapted versions of the Webster methods of apportionment and sequencing for the fair allocation of sovereignty. The final part provides concluding remarks.

II. Background to the dispute

Since the 1970s, when the strategic utility of the maritime space was widely realized, East Asian countries—particularly the four main claimants China, Malaysia, the Philippines, and Vietnam—have increased the competition over possession of the Spratly Islands. The area is prized for its political and economic value. While it is argued that the long-term utility of the Spratly Islands is in the military advantage it presents—specifically, the sea lanes—the short-term value of the maritime space is in the potential energy resources it is purported to possess.³ However, in the last four decades there has been negligible progress toward settling the fundamental issue of

³ There are conflicting reports as to the amount of hydrocarbons within the maritime space of the Spratly Islands. Whether or not the islands have high economic value is a moot point, however, and is not discussed in this analysis. See Valencia (1995, pp. 8-11); Valencia (2009, pp. 1-3); Denoon and Brams (1997, pp. 308-13); Snyder (1996, pp. 4-5); Joyner (1999, pp. 66-9); Rosenberg (2002, pp. 243-7); Gyo Koo (2009, pp. 137-41).

sovereignty; the topic is continually deferred and, instead, discussions over joint development are pursued. Yet even these dialogues have produced little in the form of long-term cooperation. Indeed, as this analysis implies, and following the conclusions of other analyses, the issue of development is intricately linked to sovereignty; therefore, separating the two is highly problematic (Park 1978; Denoon and Brams 1997; Emmers 2005; Pan 2009). Accordingly, I discuss ownership (as related to joint-development) and sovereignty together, as both necessitate cooperation on a method of division. What explains the lack of collective action? The distributional problem underscores the divergence in state preferences over the allocation of benefits—particularly territorial gains, but ownership rights as well—resulting from any agreement concerning the division of the Spratly Islands.

Figure 1 presents a map of the Spratly Islands and an approximation of each state's claim. (For now, disregard the five zones within the map.) The entire archipelago is an overlapping claim, with several areas to which more than two countries assert rights. Across the four countries, the basis of each independent claim presents a variation in historical and legal substantiation, as well as in justification on the grounds of occupation and proximity.⁴ The purpose here, however, is not to debate the legitimacy of the claims;

⁴ An outline of the claims is provided by Rosenberg (2002, p. 233).

and as I argue later, existing measures intended to validate these claims and establish boundaries are rather ineffective at resolving issues of territorial ownership and are unstable long-term solutions. Instead, my intention is to discuss the impact of the claims on the possible approaches to division.

National declarations pronouncing ownership over maritime space gradually aggravate the problem of competing claims; the occupation of islands and reefs within contested areas exacerbates the issue.⁵ Consequently, short-of-force confrontations (e.g., seizing vessels or detaining fisherman) and small clashes occur between states (Simon 1995; Denoon and Brams 1997; Joyner 1999; Rosenberg 2002). While such events are less intermittent in the contemporary period, the risk of future episodes of escalated diplomatic tensions in the South China Sea remains. Concurrently, the absence of a political resolution delays the opportunity for each party to capitalize on the military and industrial utility of the Spratly Islands. Given the political and economic reasons for collective action on a resolution, the status quo indicating noncooperative behavior is sub-optimal. However, cooperation among the claimants is affected by distributional concerns. I raise two issues related to relative gains that prevent successful settlement of the dispute.

First, the ASEAN members are at an

⁵ See Snyder (1996); Joyner (1999); Koo (2009).

impasse with China. Across the dyadic interactions between China and each ASEAN member, there is no agreement on whether to pursue multilateral or bilateral bargaining to settle delimitation of the maritime space (Cui 2003). Although cooperation on either approach would yield an outcome in which the claimants benefit in absolute terms, the distributional problem has led to the acceptance of a collectively worse payoff. China continuously advocates only for bilateral bargaining and limits discussions to the topic of joint development (Valencia 1995; Joyner 1999; Rosenberg 2002; Cui 2003; Bercovitch and Oishi 2010).⁶ One reason for China's position on bilateral engagement is the state's desire to avoid being undermined by a collective ASEAN stance (Joyner 1999). In addition, China seeks to avoid further internationalization of the dispute, which, Jie (1994, 896) explains, "would only enhance the positions of the smaller regional claimant countries in relation to China," particularly with the involvement of an external power, such as the United States, as a mediator. For China, the participation of a third party would not bring impartial judgment and, thus, would invalidate the totality of the state's claim on the Spratly Islands.

Contrarily, the ASEAN members endorse multilateralism in discussing the

⁶ China has participated multilaterally with the ASEAN states, but the scope of its participation has been in functional areas that are unrelated to sovereignty. See Bercovitch and Oishi (2010).

issue of Spratly Island ownership with China. The greatest fear among the ASEAN states is that the outcome of any initial bilateral negotiation with China would establish a precedent that negatively affects the positions of small countries in subsequent rounds (Snyder 1996; Tønnesson 2003). Vietnam and the Philippines engaged independently with China on maritime delimitation in the early 1990s, and the result in both cases was a stalemate (Marlay 1997).

