

Brams, Steven J.; Jones, Michael A.; Kilgour, D.Marc

**Working Paper**

## Forming Stable Coalitions: The Process Matters

Nota di Lavoro, No. 97.2003

**Provided in Cooperation with:**

Fondazione Eni Enrico Mattei (FEEM)

*Suggested Citation:* Brams, Steven J.; Jones, Michael A.; Kilgour, D.Marc (2003) : Forming Stable Coalitions: The Process Matters, Nota di Lavoro, No. 97.2003, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/118115>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

**Forming Stable Coalitions:  
The Process Matters**

Steven J. Brams, Michael A. Jones and  
D. Marc Kilgour  
NOTA DI LAVORO 97.2003

**OCTOBER 2003**

|                                |
|--------------------------------|
| CTN – Coalition Theory Network |
|--------------------------------|

Steven J. Brams, *Department of Politics, New York University, U.S.A.*  
Michael A. Jones, *Department of Mathematical Sciences,  
Montclair State University, U.S.A.*  
D. Marc Kilgour, *Department of Mathematics,  
Wilfrid Laurier University, Canada*

This paper can be downloaded without charge at:

The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:

[http://www.feem.it/web/activ/\\_wp.html](http://www.feem.it/web/activ/_wp.html)

Social Science Research Network Electronic Paper Collection:

[http://papers.ssrn.com/abstract\\_id=XXXXXX](http://papers.ssrn.com/abstract_id=XXXXXX)

The opinions expressed in this paper do not necessarily reflect the position of  
Fondazione Eni Enrico Mattei

# Forming Stable Coalitions: The Process Matters

## Summary

Players are assumed to rank each other as coalition partners. Two processes of coalition formation are defined and illustrated:

- Fallback (FB)*: Players seek coalition partners by descending lower and lower in their preference rankings until some majority coalition, all of whose members consider each other mutually acceptable, forms.

- Build-up (BU)*: Same descent as FB, except only majorities whose members rank each other highest form coalitions.

BU coalitions are *stable* in the sense that no member would prefer to be in another coalition, whereas FB coalitions, whose members need not rank each other highest, may not be stable. BU coalitions are bimodally distributed in a random society, with peaks around simple majority and unanimity the distributions of majorities in the US Supreme Court and in the US House of Representatives follow this pattern. The dynamics of real-life coalition-formation processes are illustrated by two Supreme Court cases.

**Keywords:** Coalition dynamics, Fallback bargaining, Manipulability, Legislatures, US Supreme Court

**JEL:** D72, C78

*Address for correspondence:*

Steven J. Brams  
Department of Politics  
726 Broadway, 7<sup>th</sup> Fl  
New York University  
New York, NY 10003  
Phone: (212) 9988510  
Fax: (212) 9954184  
U.S.A.  
E-mail: [steven.brams@nyu.edu](mailto:steven.brams@nyu.edu)

# Forming Stable Coalitions: The Process Matters

## 1. Introduction

Coalitions are collections of players. Their stability is usually defined in terms of outcomes and the incentives coalition members have to sustain them. In this paper, we show that the process by which the players come together and form coalitions also may critically affect how enduring coalitions will be.

To determine which coalitions are likely to form and be stable, we assume that each player ranks all other players as coalition partners. At the outset, we assume that players report their rankings truthfully, but we reconsider this assumption later. A coalition of  $k$  players, or  $k$ -coalition, is *stable* if no member would prefer to be in another  $k$ -coalition.

It is apparent that there is always at least one stable coalition—the grand coalition, or  $n$ -coalition, that comprises all  $n$  players—because there is no other  $n$ -coalition. But below the grand coalition, what coalitions will form, and how stable they will be, is unclear. The coalition-formation processes we postulate clarify this question and also enable us to distinguish two levels of stability.

To rule out strategic issues that arise because of differences in player size or capability,<sup>1</sup> we assume that (i) all players are of equal weight (as in a legislature in which each member has one vote) and (ii) winning coalitions are those with at least a simple majority,  $m$ , of members. While we focus on nonstrategic processes of coalition formation, we later consider the manipulability of these processes.

Coalitions form according to two processes:

- *Fallback (FB)*: Players seek coalition partners by descending lower and lower in their preference rankings until some majority coalition, all of whose members consider each other mutually acceptable, forms.

- *Build-up (BU)*: Same descent as FB, except only majorities whose members rank each other highest form coalitions.

Both these processes are driven by players' mutual preferences, not their evaluations of coalitions.<sup>2</sup>

We begin with notation and definitions in section 2. In section 3 we show that several FB majority coalitions with  $k \geq m$  members may form simultaneously. Call the set of FB coalitions that form first (i.e., at the lowest value of  $k$ )  $FB_1$ . The analogous set,  $BU_1$ , comprises a unique coalition, which is stable. If the preferences of the players are single-peaked,  $FB_1$  coalitions may be disconnected, but the  $BU_1$  coalition is always connected (in a sense to be made precise later).

$BU_1$  contains all coalitions in  $FB_1$ , which may have fewer members than  $BU_1$ . This raises the question of which majority coalition is most likely to form—smaller  $FB_1$  majority coalitions, in which some members may prefer players outside the coalition to players inside, or the  $BU_1$  coalition, in which this cannot happen? We call smaller  $FB_1$  majority coalitions *semi-stable* because at least some of their members are attracted to outside players, whereas  $BU_1$  coalitions are stable.

---

<sup>1</sup> For example, two ideologically distant players might join together if it would enable them to win, but neither would join a smaller more centrally located player if the resulting coalition were not winning.

<sup>2</sup> In Cechlárová and Romero-Medina (2000), each player uses its preference rankings of all other players to evaluate coalitions according to two criteria—the most-preferred, and the least-preferred, members that they contain. Other criteria are postulated in an agent-based simulation model in a neural-network framework, wherein political parties seek to attract a majority of players in a spatial voting game (Iizuka, Yamamoto, Suzuki, and Ohuchi, 2002). Related work on coalition-formation models is discussed in section 3.

In section 4 we show that semi-stable  $FB_1$  coalitions are *manipulable* in that a player, by announcing a false preference ranking, can induce a majority coalition that it prefers. By contrast,  $BU_1$  semi-stable coalitions are not manipulable: A manipulator may be able to induce a smaller majority coalition with a false announcement, but this coalition will not necessarily be preferred. The reason is that the larger  $BU_1$  coalition, which forms when the manipulator is truthful, must contain at least one member the manipulator prefers to some player in the smaller majority coalition—so the manipulator will not assuredly prefer the smaller coalition.

In section 5 we investigate the properties of stable coalitions.  $BU_1$  may be a simple-majority coalition, the grand coalition, or any size in between. More generally, stable coalitions of any size between  $m$  and  $n - 1$  may or may not exist. Two stable coalitions (of any size) are either disjoint, or one contains the other. A *bandwagon strategy* may enable a player to be a member of a winning coalition sooner than it would be otherwise, but it will not necessarily be a winning coalition that it prefers.

In section 6 we show that if all player preferences are equally likely, the probability that a randomly chosen majority coalition is stable first decreases to some minimum between  $m$  and  $n - 1$ , then increases to 1 when the grand coalition forms, yielding a bimodal distribution, with peaks at minimal majority and unanimity. This finding also holds for the distribution of first-forming majority coalitions when preferences, whether single-peaked or not, are randomly chosen.

Empirical data on the size of US Supreme Court majorities that we present in section 7 show the distribution to be bimodal, with most being either minimal (5-person) or maximal (9-person) majorities. We illustrate the formation of majorities on the Court

with an 8-0 decision (one justice recused himself) and a 5-4 decision. Data we present on the size of majorities in the US House of Representatives also show the distribution to be bimodal.

We conclude that FB and BU mirror different real-life coalition-formation processes. BU yields larger and less manipulable majority coalitions, compared to the more wieldy but vulnerable coalitions of FB. Together these models show how the stability of outcomes is inextricably linked to the processes that generate them.

## 2. Notation and Definitions

We assume that all players, named  $1, 2, \dots, n$ , strictly rank each other as coalition partners, as illustrated in Example A.

**Example A.** 1: 2 3 4 5    2: 1 3 4 5    3: 4 5 2 1    4: 3 2 1 5    5: 4 3 2 1.

We further assume that each player ranks itself first—that is, it most desires to be included in any majority coalition that forms. In Example A, player 1, after itself, most prefers player 2 as a coalition partner, followed by players 3, 4, and 5 in that order. A complete listing of all players' preferences, as illustrated in Example A, is called a *preference profile*.

It is clear that if there are  $n$  players, there are  $[(n - 1)!]^n$  preference profiles. In our model of a random society used later, all preference profiles are assumed to be equiprobable.

Sometimes we will assume that the players can be placed along a line—in order 1, 2, 3, ...,  $n$ , from left to right—so that the preference profile is single-peaked. That is, each player's preference for coalition partners declines monotonically to the left and right

of its position in this ordering. A preference profile that satisfies this condition is called *ordinally single-peaked* (Brams, Jones, and Kilgour, 2002). Such profiles are commonly assumed in spatial models of candidate and party ompetition.

To express single-peakedness in another way, consider the set of players in a coalition; call the left-most player  $l$  and the right-most player  $r$ . The set is *connected* if it is of the form  $\{l, l + 1, \dots, r\}$ : It contains exactly the players from  $l$  to  $r$ , inclusive. Then a preference profile is single-peaked if and only if, for each  $k = 1, 2, \dots, n$ , every player's  $k$  most-preferred coalition partners, including itself, form a connected set. Thus in Example A, when  $k = 3$ , the most-preferred 3-coalitions of players 1 (123), 2 (213), 3(345), 4 (432), and 5 (543) are all connected sets. For all other  $k$  between 1 and 5, it is easy to see that all most-preferred  $k$ -coalitions are connected, so the preference profile of Example A is ordinally single-peaked.

In fact, such a preference profile may or may not be geometrically realizable in the following sense: If  $n$  points can be positioned along a line such that a player's preference decreases as distance from its position increases, then the preference profile is called *cardinally single-peaked*. To see that this condition is not satisfied in Example A, assume that player  $i$  is located at position  $p_i$  on the line. Define the distance between two positions,  $p_i$  and  $p_j$ , to be  $d_{ij} = |p_i - p_j|$ . From player 3's preference ordering,  $d_{54} < d_{53} < d_{32}$ , whereas from player 4's ordering,  $d_{32} < d_{42} < d_{54}$ . This contradiction shows that the preference profile of Example A is ordinally but not cardinally single-peaked.<sup>3</sup>

### 3. The Fallback and Build-Up Processes

---

<sup>3</sup> In other words, the players' ordinal rankings are inconsistent with every possible cardinal representation of their positions.