The second issue is the inability for any subset of the disputants to settle on a plan for joint-economic development of overlapping territory. The basic problem in establishing economic cooperation in contested maritime space is in sharing the hydrocarbon resources and their returns—that is, the apportionment of benefits (Rosenberg 2002; Acharya 2009). While there has been some success with bilateral and multilateral cooperation in the form of granting oil exploration contracts, it should be noted that the development of energy resources has yet to occur in the areas contested by more than two parties.⁷ It is not unreasonable to assume that each of the parties has a different vision of how “joint” ought to be considered, which presumably involves an asymmetry in the gains from a given arrangement. Indeed, Valencia (1995) explicates that China is unlikely to agree to a development scheme in which the

⁷ See Valencia, *China and the South China Sea disputes*; Denoon and Brams (1997, pp. 314-5).

distribution of goods is equal among the parties. Bercovitch and Oishi (2010) note that China rebuffed a doughnut-hole proposal for joint-development because its claims would be compromised.⁸

Similarly, the ASEAN members will not independently concede to the Chinese conditions of a bilateral agreement. Bercovitch and Oishi (2010) describe that the consequence of any bilateral agreement with China is the implicit renouncement of an ASEAN member’s claim on the contested area in exchange for a share of China’s economic benefits from the area’s extracted resources. More broadly, Emmers (2005) explicates that, enhanced by the lack of a settlement on sovereignty, the present power asymmetries among the parties, including intra-ASEAN relations, undermine the negotiating positions of the states with smaller claims. Following on this, as Koo (2009) clarifies, cooperative ventures with China are impeded by the inability for ASEAN members to harmonize their preferences.

Existing regimes have attempted to settle the dispute; but as Simon (2008) asserts, most of these arrangements work toward conflict avoidance rather than resolution. On the one hand, mechanisms such as the Declaration on the Conduct in the South China Sea can be viewed as

⁸ See Bercovitch and Oishi (2010, p. 108). See Valencia (*China and the South China Sea disputes*) for more on the doughnut hole. A discussion of Valencia’s proposals is in section III of this paper.

confidence building measures (CBMs).⁹ Notwithstanding their general importance for preventing the emergence and settlement of confrontational situations involving the use of force, current CBMs have been ineffective at providing an assurance of self-restraint.¹⁰ Despite agreement to certain measures, several parties have taken provocative actions by increasing their physical presence on controlled territories and enhancing military capabilities (Emmers 2005; Simon 2007; Simon 2008; Bercovitch and Oishi 2010). Thus, CBMs are unstable stopgaps.

On the other hand, international law, through such institutions as the International Court of Justice (ICJ) and the United Nations Convention on the Law of Seas (UNCLOS), also cannot provide a stable outcome. Denoon and Brams (1997) and Valencia (2003) emphasize the biased and unpredictable nature of ICJ rulings, as the criteria for what constitutes a legitimate claim is ambiguous. Moreover, the parties are not bound to the verdicts of the ICJ. Central to the status quo of the dispute, Dutton (2007) explains that UNCLOS leaves unresolved the areas to which there are competing claims.

The distributional problem, intensified by each state's preferences, has rendered the stalemate outcome more attractive than cooperation. Accordingly, to

engender a more stable outcome, the resolution of the dispute resides in a method that incentivizes cooperation by providing a distribution of gains such that all parties receive a share that includes territory they value highest and perceive the overall value of which to be at least equal to all other shares. A system of fair division is the best alternative to bring about such a set of payoffs. Why a *fair* division? Because cooperation is hindered by the distributional problem in which there are strongly divergent preferences, and thus asymmetric payoffs, logically, only gains wherein each player perceives the value of its returns to be at least equal to those of other participants could engender collective action.

How is fairness measured? Brams and Taylor (1999) assess the "fairness" of a procedure using three criteria.¹¹ *Envy-freeness* indicates that each participant, according to her valuation, perceives her allocation to be at least equivalent to the shares of other participants; when this condition is satisfied, no player would want to trade her allotment for that of another. *Equitability* is demonstrated when every player's portion is precisely equal to all others; that is, each player in a two-person bidding process, for instance, is awarded 50% of its perceived total value of the items. *Efficiency* reveals that no other distribution of goods could achieve greater satisfaction for all players without negatively affecting the share of at least one player. Employing these criteria, I assess a few of the proposed

⁹ This declaration is the foundation for a Code of Conduct for the South China Sea.

¹⁰ For Joyner's (1999) proposal of CBMs, see pp. 89-98.

¹¹ See pp. 13-6.

methods of division that provide longer-term solutions to the sovereignty issue.

III. Methods of allocation

Contrary to the existing regimes, several solutions addressing the sovereignty issue have been proposed. These designs include variation in the extent of independent and joint ownership. Although these schemes are a significant improvement to the current regimes, the distributive implications limit their application.

Valencia (1995) devises four scenarios.¹² The first arrangement is a division of the South China Sea based on current claims; contended areas are dissolved and equidistance lines establish boundaries. This method, while simplistic, provides a disproportionate allocation of maritime space; the states with the largest claims receive significantly greater shares of territory than the other parties. The second and third plans revolve around the creation of a “doughnut hole,” each scheme delineating a central area of different size. Formed by the edges of each state’s 200 nautical mile extension into the South China Sea, the remaining central portion—the doughnut hole—a zone of shared-ownership among all the claimants, creating what Valencia (1995, 62) refers to as a “multilateral cooperative regime.” The fourth arrangement develops on this multilateralism through the design of a

¹² See pp. 54-67.