The *fallback (FB)* process of coalition formation unfolds as follows (Brams, Jones, and Kilgour, 2002; Brams and Kilgour, 2001):

1. The most preferred coalition partner of each player is considered. If two players mutually prefer each other, and this is a majority of players, then this is the majority coalition that forms. The process stops, and we call this a level 1 majority coalition because only first-choice partners are considered.
2. If there is no level 1 majority coalition, then the next-most preferred coalition partners of all players are also considered. If there is a majority of players that mutually prefer each other at this level, then this is the majority coalition (or coalitions) that forms. The process stops, and we call this a level 2 majority coalition.
3. The players successively descend to lower and lower levels in their reported rankings until a majority coalition (or coalitions), all of whose members mutually prefer each other, forms *for the first time*. The process stops, with the set of *largest* majority coalition(s)—not contained in any others at this level—designated  $FB_1$ .

What does FB yield in Example A? At level 1, observe that player 1 prefers player 2, and player 2 prefers 1, so we designate 12 as a level 1 coalition, as is coalition 34 also.<sup>4</sup> Descending one level, player 3 likes player 5 and player 5 likes player 3, yielding 35 as a coalition at level 2. Descending one more level, majority coalitions 124 and 234 form for the first time: Each player in these coalitions finds the other two players acceptable at level 3. In summary, we have the following coalitions at each level:

*Level 1:* 12, 34

*Level 2:* 35

*Level 3:* 124, 234.

Notice that coalitions are listed at the level at which they form, except that subcoalitions are never listed. Thus at level 3, pairs 14, 23, and 24 form but do not appear in our listing, because they are proper subsets of coalitions 124 or 234.

Since coalitions 124 and 234 are the first majority coalitions to form, the process stops, rendering  $FB_1 = \{124, 234\}$ . Observe that players 2 and 4 are common to both coalitions; player 2 prefers coalition 124, and player 4 prefers coalition 234. Obviously, players 1 and 3 prefer the coalition of which each is a member.

Despite the players' preferences being single-peaked, one of the two  $FB_1$  coalitions (124) is *disconnected*: There is a "hole" due to the absence of player 3. The reason that player 3 is excluded from coalition 124 is that whereas players 1 and 2 necessarily rank player 3 higher than player 4 (because of single-peakedness), player 3 ranks players 2 and 1 at the bottom of its preference order. In particular, player 3 does not consider player 1 acceptable at level 3, which excludes player 3 from coalition 124.

While FB is grounded in preferences of players for each other, it could as well be based on their preferences for different features that a policy might include. Thus in Example A, assume players rank five features,  $\{a, b, c, d, e\}$ , in the same way that they do each other. Then at level 1 player 1 would find feature  $a$  acceptable, and at level 2 feature  $b$ ; likewise, player 2 would find both  $a$  and  $b$  acceptable at level 2. Consequently, at level 2 (rather than level 1) the coalition 12 would form because of the two players' concurrence on both  $a$  and  $b$ . In this example, the level at which coalitions form changes,

---

<sup>4</sup> These preferences are truthful; we will consider later the possibility that the players strategically misreport their preferences.

but not their membership, as players switch from ranking each other to ranking policy features.<sup>5</sup>

The *build-up* (BU) process of coalition formation is the same as FB, with one major difference. As players descend to lower and lower levels, coalitions form if and only if two or more players consider each other mutually desirable *and consider players not in the coalition less desirable*. In other words, all players in a BU coalition rank each other—and no players outside the coalition—highest. In Example A, this yields the following coalitions at each level:<sup>6</sup>

*Level 1:* 12, 34                      *Level 4:* 12345.

At levels 2 and 3, no new BU coalitions form after coalitions 12 and 34 form at level 1. Only at level 4 does the first majority coalition appear; it is the grand coalition, so  $BU_1 = \{12345\}$ , or just 12345. Note that no member would prefer to be in another 5-coalition—there is none!—proving that this majority coalition is not only *stable* but uniquely so.

Compare this outcome with that produced by FB, which gave  $FB_1$  coalitions 124 and 234 at level 3. These coalitions are *semi-stable*: Even though all their members consider each other acceptable at level 3, some members of each coalition consider some excluded players more desirable as coalition partners. For coalition 124, players 1 and 2 prefer excluded player 3 to included player 4; for coalition 234, player 2 prefers excluded

---

<sup>5</sup> The number of policy features need not match the number of players. If there are more features than players, coalitions will form later than if there are fewer features than players. For examples, see Brams and Kilgour (2001).

<sup>6</sup> In Brams, Jones, and Kilgour (2002), a different BU model is proposed in a cardinal-utility context. Coalition members fuse into a single player whose position is the average of its members when preferences are defined by points on the real line.

player 1 to included players 3 and 4, and player 3 prefers excluded player 5 to included player 2.<sup>7</sup>

**Proposition 1.**  *$BU_1$  contains a unique stable coalition. If  $FB_1$  forms at the same level as  $BU_1$ ,  $FB_1 = BU_1$ . Otherwise,  $FB_1$  forms at a lower level, in which case all  $FB_1$  coalitions are semi-stable and proper subsets of the  $BU_1$  coalition.*

**Proof.** Because the grand coalition is a BU coalition,  $BU_1$  is well-defined and never empty. Suppose it contains two majority coalitions. Because both are of the same size, say  $k$ , they must contain at least one common member  $i$ .<sup>8</sup> Because the other members of both coalitions must be exactly  $i$ 's  $k$  most-preferred coalition partners, the two coalitions in  $BU_1$  must be identical. Hence,  $BU_1$  contains a unique coalition, which we henceforth call  $BU_1$ . Moreover, because all members of  $BU_1$  rank each other highest,  $BU_1$  is stable.

Every BU coalition is an FB coalition since the process of descent is the same. If the level of  $FB_1$  is the same as the level of  $BU_1$ , then  $BU_1$  belongs to  $FB_1$ . Because there cannot be any other coalition in  $FB_1$ , then  $FB_1 = BU_1$ .

Now suppose that the level at which  $BU_1$  forms is  $k$ , and the level at which  $FB_1$  forms is  $j < k$ . Consider any coalition  $C$  in  $FB_1$ . While the members of  $C$  consider each other acceptable at some level, there is at least one player in  $C$  that prefers some player not in  $C$ . (If this were not the case, then  $C$  would be  $BU_1$ , and  $j$  would equal  $k$ .) This makes  $C$  semi-stable. Moreover, because both  $C$  and  $BU_1$  are majority coalitions, they

---

<sup>7</sup> The exclusion of preferred players from a coalition, and its manipulability (section 4), are two indicators of its instability. While “there is only a relatively small number of results that guarantee the existence of a ‘stable’ coalition structure” (Greenberg and Weber, 1993, p. 60), even fewer models offer insight into the step-by-step processes of coalition formation that may (or may not) contribute to stability (Brams, Jones, and Kilgour, 2002).

must have a member in common, say  $i$ . But  $BU_1$  contains  $i$  and  $i$ 's  $k$  most-preferred coalition partners, whereas  $C$  contains  $i$  and a proper subset, with  $j$  members, of  $i$ 's most-preferred coalition partners. Therefore,  $C$  is properly contained in  $BU_1$ . Q.E.D.

Example A illustrates Proposition 1. Semi-stable  $FB_1$  coalitions 124 and 234 are contained in stable  $BU_1$  coalition 12345. There are no stable majority coalitions smaller than this grand coalition. Our next example illustrates that  $BU_1$  need not be the grand coalition.

**Example B.** 1: 2 3 4 5    2: 3 4 1 5    3: 4 2 1 5    4: 1 2 3 5    5: 4 3 2 1.

The FB coalitions at each level are:

*Level 2:* 13, 23, 24                      *Level 3:* 1234.

Whereas no two players consider each other mutually acceptable at level 1, at level 2 two pairs do. At level 3, the first majority coalition forms, so  $FB_1 = \{1234\}$ . But this 4-player coalition is also  $BU_1$ , because all its members consider each other, and no others, acceptable. Thus in Example B, the FB and BU processes produce exactly the same majority coalition, which is neither minimal nor grand. To be sure, the grand coalition is also stable, but it seems unlikely to form since players 1 - 4 are united in their opposition to player 5, which they all rank last.

If  $FB_1 \neq BU_1$ , smaller  $FB_1$  coalitions, which are semi-stable, form earlier in the descent, only later to be subsumed by a larger  $BU_1$  coalition that is stable. Thus in

---

<sup>8</sup> If preferences are single-peaked and this common member is unique, it must be the median player.

Example A, semi-stable  $FB_1$  coalitions 124 and 234 are proper subsets of stable  $BU_1$  coalition 12345.

**Proposition 2.** *If preferences are single-peaked, at least one  $FB$  coalition of two players must form at level 1.*

**Proof.** Single-peakedness requires that every player rank an adjacent player highest. Let  $C$  be the subset of players whose top-ranked coalition partners are players to their right—that is, all players  $i$  for which  $i + 1$  is first choice. Note that  $1 \in C$  (because there is no player to the left of 1) and that  $n \notin C$  (because there is no player on  $n$ 's right). Let  $r$  be the right-most (highest-numbered) player in  $C$  and note that  $r < n$ . Then  $r + 1$  must be  $r$ 's top choice, and  $r$  must be  $(r + 1)$ 's top choice, so the coalition  $\{r, r + 1\}$  must form at level 1. Q.E.D.

In Example A, two coalitions, 12 and 34, form at level 1, whereas in Example B no coalitions form at level 1 because its preference profile is not single-peaked.

**Proposition 3.** *If preferences are single-peaked, then (i)  $FB_1$  coalitions may be disconnected, but (ii)  $BU_1$  is connected.*

**Proof.** Example A, with disconnected  $FB_1$  coalition 124, proves (i). To prove (ii), assume that the left-most (lowest-numbered) member of  $BU_1$  is player  $l$ , and the right-most (highest-numbered) player is  $r$ , where  $l < r$ . We next show that  $BU_1$  must also contain any  $i$  satisfying  $l < i < r$ . If the level of  $BU_1$  is  $k$ , then  $BU_1$  comprises  $l$  and  $l$ 's  $k$  most-preferred coalition partners. By single-peakedness, these must be players  $l + 1, l + 2, \dots, l + k$ . It follows that  $l + k = r$ , and  $i \in BU_1$ , rendering  $BU_1$  connected. Q.E.D.

It is worth mentioning linkages to other work on coalition-formation processes. Grofman (1982) and Straffin and Grofman (1984) show, in a dynamic model of coalition formation that somewhat resembles our BU model, that coalitions will always be connected in one dimension but not necessarily in two or more dimensions. But under FB, as we illustrated in Example A, coalitions need not be connected, even in one dimension, if preferences are ordinally single-peaked.<sup>9</sup>

We now turn to the question of whether players can manipulate either the FB or the BU processes to their advantage. FB, as we will see, is vulnerable to manipulation, but BU is quite robust.

#### 4. The Manipulability of FB and BU

Call a process *manipulable* if one player, by reporting a preference ranking different from its true preference ranking, can induce a majority coalition that it prefers.

**Proposition 4.** *FB is manipulable.*

**Proof.** Consider the following example:

**Example C.**    1: 2 3 4 5    2: 3 4 1 5    3: 2 4 1 5    4: 3 5 2 1    5: 4 3 2 1.

The FB coalitions at each level are:

*Level 1:* 23      *Level 2:* 34, 45      *Level 3:* 123, 234      *Level 4:* 12345.

Now assume player 4 misrepresents its preferences as follows:

**4:** 3 2 5 1.

---

<sup>9</sup> For references to more recent models in this vein, and tests of these models in party-coalition formation in parliamentary systems, see Brams, Jones, and Kilgour (2002).

Then FB gives the following:

*Level 1:* 23      *Level 2:* 234      *Level 3:* 123      *Level 4:* 12345.

When player 4 is truthful,  $FB_1 = \{123, 234\}$ , whereas when player 4 misrepresents its preferences,  $FB_1 = \{234\}$ . Because player 4 prefers coalition 234 to coalition 123, misrepresentation, which precludes the possibility of coalition 123, is rational, rendering FB manipulable.<sup>10</sup> Q.E.D.

By comparison, misrepresentation will not be rational for player 4 if the comparison is between the (apparent)  $BU_1$  coalition that forms with misrepresentation and one that forms without misrepresentation. With misrepresentation,  $BU_1 = 234$ ; without misrepresentation,  $BU_1 = 12345$ . Because the larger coalition, 12345, includes both a preferred player (5) and a non-preferred player (1) compared to player 2 in the smaller coalition, 234, one cannot say that player 4 prefers 234 to 12345 or vice versa. Thus, by reporting a preference ranking different from its true preference ranking, player 4 cannot induce a majority coalition that it *assuredly* prefers, illustrating the nonmanipulability of BU.<sup>11</sup>

**Proposition 5.** *BU is not manipulable.*

---

<sup>10</sup> Thus, truthful reporting is not a Nash equilibrium under FB, given the strategies of players are to be truthful or not in a noncooperative game (player 4 would have an incentive not to be truthful in Example C). As we will show next, however, a player cannot assuredly do better by misrepresenting its preferences under BU. Thereby *when* the process of coalition formation terminates affects the stability of outcomes generated under it, underscoring our contention that “the process matters.”

<sup>11</sup> To be sure, if there were more information about preferences—in particular, cardinal valuations of different coalitions by each player—it would be possible to say whether player 4 prefers 234 to 12345 or vice versa. In the absence of such information, however, we assume that player 4 does *not* have an incentive to depart from reporting its true preference that yields 12345.



**Proof.** Assume  $BU_1$  has  $k$  members. Then a majority coalition that any member  $i$  of  $BU_1$  prefers cannot have more than  $k$  members, because it would contain members that  $i$  ranks lower than those in  $BU_1$  and no members that  $i$  ranks higher.

Suppose that  $i$  prefers a majority coalition with fewer members—specifically with  $j$  members such that  $m \leq j < k$ , where  $m$  is a simple majority. To induce this smaller majority coalition through misrepresentation,  $i$  would have to reduce its ranking of some player  $P$  not in the  $j$ -coalition, and raise some player  $Q$  into the  $j$ -coalition.

The resulting  $j$ -coalition, though an apparent BU coalition, does not contain  $i$ 's  $j - 1$  most-preferred coalition partners since it contains player  $Q$ . Moreover,  $i$  will not necessarily prefer the  $j$ -coalition to  $BU_1$ , because although it is smaller, it does not contain player  $P$ , which  $i$  prefers to  $Q$ . Thus,  $i$  is not able to induce through misrepresentation a smaller coalition that it definitely prefers. Q.E.D.

In Example C, as we saw earlier, player 4 can induce through misrepresentation coalition 234—by raising player 2 ( $Q$ ) and lowering player 5 ( $P$ ) in its reported ordering—making it an (apparent)  $BU_1$  coalition at level 2. But player 4 will not necessarily prefer coalition 234, which is an  $FB_1$  coalition, to the grand coalition, 12345.

## 5. Properties of Stable Coalitions

After the appearance of  $BU_1$ , larger and larger BU majority coalitions may—or may not—appear at subsequent levels of descent. Each larger BU majority coalition contains all smaller BU majority coalitions, as illustrated next with a cardinally single-peaked example.

**Example D.**    1: 2 3 4 5 6 7      2: 1 3 4 5 6 7      3: 2 1 4 5 6 7      4: 3 2 1 5 6 7

5: 6 4 3 2 1 7      6: 5 4 3 2 1 7      7: 6 5 4 3 2 1.

Geometrically, we can represent the preferences of these players by placing them at points along the real line:

1 2 3      4      5 6      7.

Thus, for example, the members of pairs 12 and 56 are each other's most-preferred coalition partners, for they are closer to each other in distance to each other than to any other players. Because player 3 prefers players 2 and 1 to player 4, player 3 is farther from player 4 than from player 1. Likewise, players 5 and 6 are farther from player 7 than from player 1, because they rank player 7 last.

We list below all the FB coalitions, not contained in any others at each level, distinguishing those that are also BU coalitions:

*Level 1:* 12 (BU), 56 (BU)      *Level 2:* 13, 23      *Level 3:* 1234 (BU)  
*Level 4:* 2345      *Level 5:* 123456 (BU)      *Level 6:* 1234567 (BU).

Observe that the first FB majority coalition to appear, 1234 at level 3, is also a BU majority coalition, so  $FB_1 = BU_1 = 1234$ . As the descent continues, there is no BU coalition at level 4, but at level 5 a 6-member BU coalition forms. Finally, the grand coalition, which is always a BU coalition, appears at level 6.

Given a cardinally single-peaked preference profile, define the *spread* of a coalition to be the distance between its extreme players. Thus, the spread of coalition 1234 is the distance between player 1 on the left and player 4 on the right, or  $d_{14}$ . That this distance is less than  $d_{45}$  ensures that coalition 1234 forms before player 5 is brought

into the fold. But because player 5 ranks player 6 above all other players, player 5 does not find player 1 acceptable at level 4—only players 2, 3, 4, and 6 are acceptable at this level.

Hence, coalition 12345 is not a BU coalition. On the other hand, because the spread of coalition 123456 is less than the distance between player 6 and player 7, coalition 123456 is a BU coalition at level 5, as is the grand coalition, 1234567, at level 6.

If players' preferences are cardinally single-peaked, it is easy to discern the stable coalitions that form from the players' positions and distances between them.

**Proposition 6.** *If preferences are cardinally single-peaked, then a subset of players is a BU coalition if and only if it is connected and its spread is less than the distances from each extreme member (other than 1 and  $n$ ) to the nearest player not in the subset.*

**Proof.** Suppose that the connected subset  $C = \{l, l + 1, \dots, r\}$  has the properties that either  $l = 1$  or  $d_{l(l-1)} > d_{rl}$  and either  $r = n$  or  $d_{(r+1)r} > d_{rl}$ . Clearly, the remaining members of  $C$  are  $l$ 's top choices as coalition partners, and similarly for  $r$ . Also, if  $i \in C$ ,  $j \in C$ , and  $k \notin C$ , then  $d_{ij} < d_{rl} < \min\{d_{ik}, d_{rk}\}$ , which shows that the remaining members of  $C$  are also  $i$ 's top choices as coalition partners, making  $C$  a BU coalition. The converse is obvious. Q.E.D.

Put more informally, a coalition that is disconnected cannot be a BU coalition, because members would rank the left-out member higher than some members of the coalition. Now assume a coalition is connected but that the distance of an extreme

member to an adjacent non-member—either on the left or on the right—is less than the spread. Then the adjacent non-member will be ranked higher by the extreme member than some player in the coalition, so the coalition cannot be a BU coalition.

Proposition 6 provides a characterization of BU coalitions if the players have cardinally single-peaked preferences, thereby enabling one to “read” the BU coalitions from the geometric representation. In general, members of a BU coalition must be sufficiently isolated from players outside it to rank only each other tops.

Whether players’ preferences are cardinally single-peaked or not, it is always possible to ensure the existence—or nonexistence—of BU majority coalitions at any level from  $m - 1$  (simple majority coalition) to  $n - 1$  (grand coalition).

**Proposition 7.** *BU majority coalitions may appear—or not appear—at any level, up to the appearance of the grand coalition.*

**Proof.** See Appendix.

In the proof of Proposition 7, we show that, with one exception, it is possible to construct a cardinally single-peaked preference profile whose majority BU coalitions are of any size, or combination of sizes. The exception occurs when  $n = 3$ ; in this case, ordinally and cardinally single-peaked preferences are identical and produce a  $BU_1$  coalition of size 2. When preferences are not single-peaked,  $BU_1$  is of size 3. We will describe this case in detail in section 6.

The algorithm used to prove Proposition 7 yields, in the case of Example D, the following positions  $p_i$  of players  $i$ :

|       |   |   |   |   |   |   |   |
|-------|---|---|---|---|---|---|---|
| $i$ : | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|-------|---|---|---|---|---|---|---|

$$p_i: \quad 0 \quad 1 \quad 3 \quad 7 \quad 16 \quad 16.5 \quad 34$$

These positions are approximated by the representation given on the real line earlier.

Our construction in the proof of Proposition 7 is a quantitative one that yields the stable majority coalitions (1234, 123456, and 1234567) in this example. But we emphasize that it is the ordinal rankings that determine the stability of coalitions. Thus,  $BU_1 = 1234$  in Example D, because players 1 - 4 all rank each other highest. There is no 5-member BU coalition, because player 5 does not rank players 1 - 4 in its top four places (it ranks player 1 lower, and player 6 higher, than 4<sup>th</sup> place). There is next a 6-member BU coalition, 123456, because players 1 - 6 rank each other highest. The grand coalition, 1234567, as always, is a BU coalition.

Notice that less-than-majority FB coalitions, but not BU coalitions, form at levels 2 and 4 in Example D. The two 2-member coalitions at level 2 become part of BU coalition 1234 at level 3, and the 4-member FB majority coalition, 2345, at level 4 becomes part of BU majority coalition 123456 at level 5.

The level 1 BU coalition 56 remains apart until level 5. Although player 5 is acceptable to players 1 - 4 at level 4, player 5 does not find player 1 acceptable at this level. Consequently, player 5 does not get absorbed into a majority coalition until the descent reaches level 5, when player 6—player 5's most-preferred coalition partner—also gets absorbed.

Example D illustrates that a less-than-majority BU coalition (56) and a majority BU coalition (1234) can co-exist. However, two different BU majority coalitions, which of necessity overlap, cannot co-exist, as is possible under FB (see Example A for an illustration).

**Proposition 8.** *If two BU coalitions intersect, then one contains the other.*

**Proof.** Suppose that two BU coalitions—one with  $j$  members and the other with  $k \geq j$  members—have a member  $i$  in common. The members of the  $j$ -coalition must be player  $i$  and the first  $j - 1$  players in  $i$ 's preference ranking. The members of the  $k$ -coalition must be player  $i$  and the first  $k - 1$  players in  $i$ 's preference ranking. Clearly, the  $k$ -coalition contains the  $j$ -coalition. Q.E.D.