“regional common heritage area.”¹³ Countries are entitled to their original claims, but areas of overlapping contention operate under a multinational ownership that includes only the states with competing claims.

These last three scenarios are problematic because they engender additional collective action problems, while also not satisfying the fairness criteria. Determining the parameters of joint-ownership, especially among more than two states, would be highly complex for both governments and firms. Two main challenges arise. First, there is the fundamental issue of establishing the share of each co-owner. Second, effective shared-ownership would likely necessitate a central authority to ensure compliance with the supporting regimes. Yet institution building is costly, and more practically, deeper institutionalism conflicts with the norms of East Asian international politics. These three scenarios also encounter difficulty meeting the criteria of fairness. Notwithstanding the efficient allotment afforded by the joint-ownership arrangement, shortcomings in Valencia’s (1995) proposals demonstrate a lack of envy-freeness and equitability.¹⁴

¹³ This idea eventually develops into a scenario through which “joint-development companies,” representing the areas claimed by multiple countries, are created for the purposes of organizing collaborative economic ventures. See pp. 64-6.

¹⁴ Indeed, Brams and Taylor (1999, p. 15), explain that *efficiency* by itself does not guarantee fairness.

Notably, because the status quo is used as a basis for determining initial boundaries, participants with smaller claims are *ex ante* at a disadvantage. Additionally, the size of the shared area affects the reduction in each state's allotment. Moreover, while Valencia offers an equal distribution of resources and profit among the parties, in his organizational design of the management scheme, China retains a preponderance of rights.

Divergently, Denoon and Brams (1997), and Brams and Taylor (1999), advance Adjusted Winner (AW) as a procedure for the fair division of the Spratly Islands. AW is a bidding process involving two parties that yields an equal allocation for each party in terms of their respective valuation of the items in contention. Applied to the Spratly Islands, AW organizes the maritime space into five zones, and the bidding between the two players ASEAN and China determines which areas are designated to either participant. The model ultimately produces an outcome in which there are zones of independent ownership for each party and a zone of joint management to be shared between both participants; AW establishes the fractional ownership of this zone.

The main shortcoming of AW is the two-player format. This limitation has implications for the reality of an ASEAN collective and the fairness of the procedure. Substantively, aggregating Malaysia, the Philippines, and Vietnam under ASEAN in a bargaining process suggests homogeneity

among them. However, Acharya (2009) and Cui (2003) emphasize that intra-ASEAN tension and divergent domestic interests would impede the capacity for the members to harmonize on a unified bid. Given this, AW indeed may not produce an envy-free or efficient outcome. It is true that the shares ASEAN and China receive are initially envy-free. But because the Southeast Asian countries have different independent valuations for each zone, further division of ASEAN's allotment would yield shares that are not proportional *vis-à-vis* China; each member state is allocated a share that is significantly less than the 50 percent China possesses and perhaps lower than the 20 percent minimum portion each should perceive to have been awarded. Therefore, an alternative process should account for more than two parties while satisfying conditions of fairness. I present such a procedure in the following section.

IV. The modified Webster method

The collective action problem of the Spratly Islands dispute is derived, in part, from distributional conflict. Based on the potential outcomes of the existing maritime regimes and proposed division methods, the expected asymmetric gains from cooperation obstruct progress toward reaching a political settlement. The task, therefore, is to develop a mechanism through which the payoffs from cooperation meet fair-division criteria. Specifically, the outcome must be such that each player receives a share of the Spratly Islands that includes the territory it values

highest and perceives the value of the share, at minimum, to be equal to the gains of all others.

A process of fair allocation could thus provide the conditions sufficient for cooperation. I propose adapted Webster methods of apportionment and sequencing, which I collectively refer to as the *modified Webster method*, to engender a more balanced distribution of gains. Addressing the issue of proportional representation, the divisor methods have been used to allot seats in the United States House of Representatives as well as to political parties in parliaments (Balinski and Young 1975, 1978, 1982; Brams 1989, 2008). The Webster and Jefferson methods, in particular, have also been extended to determine the allocation of ministries among political parties (Brams and Kaplan 2004; O’Leary, Grofman, and Elkit 2005; Brams 2008).

I focus on the procedure proposed by Daniel Webster in the early 19th century, which is also known as the *method of major fractions* and synonymous with the Sainte-Laguë method (Balinski and Young 1975; Brams 2008). For consistency, I refer to this as the Webster method. I apply this procedure because, as Balinski and Young (1982) and Brams (2008) contend, it is the least biased of all the divisor methods. The rounding scheme of the Jefferson procedure, for example, favors larger parties, allowing for the possibility that smaller parties are not awarded any units. In the context of the Spratly Islands dispute, then, such a bias may present an outcome in which a state is

not allocated territory despite having a quota that indicates it indeed deserves at least one territory. This undermines the fair division basis of the adapted Webster procedures.

The modified Webster method is a two-stage process, wherein the first phase involves the apportionment of the territory among the players, and the second part determines the sequence in which territory is chosen. For its application to the Spratly Islands, the “deservingness” measure of the original Webster procedure is altered in two ways. First, apportionment in the modified Webster method is based not on state population, but by how much a state values a given set of territory. The point allocation process utilized by the modified Webster method, and adopted from AW (Denoon and Brams 1997; Brams and Taylor 1999), signals a state’s value on some group of territory. Thus, in allocating territories, deservingness is measured by each state’s valuations of territory. Second, the resulting territorial allotments are equivalent to quotas under the original Webster method. Consequently, the variable representing territorial shares is used to determine the sequence of Spratly Island selection. These modifications are clarified below.