A consequence of Proposition 8 is that any majority BU coalition of a specific size is unique. In particular,  $BU_1$  contains only a single coalition, as already noted in Proposition 1. In Example D, the BU coalitions that form at levels 1 and 3 are contained in the level 5 BU coalition, which in turn is contained in the level 6 BU coalition. But BU coalition 56, which forms at level 1, is disjoint from BU majority coalition 1234 that forms at level 3. In general, if BU coalitions co-exist, then at most one is of majority size.

In section 4, we showed that members of  $BU_1$  cannot, in general, induce a preferred majority coalition, although they might be able to speed up the formation of an apparent (smaller)  $BU_1$  coalition. But what if a non-member of  $BU_1$  desires to be part of a BU coalition? We next show that such a player can conceivably benefit from a *bandwagon strategy*, which enables it, by misrepresenting its preferences, to be part of a larger BU majority coalition sooner than it would be if it were truthful.

To illustrate, suppose that player 5 in Example D reports its preference ranking to be

5: 4 3 2 1 6 7.

At level 5, BU majority coalition 12345 will form, which includes player 5. By comparison, if player 5 were truthful, the next BU majority coalition to form—after  $BU_1 = 1234$ —would be 123456. Because player 6 is player 5's most-preferred coalition partner, player 5 does not necessarily benefit from a bandwagon strategy, even though this strategy puts it into a smaller BU majority coalition at level 4 rather than level 5.

If there is a benefit, it would come by misrepresenting one's preferences in order to join the winning coalition early (i.e., "jumping on the bandwagon"). Indeed, there is evidence from US national party conventions of delegates' shifting to the expected winner—allegedly to demonstrate party unity—as soon as the handwriting of victory is on the wall. Such proclamations of support may well be motivated by cold-blooded calculations of the direct benefit (e.g., a government appointment) that sometimes accrues to former opponents (Brams, 1978).

## 6. The Probability of Stable Coalitions

Because BU coalitions may or may not exist at every level from simple majority to grand, it is useful to ask when they are most likely to form. To illustrate in a simple case, assume there are three players. Then each player can rank the two others in two ways. For example, player 1 can rank players 2 and 3 as follows:

- (i) 1: 2 3                      (ii) 1: 3 2.

Suppose (i) obtains. If player 2 has the following ranking,

2: 1 3,

$BU_1 = 12$ , whatever the ranking of player 3 (2 cases). Suppose (ii) obtains. If player 3 has the following ranking,

**3:** 1 2,

$BU_1 = 13$ , whatever the ranking of player 2 (2 cases). Whether the preferences of player 1 are (i) or (ii) (2 cases),  $BU_1 = 23$  if

**2:** 3 1

**3:** 2 1.

Altogether, there are 6 cases in which a 2-member BU coalition forms.

By comparison, there are 2 cases in which  $BU_1 = 123$ :<sup>12</sup>

**1:** 2 3

**1:** 3 2

**2:** 3 1

**2:** 1 3

**3:** 1 2

**3:** 2 1.

If the  $2^3 = 8$  cases are equally likely, the probability that there is a 2-member stable coalition is  $6/8 = 3/4$ . On the other hand, because the grand coalition is always stable, the probability that there is a 3-member stable coalition is 1.

We next generalize this result by finding a formula,  $P(n, k)$ , for the probability that a  $k$ -coalition ( $k \geq m$ ) is stable if all strict preference rankings of  $n$  players are equally likely, which we call a *random society*. The following proposition describes the behavior of this probability as the size of a majority coalition increases from  $m$  to  $n$ .

---

<sup>12</sup> The preferences of players in these two cases lead to a Condorcet voting paradox, or cyclical majorities.



**Proposition 9.** *The probability of a BU coalition, starting at  $k = m$ , decreases to a minimum at some intermediate value of  $k$  before increasing to 1 at  $k = n$ . More precisely, for each  $n \geq 3$ , there exists an integer  $k_0(n) = k_0$ , satisfying  $m \leq k_0 < n$ , such that  $P(n, k + 1) < P(n, k)$  if  $m \leq k < k_0$ ,  $P(n, k_0 + 1) \geq P(n, k_0)$ , and  $P(n, k + 1) > P(n, k)$  if  $k > k_0$ . Moreover,  $k_0(n) > m$  whenever  $n \geq 5$ .*

**Proof.** See Appendix.

For small values of  $n$  and  $k$ , we have calculated not only  $P(n, k)$  but also  $Q(n, k)$ , the probability that a  $k$ -coalition ( $k \geq m$ ) is stable when all preference rankings of the  $n$  players are ordinally single-peaked and equally likely to occur. In addition, using the method of inclusion-exclusion (Brualdi, 1999, pp. 159-168), we have made analogous calculations of the probabilities,  $P_1(n, k)$  and  $Q_1(n, k)$ , that stable majority coalitions form *for the first time*—that is, form at size  $k$  but not earlier. All these probabilities are given in Table 1 for values of  $n$  between 3 and 9, and all values of  $k$  between  $m$  and  $n$ .

---

Table 1 about here

---

In the 3-player case we just described,  $P(3, 2) = 0.75$  and  $P(3, 3) = 1$ , as we showed. When preferences are restricted to those that are ordinally single-peaked,  $Q(3, 2) = Q(3, 3) = 1$ , because there are no instances in which  $BU_1$  coalitions do not form at level 1.

The probabilities of  $BU_1$  coalitions appearing for the first time are  $P_1(3, 2) = 0.75$  and  $P_1(3, 3) = 0.25$ , because 2 of the 8 preference profiles yield  $BU_1$  coalitions when  $k =$

3. But when preferences are ordinally single-peaked,  $Q_1(3, 2) = 1$  and  $Q_1(3, 3) = 0$ , because all 6 preference profiles yield  $BU_1$  coalitions when  $k = 2$ .

Now consider the  $\underline{P}$  values in the Table 1A. For fixed  $n$ , these probabilities are virtually identical when  $n = 7$  and  $n = 9$ . They first decrease going from  $k = m$  to some intermediate value of  $k$ , and then increase to almost 1 in the case of  $P_1(n, k)$ , and to 1 in the case of  $P(n, k)$ .

What Proposition 9 does not indicate, though the numerical values of both  $P(n, k)$  and  $P_1(n, k)$  do, is that even when  $k = m$ , these probabilities are very small compared with their values when  $k = n$ . In other words, almost all  $BU_1$  coalitions in a random society form—in fact, form for the first time—only when the grand coalition appears.

It is evident that the probability that *any* BU majority coalition (except the grand coalition) forms in a random society becomes vanishingly small as  $n$  increases. This reflects the fact that there is at most one BU coalition at each majority size, and that stability is a certainty only for the grand coalition.

While the probability values in Table 1 may not be empirically accurate, the *distributions* may be qualitatively correct in many situations. As we will see later, majority coalitions in real-life voting bodies often do cluster around simple majority and grand—that is, their distribution is V-shaped between  $k = m$  and  $k = n$ , as the BU model predicts.

To be sure, the bimodal distribution of the probability values for general preferences concentrates almost all the support on the grand coalition. This support is dampened somewhat if preferences are restricted to profiles that are ordinally single-peaked (see the  $Q$  values in Table 1B). When  $n = 5$ , for example,  $Q_1(5, 3) = 0.333$  and

$Q_1(5, 4) = 0.104$ , compared with  $P_1(5, 3) = 0.046$  and  $P_1(5, 4) = 0.016$ . Thus, in the former case there is a 44% chance that  $BU_1$  will not be the grand coalition, whereas in the latter case there is only a 6% chance.

Of course, coalition formation does not generally occur in a random society. Subsets of players, such as political parties in a national legislature, will have members with similar preferences. In such situations, we would expect less-than-grand coalitions to form more frequently and be stable.

We conjecture that the distribution of  $FB_1$  semi-stable majority coalitions in a random society, for which we have not yet made detailed calculations, is also  $V$ -shaped, whether preferences are general or ordinally single-peaked. But instead of the  $V$ 's being so heavily weighted on the side of the grand coalition—that the  $V$  looks more like a  $J$ —our preliminary calculations indicate that the  $FB_1$  distribution will be considerably flattened, so there will be more weight in the middle as well as around a simple majority.

In the next section, we present empirical data on the distribution of majorities in the Supreme Court and illustrate coalition formation on the Court with two cases. In addition, we present data on the distribution of majorities in the House of Representatives, showing that, like the Court, the distribution is bimodal.

## **7. The Formation of Majorities on the Supreme Court**

In the 9-person US Supreme Court, majority coalitions fit the bimodal probability distribution we found under  $BU$ , with majorities tending to be either minimal winning or

unanimous. Between 1962 and 1997, we have the following distribution, with the minimum occurring at majority size 7:<sup>13</sup>

|                   |    |    |    |    |    |
|-------------------|----|----|----|----|----|
| Majority size:    | 5  | 6  | 7  | 8  | 9  |
| Percent of cases: | 24 | 21 | 13 | 14 | 27 |

These statistics, however, do not elucidate the process by which justices actually coalesce, either in divided 5-4 majorities and in consensual 9-0 decisions. For this purpose we consider two examples, one in which the Court was unanimous and the other in which it was sharply divided.

We start with the unanimous decision, *United States v. Nixon*, 418 U.S. 683 (1974), the infamous White House tapes case, which was actually decided by an 8-0 vote.<sup>14</sup> Before this case reached the Court, it looked like it would be contentious, based on an unofficial poll by Justice William Brennan. The four Nixon appointees favored the president's claim of executive privilege on withholding the White House tapes, and four took the other side, with Justice Byron White, who usually kept his counsel, inscrutable (Woodward and Armstrong, 1979, p. 289). Because the decision in this case triggered an unprecedented event—the resignation of a president—Schwartz (1996, p. 145) views it as “the most spectacular case decided by the Burger Court.”

In the Court's deliberations, Chief Justice Warren Burger, a Nixon appointee, initially sided with the president on executive privilege but was opposed by the rest of the Court. Acting as a kind of rump committee, the other justices redrafted Burger's original

---

<sup>13</sup> These data are drawn from Edelman and Sherry (2000), who also note the bimodal character of the Supreme Court majority decisions. They explain it in terms of a Markov process of coalition formation, using the Supreme Court voting data to calculate the probability of different absorbing states. By contrast, our work suggests a V-shaped distribution on theoretical grounds, independent of any data.

opinion, with different twosomes and threesomes rewriting its seven parts (Schwartz, 1996, p. 147). While *Nixon* was not the only such case of “decision by committee” during the Burger reign—another exception was *Buckley v. Valeo*, 424 U.S. 1 (1976), an important campaign-finance case (Schwartz, 1996, pp. 143-144)—*Nixon* is particularly insightful on how the build-up toward a final consensus was achieved.

The analysis of *Nixon* that follows does not do justice to Woodward and Armstrong’s (1979) 63-page blow-by-blow account, or even Schwartz’s (1996) 4-page insider account that includes a page from the personal files of one justice. Although the justices agreed that executive privilege was neither absolute nor unreviewable (especially *in camera*), they differed on how much confidentiality should be accorded presidential conversations and papers.

Because of the paramount importance and extreme public interest in the case, most justices believed that the decision should be the strongest possible—in particular, one delivered as a joint opinion, not written by a particular justice.<sup>15</sup> But Chief Justice Burger refused to go along, saying, “The responsibility is on my shoulders.” Schwartz (1996, pp. 145-146) summarizes the situation that then developed:

---

<sup>14</sup> Justice William Rehnquist recused himself because of his earlier service in the Nixon administration.

<sup>15</sup> It was not just a matter of writing a strong opinion; the justices were also extremely concerned that President Nixon would not abide by their decision unless it was “definitive,” a term used but never defined by Nixon that was widely interpreted to mean unanimous. Brams (1978, ch. 5) argues that Nixon’s implicit threat set up a game between Nixon and his two appointees, Burger and Harry Blackmun, who had to decide whether to make the decision unanimous by siding with the 6-person majority; Nixon, in turn, had to decide whether to comply with the decision or not. Rational strategies in the game are for Burger and Blackmun to side with the majority, and for Nixon to comply, which is, of course, what happened and forced Nixon’s resignation 17 days later. But treating Burger and Blackmun as a single player belies newer evidence, cited here, indicating that Burger alone was the only significant holdout. For a more informal treatment of strategizing on the Supreme Court that includes a statistical analysis of cases, see Maltzman, Spriggs, and Wahlbeck (2000).

He [Burger] would prepare the opinion and would circulate its different parts as he finished them. But the drafts he sent around took a more expansive view of presidential power than the others were willing to accept. The Justices refused to go along and virtually wrested the opinion-drafting process from the Chief Justice in order to secure an opinion that they could join.

In granting *certiorari* under a provision that allowed for expedited review of cases “of imperative public importance,” five—rather than the usual four—justices needed to agree to review the case. Justice William Brennan took the lead in putting together the votes, making the following calculation (Woodward and Armstrong, p. 290):

He could count on [William] Douglas and [Thurgood] Marshall. Douglas was eager to come to grips with his long-time antagonist.... They might well be joined by [Potter] Stewart.... [Byron] White could be within reach. Burger was beyond hope.... Blackmun was a possible cert vote.... It was difficult to tell where [Lewis] Powell stood.

In the end, the expedited *certiorari* decision received six votes.

Brennan and Douglas, the core of the coalition against Nixon, worried that the other justices might resent their doing most of the writing if Burger did not go along. Marshall signed on next, and Stewart seemed receptive. But even at the start of deliberations, Brennan found Douglas’s draft opinion “rais[ed] issues that were likely to derail consensus” that “did not need to be addressed” (Woodward and Armstrong, 1979, p. 297).

Subsequently, these drafts were modified, but Powell and Stewart still had misgivings, not wanting to put the functionings of government “into a goldfish bowl,” exposed to all and undermining the principle of confidentiality. Blackmun had another misgiving, fretting that if the Court reached a consensus against the president, Burger might assign the case to himself. This would raise serious questions about his impartiality if the president were impeached and, subsequently, there was trial in the Senate, over which he as chief justice would preside (Woodward and Armstrong, 1979, pp. 298, 301).

In the end, a liberal coalition comprising Brennan, Douglas, and Marshall, and a moderate coalition comprising Blackmun, Powell, and White, formed, with Stewart the linchpin that brought the two sides together.<sup>16</sup> He was assisted by Brennan, the greatest consensus builder then sitting on the Court.

It is reasonable to suppose that each of the 3-member coalition members ranked Stewart fourth, followed by members of the other coalition, with Burger, who held out until the end, ranked last by all the other justices. Under FB, the first majority coalition of five or more members to form would comprise Stewart and either the liberal coalition and one or more conservatives, or the conservative coalition and one or more liberals. The first BU coalition to form would then include all justices except Burger.

Once the other seven justices had reached agreement, however, the pressure was on Burger, who felt that the others had been “merciless” and that he had been “sandbagged” (Woodward and Armstrong, 1979, pp. 340-341). Ultimately he acquiesced, not wanting

---

<sup>16</sup> Stearns (2000, p. 236) classifies Blackmun as liberal, though he almost always voted with Burger, whom he classifies as conservative. In fact, Burger and Blackmun had the highest agreement level of any pair of justices in the 1970-74 period (83.5 percent), which is why they were called the “Minnesota twins.”

to be a minority of one—but not without claiming authorship of the “committee” decision, which he made his own.<sup>17</sup>

We now turn to the 5-4 case (*Miller v. California*, 413 U.S. 15 (1973)). The Supreme Court has considered many obscenity cases over the past 40 years, and almost all its decisions have been divided and contentious. Instead of examining the build-up of coalitions on any single case, we jump to the final stage of this decision. With the Court deadlocked 4-4, it turned to Blackmun to cast the fifth and decisive vote: Between the two protagonists, “he [Blackmun] could make his new friend Brennan or his old friend the Chief [Burger] author of the majority opinion” (Woodward and Armstrong, 1979, p. 252).

Blackmun worried that Burger’s broad definition of obscenity could lead to the banning of much worthwhile literature. When Blackmun threatened not to support Burger, Burger reluctantly agreed to incorporate a more limited definition of obscenity into his opinion. Blackmun then became Burger’s fifth vote; subsequently, Brennan revised his opinion as a dissent (Woodward and Armstrong, 1979, p. 252).

In effect, Blackmun ranked Burger coalition members above Brennan coalition members, and they him, making this 5-member coalition both an FB and a BU majority coalition. But, of course, it did not become a winning coalition until Burger made a concession, illustrating that the rankings presumed in the FB and BU models may not be set in stone.

---

<sup>17</sup> And how might this decision be described? “It was now virtually impossible to trace the turns and twists the opinion had taken: ideas articulated by Douglas and Powell, modified by Brennan, quickly sketched by the Chief [Burger]; a section substituted by White; a footnote dropped for Marshall; Blackmun’s facts embroidered over the Chief’s; Stewart’s constant tinkering and his ultimatum” (Woodward and Armstrong, 1979, p. 344).



In fact, players change their minds, sometimes because of a change of heart and sometimes for strategic reasons (Burger in the two cases considered here). As an example of a more sincere switch, Brennan renounced all definitions of obscenity after the 1972 case, allying himself with Douglas's more liberal view and ending their 16 years of disagreement on this issue (Woodward and Armstrong, 1979, p. 253).

There are other voting bodies in which our models seem applicable, including the U.S. House of Representatives. Indeed, as in the Supreme Court, there is a bimodal distribution of majority sizes, based on the 12,688 roll call votes between 1955 through 1990:<sup>18</sup>

|                        |       |       |       |       |        |
|------------------------|-------|-------|-------|-------|--------|
| Percent majority:      | 50–60 | 60-70 | 70-80 | 80-90 | 90-100 |
| Percent of roll calls: | 26    | 19    | 14    | 11    | 30     |

Although the minimum occurs in the 80-90 percent range, not the middle 70-80 percent range, the two modes are the near-majority and near-unanimity ranges, consistent with the BU model.

In the final section we will assess the stability of the grand and smaller majority coalitions in light of both the FB and BU models. We will also suggest some empirical observations and data that might be useful in further testing the model.

## 8. Conclusions

BU seems most applicable to studying coalition formation in multimember courts and legislatures, in which small subsets of members coalesce and build up to a majority, all of whose members rank each other highest and are therefore stable. FB probably

better describes the formation of a governing coalition in parliamentary democracies, wherein disconnected coalitions sometimes form. Because parties in such coalitions rank some parties outside the coalition higher than parties in it, these coalitions are at best semi-stable.<sup>19</sup>

Insofar as voters' preferences are single-peaked, the coalition governments that form are usually connected. Indeed, they are often described by such terms as "left-center" or "center-right." On occasion, however, the left and right do get together and form national-unity governments—sometimes in response to a crisis, like the threat of war—in which many members may be far from each other's favorite coalition partners.

Such semi-stable coalitions, which may be disconnected, tend not to last. According to Riker's (1962) size principle, some of their members grow disaffected and leave if there are insufficient resources to reward them in an oversized coalition.

Through manipulation, players can disrupt semi-stable coalitions by announcing false preferences. Not all these changes, however, may be purely opportunistic. For example, Jim Jeffords, a US Senator from Vermont, switched from the Republican party to become an independent in 2001, turning the Democratic party into the majority party in the Senate. He seems to have been motivated by a genuine belief that he could better serve Vermont and his country by changing his party affiliation. By contrast, we suggested that the preference changes that create bandwagons may not be so sincere.

To conclude, coalition-formation processes affect the size and stability of the coalitions they generate. If stability can be measured by durability, then our models may

---

<sup>18</sup> We are grateful to Jeffrey E. Cohen for calling our attention to these data, which were compiled by David W. Rohde for the Inter-University Consortium for Political and Social Research in January 1995.

provide insight into why parliamentary coalitions in a country like Italy are less durable than those in the Scandinavian countries, where government coalitions sometimes do not include even a simple majority of members.

The models might also enhance our understanding of the stability of coalitions in other arenas, including international relations. Some international alliances like NATO have been long-lasting, others ephemeral. Is the process that led to the former more BU-like, the latter more FB-like? Our models, we believe, provide tools for investigating such questions.

---

<sup>19</sup> Because the significant players in parliamentary democracies are different-size parties, strategic considerations come into play that the FB and BU do not take account of (see note 1). Data on coalition governments in Western Europe can be found in Müller and Strom (2000).

## Appendix

**Proposition 7.** *BU majority coalitions may appear—or not appear—at any level, up to the appearance of the grand coalition.*

**Proof.** Assume that there are  $n > 3$  players and that  $m = \lceil (n + 1)/2 \rceil$ . The following algorithm positions player  $i$  at  $x_i$  on the real line. Players' preferences are then defined by Euclidean distance—that is, player  $i$  prefers player  $j$  over player  $k$  if the distance between  $x_i$  and  $x_j$  is less than the distance between  $x_j$  and  $x_k$ . The following algorithm constructs cardinally single-peaked preferences in which the only stable majority coalitions are of size  $k_h$ ,  $h = 1, 2, \dots, t$ , where  $m \leq k_1 < k_2 \dots < k_t = n$ . Note that  $t \geq 1$ .

Assign  $x_1 = 0$ . For  $1 < i \leq m$ , let player  $i$ 's position be defined recursively by  $x_i = 2x_{i-1} + 1$ . By construction, for  $1 < i < m$ , player  $i$ 's single-peaked preferences are

$$i: i-1 \quad i-2 \quad \dots \quad 2 \quad 1 \quad i+1 \quad i+2 \quad \dots \quad m-1 \quad m \quad m+1 \quad \dots \quad n.$$

Notice that player  $i$  most prefers player  $i-1$  as a coalition partner.

The construction considers two separate cases. First suppose  $t = 1$  (i.e., only the grand coalition is stable and  $k_1 = n$ .) Let  $x_{m+1} = x_m + 1/2$  and define  $x_i$  for  $i > m+1$  by  $x_{m+k+1} = x_{m+k} + x_{m-k+1} - x_{m-k}$ . Since the distance between  $x_{m+k+1}$  and  $x_{m+k}$  is the same as the distance between  $x_{m-k+1}$  and  $x_{m-k}$ , it follows that, for  $m+1 < j < n$ , player  $j$  most prefers player  $j+1$ .