In the following section, I describe the procedure and illustrate its application through an example in which players are concerned with maximizing their geographic security. Although a simplification, this single-goal scenario demonstrates the possibility of fair division among more than two parties, and therefore, cooperation on a

political settlement of the Spratly Islands. As will be revealed, the modified Webster method yields gains that are envy-free and efficient.

Structure

The modified Webster method is composed of two stages: apportionment and sequencing. The first phase involves a point allocation process wherein players bid on territories that are clustered across five zones. Using the Webster divisor method, point assignments, rather than population, determine the territorial quota for each player. The second phase is the selection of the territories according to an order determined by the apportionment outcome.

In the modified Webster method, the number of players $n = 4$, which consists of China, Malaysia, the Philippines, and Vietnam.¹⁵ Each participant i is endowed with a fixed number of points P , wherein $P = 230$. This quantity corresponds to the approximate number of territories comprising the Spratly Islands (Denoon and Brams 1997; Brams and Taylor 1999; Joyner 1999).¹⁶ Define *territory* as an island

or islet and the accompanying features (e.g., reefs and shoals) and surrounding maritime space, over which jurisdiction would be given by boundaries marked using equidistance lines. Organizationally, the 230 territories are divided into k zones, where $k = 5$ and is delineated according to those in the AW application¹⁷: East, North Central, South Central, South, and Southwest. These areas are illustrated in figure 1. Due to a lack of official estimates, for the purposes of explaining the procedure, I assume the following ex ante distribution of territory across the five zones, which is depicted in table 1.¹⁸

Players allocate their 230 points across all, or only some, of the five zones; thus, a player can choose not to distribute points to a zone. The modified Webster method then transforms players' point assignments into the shares of territory of which they are deserving. The size of each participant's territorial share in a given zone is utilized to determine the sequence by which territory is selected by the claimants. The modified Webster method proceeds as follows.

¹⁵ In any application of this method, $n \geq 2$. Thus, the procedure could include more than the four East Asian claimants discussed here.

¹⁶ Any number, such as 100 in AW, could be the fixed-point scheme; here, the quantity of 230 provides for a simple calculation of each state's territorial share resulting from the modified Webster method.

¹⁷ See Denoon and Brams (1997); Brams and Taylor (1999).

¹⁸ This ex ante distribution of territory is also noted in parentheses in figure 1 (p. 5). The territories are organized into zones, corresponding to AW's format, to avoid allocating points across an extensive set of items.

Apportionment

A state $i \in \{1, \dots, n\}$ allocates p_i points, from its endowment P_i of 230 points, to a zone $j \in \{1, \dots, k\}$. Thus, for each zone j , state i 's allotment of points is p_{ij} , wherein $0 \leq p_{ij} \leq 230$. In aggregate, the bids for state i across all five zones cannot exceed 230 points. The sum of all players' point allocations to a zone j is given by $\sum_{i=1}^n (p_{ij})$.

To illustrate the modified Webster method, consider the following example. Suppose that the goal of each player is to maximize its geographic security. The states thus allocate more points to the territory in zones that are closest to its national borders, particularly those corresponding to its present occupancy. Given this condition, I view as reasonable the hypothetical point assignments displayed in table 2. The first column presents the n players in the procedure. As in table 1, the first row displays the five zones and the distribution of territory. Rows 2 through 5 represent the point allocation for every participant across all the zones. Consistent with the procedure's rules, the summation of a player i 's points over all zones returns a value of 230 points, as indicated in the last column of table 2.

Since the states are functionally similar, given their concern for geographic security, I believe it is rational that each player has a higher utility for the zones in which it currently maintains a physical presence; this preference over territory is reflected in the allocation of points in table 2.

This information is provided by the maps of Valencia (1995), Denoon and

Brams (1997), and Brams and Taylor (1999).¹⁹ Based on this distribution of points in table 2, the "winner" of zones 1 and 2 is the Philippines; China, Malaysia, and Vietnam are the winners of zones 3, 4 and 5, respectively. (The winning allocations are in bold.) Winners are rewarded with first-mover advantage in the sequencing stage of the modified Webster method, on which I elaborate later. I now describe the calculation of the players' territorial shares.

The divisor procedure transforms players' point allocations into the shares of territory to be awarded. Consistent with the original Webster procedure, a rounding rule is used to convert exact territorial quotas with fractional parts into integer territorial shares. The process commences with the selection of a divisor for a given zone d_j . The objective is to find a divisor such that when the resulting quotients are rounded to the nearest integer, per the rounding rule, the sum is equal to the number of territories to be distributed (Brams 2008). Define m_j as the maximum quantity of territory that can be distributed in a zone. The simplest method for determining d_j is to divide the sum of the points assigned to a zone by the number of territories in that zone. That is, $d_j = (\sum_{i=1}^n (p_{ij}))/m_j$. Refer to table 3, which interprets the apportionment of territory in

¹⁹ Valencia (1995, pp. 5, 65); Denoon and Brams (1997, p. 311); Brams and Taylor (1999, p. 134).

zone 3. Given the point allocations by all players, $d_j = 250/70 = 3.57$.