Player  $m$  has the following preferences, depending on whether  $n$  is odd or even, respectively,

$$m: m+1 \quad m-1 \quad m+2 \quad m-2 \quad \dots \quad m+k \quad m-k \quad \dots \quad n-1; \text{ or}$$

$$m: m+1 \quad m-1 \quad m+2 \quad m-2 \dots m+k \quad m-k \dots n \quad 2 \quad 1.$$

Because preferences are single-peaked, any  $k$ -stable coalition for  $k \geq m$  must contain the median voter(s). Hence, we can focus on player  $m$ 's preferences.

Any  $k$ -stable majority coalition must comprise the first  $k-1$  players in player  $m$ 's ranking. If  $k-1 = 2l$ , then player  $m$  ranks player  $m-l$  in position  $k-1$  of its ranking. So a  $k$ -stable coalition must contain players  $m$  and  $m-l$ . But, player  $m-l$  most prefers player  $m-l-1$ . Since player  $m$  does not rank player  $m-l-1$  among its  $k-1$  most-preferred coalition partners (because player  $m-l$  is the least-preferred player in the coalition), the coalition is not  $k$ -stable. Similarly, if  $k-1 = 2l-1$ , then player  $m$  ranks player  $m+l$  in position  $k-1$  of its ranking.

A  $k$ -stable coalition must contain players  $m$  and  $m+l$ . But, player  $m+l$  most prefers player  $m+l+1$  as a coalition partner, which is not among player  $m$ 's top  $k-1$  players. And no majority coalition of size  $k < n$  is stable.

Now suppose  $t > 1$ , so  $k_1 < n$ . For  $m \leq i < k_1 < n$ , let  $j$  satisfy  $i = m + j$ . Then player  $i$ 's position is given by  $x_i = x_m$  for  $j = 0$  and  $x_i = x_{i-1} + \frac{1}{2^j}$  for  $j \geq 1$ . Similarly, for  $k_1 < i \leq k_2$ , let  $j$  satisfy  $i = k_1 + j$ . Define  $x_i = 2x_m + 2$  for  $j = 1$  and  $x_i = x_{i-1} + \frac{1}{2^{j-1}}$  for  $j > 1$ . Finally, for  $k_{s-1} < i \leq k_s \leq n$ , let  $j$  satisfy  $i = k_{s-1} + j$ . Player  $i$ 's position is given by  $x_i = 2x_{k_{s-1}} + 2$  for  $j = 1$  and  $x_i = x_{i-1} + \frac{1}{2^{j-1}}$  for  $j > 1$ .

It is possible to describe player  $i$ 's preferences for  $i \geq m$ , too. If  $k_{s-1} < i \leq k_s$  where  $j$  satisfies  $i = k_{s-1} + j$ , then player  $i$ 's ranking of coalition partners is

$$i: i+1 \ i+2 \ \dots \ k_s \ i-1 \ i-2 \ \dots \ 2 \ 1 \ k_s+1 \ k_s+2 \ \dots \ n.$$

Any majority stable coalition that contains player  $i$  must contain a player  $j$  where  $1 < j < m$ . But, by construction, player  $j$  most prefers player  $j-1$ . This implies that all of the players less than  $i$  must be in the coalition. Since player  $i$ 's most-preferred coalition partners are players  $i+1, i+2, i+3, \dots$ , and  $k_s$ , only coalitions of the form  $\{1, 2, \dots, k_s\}$  are stable. The same argument holds for  $i$  where  $m \leq i \leq k_h$  as well. Q.E.D.

**Proposition 9.** *The probability of a BU coalition, starting at  $k = m$ , decreases to a minimum at some intermediate value of  $k$  before increasing to 1 at  $k = n$ . More precisely, for each  $n \geq 3$ , there exists an integer  $k_0(n) = k_0$ , satisfying  $m \leq k_0 < n$ , such that  $P(n, k+1) < P(n, k)$  if  $m \leq k < k_0$ ,  $P(n, k_0+1) \geq P(n, k_0)$ , and  $P(n, k+1) > P(n, k)$  if  $k > k_0$ . Moreover,  $k_0(n) > m$  whenever  $n \geq 5$ .*

**Proof.** Because each player can rank all other players in  $(n-1)!$  ways, there are a total of  $[(n-1)!]^n$  preference profiles. Suppose a  $k$ -coalition is stable, where  $2 \leq k \leq n$ . Then for each member of the coalition, the first  $k-1$  players in its preference ranking must be the other members of the coalition. It follows that the number of preference rankings admitting a stable coalition of  $k$  members is

$$\binom{n}{k} [(k-1)!(n-k)!]^k [(n-1)!]^{n-k}. \quad (1)$$

To justify this formula, note that there are  $\binom{n}{k}$  ways to choose the members of the stable  $k$ -coalition. For each of the  $k$  members of this coalition, the other members (which come highest in its preference ranking) can be arranged in  $(k-1)!$  ways; for each of the non-

members of the coalition, which come lower in its preference ranking, can be arranged in  $(n - k)!$  ways. Finally, there are  $(n - 1)!$  ways to choose the preference rankings of each of the  $n - k$  non-members of the coalition.

Formula (1) is not very useful for small values of  $k$ , because it double-counts instances when there are two or more disjoint stable coalitions with  $k$  members. But for  $m \leq k \leq n$ , formula (1) gives the number of preference rankings, out of  $[(n - 1)!]^n$ , in which a (unique) stable majority coalition exists (see Proposition 8).

It follows from the preceding argument that in a random society with  $n$  players, the probability that there is a BU coalition with  $k$  members, where  $m \leq k \leq n$ , is

$$\begin{aligned}
 P(n, k) &= \frac{\binom{n}{k} [(k - 1)!(n - k)!]^k [(n - 1)!]^{n - k}}{[(n - 1)!]^n} \\
 &= \binom{n}{k} \left[ \frac{(k - 1)!(n - k)!}{(n - 1)!} \right]^k = \frac{\binom{n}{k}}{\binom{n - 1}{k - 1}}. \tag{2}
 \end{aligned}$$

By construction,  $0 < P(n, k) \leq 1$ . Also, it is easy to check that  $P(n, n) = 1$ .

If  $k < n$ , it follows from (2) that

$$\frac{P(n, k + 1)}{P(n, k)} = \frac{\binom{n}{k + 1} \binom{n - 1}{k}^{-(k + 1)}}{\binom{n}{k} \binom{n - 1}{k - 1}^{-k}}$$

$$\begin{aligned}
&= \frac{\binom{n}{k+1}}{\binom{n}{k}} \left[ \frac{\binom{n-1}{k-1}}{\binom{n-1}{k}} \right]^k \frac{1}{\binom{n-1}{k}} \\
&= \frac{n-k}{k+1} \left( \frac{k}{n-k} \right)^k \frac{1}{\binom{n-1}{k}}. \tag{3}
\end{aligned}$$

From (3) it follows that  $P(n, k+1) \geq P(n, k)$  if and only if

$$\binom{n-1}{k} \leq \frac{n-k}{k+1} \left( \frac{k}{n-k} \right)^k. \tag{4}$$

Moreover,  $P(n, k+1) > P(n, k)$  if and only if strict inequality holds in (4).

Now suppose that  $k$  satisfies  $m \leq k < n$  and that  $P(n, k+1) \geq P(n, k)$ . Therefore (4) holds. We show that  $P(n, k+2) > P(n, k+1)$  by showing that strict inequality holds on the right side of (4) when  $k+1$  is substituted for  $k$ . Because  $k+1 > k > n/2$ , it follows that

$$\binom{n-1}{k+1} < \binom{n-1}{k} \leq \frac{n-k}{k+1} \left( \frac{k}{n-k} \right)^k < \frac{n-k-1}{k+2} \left( \frac{k+1}{n-k-1} \right)^{k+1}. \tag{5}$$

The final equality of (5) is true because

$$\frac{k}{n-k} < \frac{k+1}{n-k-1}$$

and



$$\frac{n-k}{k+1} < \frac{n-k-1}{k+2} \left( \frac{k+1}{n-k-1} \right) = \frac{k+1}{k+2}. \quad (6)$$

To verify the inequality of (6), note that it is equivalent to

$$2k^2 - (n-4)k - (2n-1) > 0,$$

which is easily shown to be true because  $k > n/2$ .

It is not difficult to show that when  $n \geq 5$  and  $k = m$ , the right side of (4) is approximately equal to  $e^{3/2} = 4.48$ . Therefore,  $k_0$ , the minimum value of  $k$  for which (4) holds, exceeds  $m$  if and only if  $n \geq 5$ . Q.E.D.

## References

- Brams, Steven J. (1978). *The Presidential Election Game*. New Haven, CT: Yale University Press.
- Brams, Steven J., Michael A. Jones, and D. Marc Kilgour (2002). "Single-Peakedness and Disconnected Coalitions." *Journal of Theoretical Politics* 14, no. 3 (July): 359-383.
- Brams, Steven J., and D. Marc Kilgour (2001). "Fallback Bargaining." *Group Decision and Negotiation* 10, no. 4 (July): 287-316.
- Brualdi, Richard A. (1999). *Introductory Combinatorics*. Upper Saddle River, NJ: Prentice-Hall.
- Cechlárová, Katarina, and Antonio Romero-Medina (2000). "Stability in Coalition Formation Games." *International Journal of Game Theory* 29, no. 4 (December): 487-494.
- Edelman, Paul H., and Suzanna Sherry (2000). "All or Nothing: Explaining the Size of Supreme Court Majorities." *North Carolina Law Review* 78, no. 5 (June): 1225-52.
- Greenberg, Joseph, and Shlomo Weber (1993). "Stable Coalition Structures with a Unidimensional Set of Alternatives." *Journal of Economic Theory* 60, no. 1: 62-82.
- Grofman, Bernard (1982). "A Dynamic Model of Protocoalition Formation in Ideological  $N$ -Space." *Behavioral Science* 27: 77-99.
- Iizuka, Hiroyuki, Masahito Yamamoto, Keji Suzuki, and Azuma Ohuchi (2002). "Bottom-up Consensus Formation in Voting Games." *Nonlinear Dynamics*,

*Psychology, and Life Sciences* 6, no. 2 (April): 185-195.

Maltzman, Forrest, James F. Spriggs II, and Paul J. Wahlbeck (2000). *Crafting Law on The Supreme Court: The Collegial Game*. New York. Cambridge University Press.

Müller, Wolfgang C., and Kaare Strom (eds.) (2001). *Coalition Government in Western Europe*. Oxford, UK: Oxford University Press.

Riker, William H. (1962). *The Theory of Political Coalitions*. New Haven, CT: Yale University Press.

Schwartz, Bernard (1996). *Decision: How the Supreme Court Decides Cases*. New York: Oxford University Press.

Stearns, Maxwell L. (2000). *Constitutional Process: A Social Choice Analysis of the Supreme Court Decision Making*. Ann Arbor, MI: University of Michigan Press.

Straffin, Philip D., Jr., and Bernard Grofman (1984). "Parliamentary Coalitions: A Tour of Models." *Mathematics Magazine* 57, no. 5: 259-274.

Woodward, Bob, and Scott Armstrong (1979). *The Brethren: Inside the Supreme Court*. New York: Simon and Schuster.

**Table 1**

**Probabilities of Stable (BU) Coalitions ( $P, Q$ ) and  
First-Forming Stable (BU<sub>1</sub>) Coalitions ( $P_1, Q_1$ )**

*A. All preference profiles equiprobable*

|            | $k=2$ | $k=3$  | $k=4$                 | $k=5$                 | $k=6$                 | $k=7$                 | $k=8$                 | $k=9$    |
|------------|-------|--------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------|
| $P(3,k)$   | 0.75  | 1      |                       |                       |                       |                       |                       |          |
| $P_1(3,k)$ | 0.75  | 0.25   |                       |                       |                       |                       |                       |          |
| $P(4,k)$   |       | 0.1481 | 1                     |                       |                       |                       |                       |          |
| $P_1(4,k)$ |       | 0.1481 | 0.8519                |                       |                       |                       |                       |          |
| $P(5,k)$   |       | 0.0463 | 0.0195                | 1                     |                       |                       |                       |          |
| $P_1(5,k)$ |       | 0.0463 | 0.0166                | 0.9371                |                       |                       |                       |          |
| $P(7,k)$   |       |        | $2.19 \times 10^{-4}$ | $2.77 \times 10^{-5}$ | $1.50 \times 10^{-4}$ | 1                     |                       |          |
| $P_1(7,k)$ |       |        | $2.19 \times 10^{-4}$ | $2.76 \times 10^{-5}$ | $1.50 \times 10^{-4}$ | 0.9996                |                       |          |
| $P(9,k)$   |       |        |                       | $7.50 \times 10^{-8}$ | $2.72 \times 10^{-9}$ | $2.67 \times 10^{-9}$ | $5.36 \times 10^{-7}$ | 1        |
| $P_1(9,k)$ |       |        |                       | $7.50 \times 10^{-8}$ | $2.72 \times 10^{-9}$ | $2.67 \times 10^{-9}$ | $5.36 \times 10^{-7}$ | 0.999999 |

*B. All ordinally single-peaked preference profiles equiprobable*

|            | $k=2$ | $k=3$  | $k=4$  | $k=5$                 | $k=6$                 | $k=7$                 | $k=8$                 | $k=9$  |
|------------|-------|--------|--------|-----------------------|-----------------------|-----------------------|-----------------------|--------|
| $Q(3,k)$   | 1     | 1      |        |                       |                       |                       |                       |        |
| $Q_1(3,k)$ | 1     | 0      |        |                       |                       |                       |                       |        |
| $Q(4,k)$   |       | 0.4444 | 1      |                       |                       |                       |                       |        |
| $Q_1(4,k)$ |       | 0.4444 | 0.5556 |                       |                       |                       |                       |        |
| $Q(5,k)$   |       | 0.3333 | 0.1875 | 1                     |                       |                       |                       |        |
| $Q_1(5,k)$ |       | 0.3333 | 0.1042 | 0.5625                |                       |                       |                       |        |
| $Q(7,k)$   |       |        | 0.0640 | 0.0640                | 0.0308                | 1                     |                       |        |
| $Q_1(7,k)$ |       |        | 0.0640 | 0.0591                | 0.0272                | 0.8497                |                       |        |
| $Q(9,k)$   |       |        |        | $8.55 \times 10^{-3}$ | $2.75 \times 10^{-3}$ | $2.12 \times 10^{-3}$ | $4.81 \times 10^{-3}$ | 1      |
| $Q_1(9,k)$ |       |        |        | $8.55 \times 10^{-3}$ | $2.54 \times 10^{-3}$ | $2.01 \times 10^{-3}$ | $4.65 \times 10^{-3}$ | 0.9822 |

## NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

### Fondazione Eni Enrico Mattei Working Paper Series

Our working papers are available on the Internet at the following addresses:

<http://www.feem.it/Feem/Pub/Publications/WPapers/default.html>

<http://papers.ssrn.com>

|                          |         |  |
|--------------------------|---------|--|
| SUST                     | 1.2002  | <i>K. TANO, M.D. FAMINOW, M. KAMUANGA and B. SWALLOW: <u>Using Conjoint Analysis to Estimate Farmers' Preferences for Cattle Traits in West Africa</u></i>                                 |
| ETA                      | 2.2002  | <i>Efrem CASTELNUOVO and Paolo SURICO: <u>What Does Monetary Policy Reveal about Central Bank's Preferences?</u></i>   |
| WAT                      | 3.2002  | <i>Duncan KNOWLER and Edward BARBIER: <u>The Economics of a "Mixed Blessing" Effect: A Case Study of the Black Sea</u></i>   |
| CLIM                     | 4.2002  | <i>Andreas LÖSCHEL: <u>Technological Change in Economic Models of Environmental Policy: A Survey</u></i>   |
| VOL                      | 5.2002  | <i>Carlo CARRARO and Carmen MARCHIORI: <u>Stable Coalitions</u></i>  |
| CLIM                     | 6.2002  | <i>Marzio GALEOTTI, Alessandro LANZA and Matteo MANERA: <u>Rockets and Feathers Revisited: An International Comparison on European Gasoline Markets</u></i>                                |
| ETA                      | 7.2002  | <i>Effrosyni DIAMANTOUDI and Efthios S. SARTZETAKIS: <u>Stable International Environmental Agreements: An Analytical Approach</u></i>  |
| KNOW                     | 8.2002  | <i>Alain DESDOIGTS: <u>Neoclassical Convergence Versus Technological Catch-up: A Contribution for Reaching a Consensus</u></i>   |
| NRM                      | 9.2002  | <i>Giuseppe DI VITA: <u>Renewable Resources and Waste Recycling</u></i>  |
| KNOW                     | 10.2002 | <i>Giorgio BRUNELLO: <u>Is Training More Frequent when Wage Compression is Higher? Evidence from 11 European Countries</u></i>   |
| ETA                      | 11.2002 | <i>Mordecai KURZ, Hehui JIN and Maurizio MOTOLESE: <u>Endogenous Fluctuations and the Role of Monetary Policy</u></i>  |
| KNOW                     | 12.2002 | <i>Reyer GERLAGH and Marjan W. HOFKES: <u>Escaping Lock-in: The Scope for a Transition towards Sustainable Growth?</u></i>   |
| NRM                      | 13.2002 | <i>Michele MORETTO and Paolo ROSATO: <u>The Use of Common Property Resources: A Dynamic Model</u></i>  |
| CLIM                     | 14.2002 | <i>Philippe QUIRION: <u>Macroeconomic Effects of an Energy Saving Policy in the Public Sector</u></i>  |
| CLIM                     | 15.2002 | <i>Roberto ROSON: <u>Dynamic and Distributional Effects of Environmental Revenue Recycling Schemes: Simulations with a General Equilibrium Model of the Italian Economy</u></i>            |
| CLIM                     | 16.2002 | <i>Francesco RICCI (I): <u>Environmental Policy Growth when Inputs are Differentiated in Pollution Intensity</u></i>   |
| ETA                      | 17.2002 | <i>Alberto PETRUCCI: <u>Devaluation (Levels versus Rates) and Balance of Payments in a Cash-in-Advance Economy</u></i>   |
| Coalition Theory Network | 18.2002 | <i>László Á. KÓCZY (liv): <u>The Core in the Presence of Externalities</u></i>   |
| Coalition Theory Network | 19.2002 | <i>Steven J. BRAMS, Michael A. JONES and D. Marc KILGOUR (liv): <u>Single-Peakedness and Disconnected Coalitions</u></i>   |
| Coalition Theory Network | 20.2002 | <i>Guillaume HAERINGER (liv): <u>On the Stability of Cooperation Structures</u></i>  |
| NRM                      | 21.2002 | <i>Fausto CAVALLARO and Luigi CIRAULO: <u>Economic and Environmental Sustainability: A Dynamic Approach in Insular Systems</u></i>   |
| CLIM                     | 22.2002 | <i>Barbara BUCHNER, Carlo CARRARO, Igor CERSOSIMO and Carmen MARCHIORI: <u>Back to Kyoto? US Participation and the Linkage between R&amp;D and Climate Cooperation</u></i>                 |
| CLIM                     | 23.2002 | <i>Andreas LÖSCHEL and ZhongXIANG ZHANG: <u>The Economic and Environmental Implications of the US Repudiation of the Kyoto Protocol and the Subsequent Deals in Bonn and Marrakech</u></i> |
| ETA                      | 24.2002 | <i>Marzio GALEOTTI, Louis J. MACCINI and Fabio SCHIANTARELLI: <u>Inventories, Employment and Hours</u></i>   |
| CLIM                     | 25.2002 | <i>Hannes EGLI: <u>Are Cross-Country Studies of the Environmental Kuznets Curve Misleading? New Evidence from Time Series Data for Germany</u></i>   |
| ETA                      | 26.2002 | <i>Adam B. JAFFE, Richard G. NEWELL and Robert N. STAVINS: <u>Environmental Policy and Technological Change</u></i>  |
| SUST                     | 27.2002 | <i>Joseph C. COOPER and Giovanni SIGNORELLO: <u>Farmer Premiums for the Voluntary Adoption of Conservation Plans</u></i>   |
| SUST                     | 28.2002 | <i><u>The ANSEA Network: Towards An Analytical Strategic Environmental Assessment</u></i>  |
| KNOW                     | 29.2002 | <i>Paolo SURICO: <u>Geographic Concentration and Increasing Returns: a Survey of Evidence</u></i>  |
| ETA                      | 30.2002 | <i>Robert N. STAVINS: <u>Lessons from the American Experiment with Market-Based Environmental Policies</u></i>   |