The divisor is then utilized to derive each player's territorial quota. Let t_{ij} be the unrounded, exact territorial quotient, or share, t of a state i for a zone j . These allotments are given by $t_{ij} = p_{ij}/d_j$. To demonstrate the apportionment scheme, consider Malaysia's point assignment for zone 3 in row 2 of table 3. Applying the divisor $d_j = 3.57$, the state's $t_{ij} = 80/3.57 = 22.4$. As the final row of column 2 indicates, the sum of the territorial quotas in a zone is equal to the maximum quantity of territory in that zone; i.e., $\sum_{i=1}^n(t_{ij}) = m_j$.

Because t_{ij} is any real nonnegative number, some values will have fractional parts, as illustrated by Malaysia's territorial quotient. Although a single territory could be divided among two or more parties, this presents an additional challenge. Consistent with the original Webster procedure, the modified method employs the rounding rule wherein values with fractional parts greater than or equal to .50 are rounded up to the nearest integer, while lower fractional parts are rounded down. Referring to Malaysia, its quota of 22.4 for zone 3 is rounded down to 22, as displayed in column 3 of table 3. The outcome is thus integer shares of territory; define t_{ij}^* as the rounded territorial quota for a player i for a zone j . The apportionment process thus transforms t_{ij} , the value of which may consist of a fractional part, to t_{ij}^* , an integer. If an appropriate divisor has been selected, the sum of the rounded territorial shares will be equal to the quantity of

territory to be awarded in the zone; that is $\sum_{i=1}^n(t_{ij}^*) = m_j$.

The rounding method for all players in zone 3 is demonstrated in table 3. The second column provides t_{ij} for every participant based on the point allocations derived from table 2 and the divisor selected ($d_j = 3.57$). As presented in the last row of column 2, $\sum_{i=1}^n(t_{ij}) = m_j = 70$. Following the Webster scheme, the third column displays the integer apportionment of territory for each player. Malaysia's quotient is rounded down to 22, while the shares of the Philippines and Vietnam are rounded up to 3 and 17, respectively. China's quota requires no rounding. As indicated in the last row of column 3, the divisor selected ($d_j = 3.57$) results in t_{ij}^* for every player such that $\sum_{i=1}^n(t_{ij}^*) = 70$.

Note the following caveat in selecting the divisor. While $d_j = (\sum_{i=1}^n(p_{ij}))/m_j$ represents the simplest method for deriving a divisor, the sum of the rounded quotas may not equal the total number of units to be allocated. This necessitates manipulation of the divisor. The divisor must be decreased in the case that the sum of the quotas, after rounding, is lower than the unit total; otherwise, it must be increased if the sum of the quotas is in excess of the total (Young 1994).

Having demonstrated the derivation of a player i 's awarded territorial share, table 4 reveals t_{ij}^* for all players in this hypothetical scenario, which is based on the point assignments in table 2. Surveying the rows, the integer shares of territory are

located on the first line. The figures in parentheses on the second line are the exact quotas. The last column displays each participant's total territorial share across all zones; this represents the aggregate portion of Spratly Island sovereignty won by each state.

As the results in table 4 convey, each of the states gains a share of the territory in the zones to which they allocate points. One general finding is that a player i 's territorial share in a given zone j increases as it allocates more points to that zone. Focusing on the pure goal of maximizing geographic security, the distributed territorial shares enable the claimants to establish or sustain a physical presence in the areas they perceive to be most important to their respective geo-strategic interests. Furthermore, overlapping claims are settled by permitting multiple ownership in those areas, which is achieved through the control of a single territory.

Sequential Allocation

The second stage of the modified Webster method is the selection of the territory in each zone by the players. The order in which players choose territory is determined by the Webster method of sequencing (Brams and Kaplan 2004). Succinctly, the “winner” of each zone—i.e., the player who allocated the most points and thus received the greatest share of territory—gains first-mover advantage in selecting territory; the Webster method of sequencing consistently provides such a result. While the first choice is not a

problem, the order of subsequent turns must be determined.

In its original form, the Webster procedure uses a formula (the inputs of which are derived from the method of apportionment) to arrive at a sequence for allocating ministries to parliamentary parties (Brams and Kaplan 2004; O’Leary et al. 2005; Brams 2008). The order of selecting ministries is based on the values of deservingness returned from the formula, which is in part influenced by a party’s quota. As I demonstrate below, in the process of establishing an order for selection, parties with larger quotas return higher values and are deemed to be more deserving of choosing next in the sequence; those parties thus receive an advantage.

Since deservingness in the Spratly Islands context is a function not of allotted seats but allocated territory, I alter the equation to include the relevant variable t_{ij}^* , which replaces the conventional quota variable s_i representing apportioned seats. In the adapted sequencing procedure, the order for selecting territories in each zone is given by

$$(1) \quad W_{ij} = t_{ij}^* / (a_{ij} + 1/2).^{20}$$

As Brams and Kaplan (2004) and Brams (2008) explicate, participant turns are determined by the highest values of W . W_{ij} therefore functions as a ranking value for a player i in zone j . In equation (1), a player’s

²⁰ See Brams and Kaplan (2004) and Brams (2008).

integer share of territory is represented by t_{ij}^* , and a_{ij} represents the *current* number of selected territories for a player i in zone j at a given turn in the order. Thus, while a 's value is initially zero for all players, a is updated and increased by the integer 1 after every instance that player i selects a territory. A player i is awarded one turn in the sequence until the value of W for player i is lower than that of a player $-i$; that is, when $W_{ij} \leq W_{-ij}$.

To demonstrate this sequencing method, I refer to the states' territorial shares t_{ij}^* of zone 3 in table 4. China—the winner of the zone—receives 28 territories, Malaysia acquires 22, the Philippines obtains 3, and Vietnam gains 17. Effectively, the number of territories to which a player is entitled is equal to the number of turns that player will have in the sequence. Table 5 displays the first several instances of each player's W_{ij} , which is the value represented on the first line. As the winner, China selects first; and equation (1) returns a W_{ij} that is highest for China. At the start of the ranking, China has not yet selected a territory, so $a_{ij} = 0$. Following (1), $28/(1/2) = 56 = W_{ij}$. Likewise, the other players also have not selected territory at the commencement of the sequencing method; therefore for each participant, $a_{ij} = 0$. For Malaysia, $22/(1/2) = 44 = W_{ij}$. As the sequencing method continues, a_{ij} for each player increases by a value of 1. Therefore, in calculating W_{ij} for China in the second instance, $a = 1$, which then produces $W_{ij} = 28/(3/2) = 18.667$. At the third instance, $a = 2$, which yields $28(5/2) = 11.2$. This process continues until each

player has selected the number of territories it is apportioned, wherein for a player i , $a_{ij} = t_{ij}^* - 1$. Thus, in the final calculation for China, $a_i = t_{ij}^* - 1 = 27$, which results in $W_{ij} = 1.018$.

The values of W_{ij} for all players are ranked, forming a sequence. Table 5 displays the ranking for the first 14 values of W , which is the figure in parentheses on the second line. China's value of 56 is the highest; it therefore chooses territory first. The second choice belongs to Malaysia, whose value of 44 is the next-highest. The subsequent selection is made by Vietnam, whose value of 34 ranks third. Following the rankings, the next three choices, in order, are made by China, Malaysia, and Vietnam. Unfortunately, for the Philippines, its initial selection does not occur until the thirteenth turn in the sequence. The state's highest value of W —6—is lower than the other players' successive values of W , which are correlated with their greater allocation of points to the zone in the bidding stage.

This process of ranking W_{ij} persists until the sum of the players' turns is equal to the quantity of territory to be awarded in that zone. Continuing with the example of zone 3 and the ranking displayed in table 5, a sequence of 70 turns is developed. This selection order is described in Figure 2, wherein the abbreviations C, M, V, and P refer to China, Malaysia, Vietnam, and the Philippines, respectively. The slash in the middle of the sequence occurring between the turns of Vietnam and the Philippines indicates a tie in the values of W . There is no

convention for this circumstance. Because the Webster method is concerned with deservingness, I award Vietnam with the opportunity to choose before the Philippines. In this example of maximizing geographic security, Vietnam values the zone more highly, and thus allocates more points to its territory, signaling its deservingness of a turn.

Winners will *always* select first. The results from the point allocation process indicate that higher point allocations by a player i are increasing in i 's territorial share, and consequently, the number of turns in the selection order. As the 70-turn sequence of zone 3 suggests, players who have greater territorial shares are awarded with more turns before those participants with the smaller shares have the opportunity to choose. For example, the Philippines' first selection is not until the thirteenth turn in the overall sequence; by this point in the selection, the other three states have each had at least three opportunities to select territory. These observations about the allocation and sequencing outcomes of the modified Webster method are the result of each player's private valuation of a zone and the competition over winning the zones, both of which are indicated by a participant's initial point allocations.

Discussion

The purpose of the modified Webster method is to provide an outcome of fair division. In accordance with the original

conception of the divisor methods, the fairness captured by the modified Webster procedure is also based on deservingness. However, deservingness here is a function of valuations over territory, which excludes *ex ante* advantages to any party. For example, if state population is used to determine apportionment and sequencing, the process would favor China. Moreover, private valuations provide states the opportunity to express their preferences; thus one participant is not limited by the extent of another party's claims.

In reviewing the example of geographic security, how fair is the distribution? The results reveal that the allocations are envy-free and efficient. Assuming sincere bidding in players' point allocations, the resulting territorial distribution is envy-free²¹; that is, none of the countries should be willing to exchange its share for another state's share, since this would result in a loss on the zones each values highest. A corollary is that the outcome is Pareto-optimal, as the allocation cannot be reorganized without another state incurring a cost—i.e., a territorial loss.

One limitation to the modified Webster method is that it does not provide an equitable division of the Spratly Islands. In the outcome of the model in table 4, the countries are not guaranteed equal quantities of territory. There is variance, albeit small, in the players' gains; each state receives

²¹ See Brams and Taylor (1999, pp. 13-4), for additional clarification on envy-freeness.

some share in the range of 50 to 65 territories. This has implications for reaching what Brams (2008) and Brams and Kaplan (2004) refer to as *bundle Pareto-optimality*.²² The trading mechanism they propose provides an interesting dimension for addressing bundle Pareto-nonoptimality that may occur in fair division alternatives. Nonetheless, the results in table 4 are hypothetical and intended only to illustrate the modified Webster method. I note two caveats about the preceding analysis. First, the territorial allocations are based on limited information about the utility of the Spratly Islands. Especially vague is the available analysis on the economic potential of the maritime space. Second, the example referred to throughout is based on a concern for geographic security. In reality, the calculus of political leaders includes a mix of motives—and the extent to which political and economic motives, *inter alia*, affect the decision-making process cannot be known with certainty.

Reviewing its methods, the modified Webster procedure addresses the limitations of other proposals. In terms of its structure, its *n*-player design is conducive for the number of parties to the dispute—in this analysis, $n = 4$. This is a critical dimension to the bargaining circumstances among the claimants; specifically, the heterogeneity in the valuation processes across the ASEAN countries implies that the member states

cannot be treated as a collective unit. The *n*-player condition will continue to pose problems for any division process applied to the Spratly Islands. The method also differs from AW, in that a zone “won” is not the exclusive territory of the highest bidder. This has implications for the distribution of territory. Whereas AW settles the competing claims dimension through sole sovereignty, and thus excludability, the modified Webster method permits multiple parties to maintain a stake in contested maritime space.²³ In this way, the modified Webster method allows for the possibility of states gaining sovereignty over territories in each of the five zones, while ensuring that the total number of allocated territories does not exceed the population of islands.

The outcomes of the modified Webster method provide for “winners”—as determined by deservingness—and yield territorial shares that are affected by competitive point allocations. Despite the shortcoming concerning equitability, the modified method satisfies the fair-division criteria of envy-freeness and efficiency. The procedure is intended to respond to the distributional implications of other proposed alternatives, such as Valencia’s (1995) joint-development schemes and AW (Denoon and Brams 1997; Brams and Taylor 1999). In achieving fairness, the modified Webster method, most importantly, excludes the

²² See Brams (2008), *n.9*, pp. 208-9, and Brams and Kaplan (2004), *n.8*, p. 153, for an explanation of bundle Pareto-optimality.

²³ There is the exception of possible shared-ownership over a zone in AW; nevertheless, the distribution from AW excludes “losers” from the “winner’s” set of items.

significance of claims prior to the process; instead, the claims are a private baseline for each state's independent valuation. Accordingly, every party is fundamentally entitled to an equal claim to the islands.

V. Conclusion

In this analysis, I examine the collective action problem embedded in the Spratly Islands dispute. I contend that the lack of cooperation among the claimants toward resolving the fundamental issue of sovereignty, or even the matter of joint-development, is in part a consequence of the distributional problem. The effect of relative gains on collective action is the enduring acceptance by the disputants of the sub-optimal status quo. Given the limitations of existing regimes and proposed methods of division, an alternative solution is required.

I propose the modified Webster method as a fair-division procedure for mitigating the distributional problem. As the example of geographic security demonstrates, the adapted apportionment and sequential allocation methods yield envy-free and efficient shares of territory, which should incentivize cooperation. Provided that the players are bidding sincerely, each state would receive a share of territory that it values highest and therefore not desire to trade its gains for those of another state. Accordingly, the outcome is Pareto-optimal. Although the scenario presented abstracts from the complexity of the distributional conflict, the

procedure reveals the possibility of overcoming the asymmetry in gains that results in other alternatives. Ultimately, this research is intended to build on the existing fair-settlement methodology (Brams and Denoon 1997; Brams and Taylor 1999).

Of the fundamental obstacles to collective action, I have addressed the relative gains issue. Another impediment to collective action is compliance, which ought to be the focus of future research. Moreover, the practical application of any fair division procedure is challenged by the problem of securing the willingness of all parties to agree and bind themselves to the process; thus, enhancing the prospects for multilateralism is also a topic that requires attention. A final dimension to consider is the regime or ad-hoc conflict mediation mechanism through which bargaining or negotiations will occur. The construction of a new regime may be required to commence the division process, and this may be a costly alternative. Another option is a mediator, a role Indonesia has assumed in the past (Simon 1995; Acharya 2009); yet the involvement of a non-claimant state will be met with resistance, particularly from China.

This analysis has endeavored to explain the noncooperative behavior among the claimants and develop an alternative method for allocating sovereignty. Since competition over the strategic territories intensified in the 1970s, there has been marginal progress toward a political settlement. The status quo affects the

opportunity for the parties to collectively benefit from the political and economic value of the maritime space. Moreover, the mercurial behavior from governments in response to “infringements” on national territory has escalated to low-level militarized interstate disputes. These observations underscore the need for a political solution in the near future. Therefore, the modified Webster method should be considered a methodological starting point for overcoming the relative gains issue that obstructs progress toward a fair resolution to the Spratly Islands dispute.

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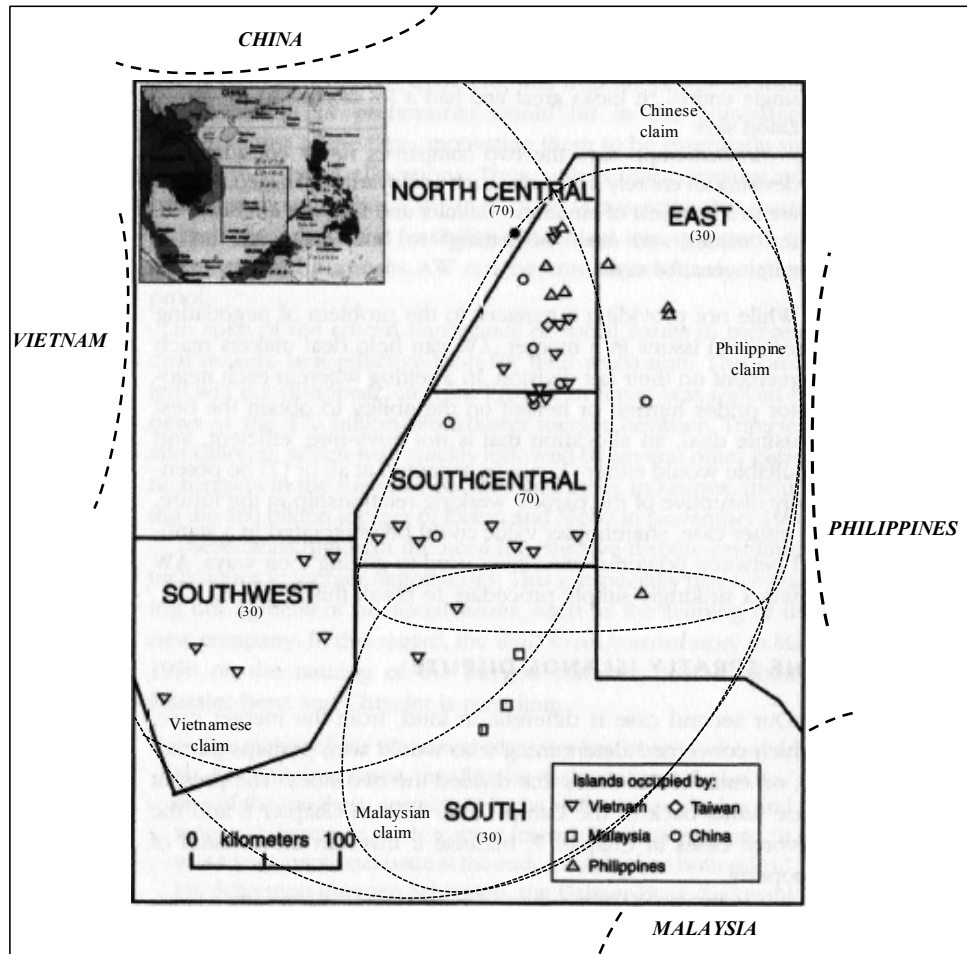
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Figure 1. Map of the Spratly Islands and national claims.



Source: Adapted from Denoon and Brams (1997); Brams and Taylor (1999); Valencia (1995); U.S. Department of State.

Table 1: Distribution of territory.

Zone 1 = 30 (East)	Zone 2 = 70 (No. Central)	Zone 3 = 70 (So. Central)	Zone 4 = 30 (South)	Zone 5 = 30 (Southwest)
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Table 2: Players' point allocations under a scenario of geographic security.

State	Zone 1 = 30 (East)	Zone 2 = 70 (No. Central)	Zone 3 = 70 (So. Central)	Zone 4 = 30 (South)	Zone 5 = 30 (Southwest)	Total
China	20	100	100	—	10	230
Malaysia	10	—	80	140	—	230
The Philippines	110	110	10	—	—	230
Vietnam	—	80	60	10	80	230
<i>Total</i>	140	290	250	150	90	

Table 3: Apportionment of territory for zone 3.

State	Point Allocation, p_{ij}	Exact Share, t_{ij} ($d_j = 3.57$)	Integer Share, t^*_{ij}
China	100	28	28
Malaysia	80	22.4	22
The Philippines	10	2.8	3
Vietnam	60	16.8	17
<i>Total</i>	250	70	70

Table 4: Territorial share t_{ij}^* for all players.

State	Zone 1 = 30 (East)	Zone 2 = 70 (No. Central)	Zone 3 = 70 (So. Central)	Zone 4 = 30 (South)	Zone 5 = 30 (Southwest)	Total
China	4 (4.29)	24 (24.15)	28 (28)	—	3 (3.33)	59
Malaysia	2 (2.14)	—	22 (22.4)	28 (28)	—	52
The Philippines	24 (23.61)	27 (26.57)	3 (2.8)	—	—	54
Vietnam	—	19 (19.32)	17 (16.8)	2 (2)	27 (26.67)	65
<i>Total</i>	30	70	70	30	30	230
$\sum_{i=1}^n (p_{ij})$	140	290	250	150	90	
d	4.66	4.14	3.57	5	3	

Note: Integer shares of territory are the figures on the first line.

Exact territorial quotas are the figures in parentheses on the second line.

Table 5: Results of the Webster sequencing method.

State	$a_{ij} = 0$	$a_{ij} = 1$	$a_{ij} = 2$	$a_{ij} = 4$	$a_{ij} = 5$	$a_{ij} = 6$
China (W_{ij})	56 (1)	18.667 (4)	11.2 (7)	8 (9)	6.222 (12)	5.091 (14)
Malaysia (W_{ij})	44 (2)	14.667 (5)	8.8 (8)	6.286 (11)	4.889 (15)	4
The Philippines (W_{ij})	6 (13)	2	1.2	—	—	—
Vietnam (W_{ij})	34 (3)	11.333 (6)	6.8 (10)	4.857 (16)	3.778	3.091

Note: W_{ij} is the figure listed on the first line.