|           |         |   |
|-----------|---------|---|
| NRM       | 31.2002 | <i>Carlo GIUPPONI and Paolo ROSATO: <u>Multi-Criteria Analysis and Decision-Support for Water Management at the Catchment Scale: An Application to Diffuse Pollution Control in the Venice Lagoon</u></i>               |
| NRM       | 32.2002 | <i>Robert N. STAVINS: <u>National Environmental Policy During the Clinton Years</u></i>   |
| KNOW      | 33.2002 | <i>A. SOUBEYRAN and H. STAHN : <u>Do Investments in Specialized Knowledge Lead to Composite Good Industries?</u></i>  |
| KNOW      | 34.2002 | <i>G. BRUNELLO, M.L. PARISI and Daniela SONEDDA: <u>Labor Taxes, Wage Setting and the Relative Wage Effect</u></i>  |
| CLIM      | 35.2002 | <i>C. BOEMARE and P. QUIRION (lv): <u>Implementing Greenhouse Gas Trading in Europe: Lessons from Economic Theory and International Experiences</u></i>   |
| CLIM      | 36.2002 | <i>T. TIETENBERG (lv): <u>The Tradable Permits Approach to Protecting the Commons: What Have We Learned?</u></i>  |
| CLIM      | 37.2002 | <i>K. REHDANZ and R.J.S. TOL (lv): <u>On National and International Trade in Greenhouse Gas Emission Permits</u></i>  |
| CLIM      | 38.2002 | <i>C. FISCHER (lv): <u>Multinational Taxation and International Emissions Trading</u></i>   |
| SUST      | 39.2002 | <i>G. SIGNORELLO and G. PAPPALARDO: <u>Farm Animal Biodiversity Conservation Activities in Europe under the Framework of Agenda 2000</u></i>  |
| NRM       | 40.2002 | <i>S.M. CAVANAGH, W. M. HANEMANN and R. N. STAVINS: <u>Muffled Price Signals: Household Water Demand under Increasing-Block Prices</u></i>  |
| NRM       | 41.2002 | <i>A. J. PLANTINGA, R. N. LUBOWSKI and R. N. STAVINS: <u>The Effects of Potential Land Development on Agricultural Land Prices</u></i>  |
| CLIM      | 42.2002 | <i>C. OHL (lvi): <u>Inducing Environmental Co-operation by the Design of Emission Permits</u></i>   |
| CLIM      | 43.2002 | <i>J. EYCKMANS, D. VAN REGEMORTER and V. VAN STEENBERGHE (lvi): <u>Is Kyoto Fatally Flawed? An Analysis with MacGEM</u></i>   |
| CLIM      | 44.2002 | <i>A. ANTOCI and S. BORGHESI (lvi): <u>Working Too Much in a Polluted World: A North-South Evolutionary Model</u></i>   |
| ETA       | 45.2002 | <i>P. G. FREDRIKSSON, Johan A. LIST and Daniel MILLIMET (lvi): <u>Chasing the Smokestack: Strategic Policymaking with Multiple Instruments</u></i>  |
| ETA       | 46.2002 | <i>Z. YU (lvi): <u>A Theory of Strategic Vertical DFI and the Missing Pollution-Haven Effect</u></i>  |
| SUST      | 47.2002 | <i>Y. H. FARZIN: <u>Can an Exhaustible Resource Economy Be Sustainable?</u></i>   |
| SUST      | 48.2002 | <i>Y. H. FARZIN: <u>Sustainability and Hamiltonian Value</u></i>  |
| KNOW      | 49.2002 | <i>C. PIGA and M. VIVARELLI: <u>Cooperation in R&amp;D and Sample Selection</u></i>   |
| Coalition | 50.2002 | <i>M. SERTEL and A. SLINKO (liv): <u>Ranking Committees, Words or Multisets</u></i>   |
| Theory    |         |   |
| Network   |         |   |
| Coalition | 51.2002 | <i>Sergio CURRARINI (liv): <u>Stable Organizations with Externalities</u></i>   |
| Theory    |         |   |
| Network   |         |   |
| ETA       | 52.2002 | <i>Robert N. STAVINS: <u>Experience with Market-Based Policy Instruments</u></i>  |
| ETA       | 53.2002 | <i>C.C. JAEGER, M. LEIMBACH, C. CARRARO, K. HASSELMANN, J.C. HOURCADE, A. KEELER and R. KLEIN (liii): <u>Integrated Assessment Modeling: Modules for Cooperation</u></i>  |
| CLIM      | 54.2002 | <i>Scott BARRETT (liii): <u>Towards a Better Climate Treaty</u></i>   |
| ETA       | 55.2002 | <i>Richard G. NEWELL and Robert N. STAVINS: <u>Cost Heterogeneity and the Potential Savings from Market-Based Policies</u></i>  |
| SUST      | 56.2002 | <i>Paolo ROSATO and Edi DEFRANCESCO: <u>Individual Travel Cost Method and Flow Fixed Costs</u></i>  |
| SUST      | 57.2002 | <i>Vladimir KOTOV and Elena NIKITINA (lvii): <u>Reorganisation of Environmental Policy in Russia: The Decade of Success and Failures in Implementation of Perspective Quests</u></i>                                    |
| SUST      | 58.2002 | <i>Vladimir KOTOV (lvii): <u>Policy in Transition: New Framework for Russia's Climate Policy</u></i>  |
| SUST      | 59.2002 | <i>Fanny MISSELDT and Arturo VILLAVICENCO (lvii): <u>How Can Economies in Transition Pursue Emissions Trading or Joint Implementation?</u></i>  |
| VOL       | 60.2002 | <i>Giovanni DI BARTOLOMEO, Jacob ENGWERDA, Joseph PLASMANS and Bas VAN AARLE: <u>Staying Together or Breaking Apart: Policy-Makers' Endogenous Coalitions Formation in the European Economic and Monetary Union</u></i> |
| ETA       | 61.2002 | <i>Robert N. STAVINS, Alexander F. WAGNER and Gernot WAGNER: <u>Interpreting Sustainability in Economic Terms: Dynamic Efficiency Plus Intergenerational Equity</u></i>   |
| PRIV      | 62.2002 | <i>Carlo CAPUANO: <u>Demand Growth, Entry and Collusion Sustainability</u></i>  |
| PRIV      | 63.2002 | <i>Federico MUNARI and Raffaele ORIANI: <u>Privatization and R&amp;D Performance: An Empirical Analysis Based on Tobin's Q</u></i>  |
| PRIV      | 64.2002 | <i>Federico MUNARI and Maurizio SOBRERO: <u>The Effects of Privatization on R&amp;D Investments and Patent Productivity</u></i>   |
| SUST      | 65.2002 | <i>Orley ASHENFELTER and Michael GREENSTONE: <u>Using Mandated Speed Limits to Measure the Value of a Statistical Life</u></i>  |
| ETA       | 66.2002 | <i>Paolo SURICO: <u>US Monetary Policy Rules: the Case for Asymmetric Preferences</u></i>   |
| PRIV      | 67.2002 | <i>Rinaldo BRAU and Massimo FLORIO: <u>Privatisations as Price Reforms: Evaluating Consumers' Welfare Changes in the U.K.</u></i>   |
| CLIM      | 68.2002 | <i>Barbara K. BUCHNER and Roberto ROSON: <u>Conflicting Perspectives in Trade and Environmental Negotiations</u></i>  |
| CLIM      | 69.2002 | <i>Philippe QUIRION: <u>Complying with the Kyoto Protocol under Uncertainty: Taxes or Tradable Permits?</u></i>   |
| SUST      | 70.2002 | <i>Anna ALBERINI, Patrizia RIGANTI and Alberto LONGO: <u>Can People Value the Aesthetic and Use Services of Urban Sites? Evidence from a Survey of Belfast Residents</u></i>  |
| SUST      | 71.2002 | <i>Marco PERCOCO: <u>Discounting Environmental Effects in Project Appraisal</u></i>   |

|      |          |  |
|------|----------|--|
| NRM  | 72.2002  | <i>Philippe BONTEMS and Pascal FAVARD: <u>Input Use and Capacity Constraint under Uncertainty: The Case of Irrigation</u></i>  |
| PRIV | 73.2002  | <i>Mohammed OMRAN: <u>The Performance of State-Owned Enterprises and Newly Privatized Firms: Empirical Evidence from Egypt</u></i>   |
| PRIV | 74.2002  | <i>Mike BURKART, Fausto PANUNZI and Andrei SHLEIFER: <u>Family Firms</u></i>   |
| PRIV | 75.2002  | <i>Emmanuelle AURIOL, Pierre M. PICARD: <u>Privatizations in Developing Countries and the Government Budget Constraint</u></i>   |
| PRIV | 76.2002  | <i>Nichole M. CASTATER: <u>Privatization as a Means to Societal Transformation: An Empirical Study of Privatization in Central and Eastern Europe and the Former Soviet Union</u></i>  |
| PRIV | 77.2002  | <i>Christoph LÜLSFESMANN: <u>Benevolent Government, Managerial Incentives, and the Virtues of Privatization</u></i>  |
| PRIV | 78.2002  | <i>Kate BISHOP, Igor FILATOTCHEV and Tomasz MICKIEWICZ: <u>Endogenous Ownership Structure: Factors Affecting the Post-Privatisation Equity in Largest Hungarian Firms</u></i>  |
| PRIV | 79.2002  | <i>Theodora WELCH and Rick MOLZ: <u>How Does Trade Sale Privatization Work? Evidence from the Fixed-Line Telecommunications Sector in Developing Economies</u></i>   |
| PRIV | 80.2002  | <i>Alberto R. PETRUCCI: <u>Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy</u></i>  |
| CLIM | 81.2002  | <i>Timothy SWANSON and Robin MASON (Iv): <u>The Impact of International Environmental Agreements: The Case of the Montreal Protocol</u></i>  |
| PRIV | 82.2002  | <i>George R.G. CLARKE and Lixin Colin XU: <u>Privatization, Competition and Corruption: How Characteristics of Bribe Takers and Payers Affect Bribe Payments to Utilities</u></i>  |
| PRIV | 83.2002  | <i>Massimo FLORIO and Katuscia MANZONI: <u>The Abnormal Returns of UK Privatisations: From Underpricing to Outperformance</u></i>  |
| NRM  | 84.2002  | <i>Nelson LOURENÇO, Carlos RUSSO MACHADO, Maria do ROSÁRIO JORGE and Luís RODRIGUES: <u>An Integrated Approach to Understand Territory Dynamics. The Coastal Alentejo (Portugal)</u></i>   |
| CLIM | 85.2002  | <i>Peter ZAPFEL and Matti VAINIO (Iv): <u>Pathways to European Greenhouse Gas Emissions Trading History and Misconceptions</u></i>   |
| CLIM | 86.2002  | <i>Pierre COURTOIS: <u>Influence Processes in Climate Change Negotiations: Modelling the Rounds</u></i>  |
| ETA  | 87.2002  | <i>Vito FRAGNELLI and Maria Erminia MARINA (Iviii): <u>Environmental Pollution Risk and Insurance</u></i>  |
| ETA  | 88.2002  | <i>Laurent FRANCKX (Iviii): <u>Environmental Enforcement with Endogenous Ambient Monitoring</u></i>  |
| ETA  | 89.2002  | <i>Timo GOESCHL and Timothy M. SWANSON (Iviii): <u>Lost Horizons. The noncooperative management of an evolutionary biological system.</u></i>  |
| ETA  | 90.2002  | <i>Hans KEIDING (Iviii): <u>Environmental Effects of Consumption: An Approach Using DEA and Cost Sharing</u></i>   |
| ETA  | 91.2002  | <i>Wietze LISE (Iviii): <u>A Game Model of People's Participation in Forest Management in Northern India</u></i>   |
| CLIM | 92.2002  | <i>Jens HORBACH: <u>Structural Change and Environmental Kuznets Curves</u></i>   |
| ETA  | 93.2002  | <i>Martin P. GROSSKOPF: <u>Towards a More Appropriate Method for Determining the Optimal Scale of Production Units</u></i>   |
| VOL  | 94.2002  | <i>Scott BARRETT and Robert STAVINS: <u>Increasing Participation and Compliance in International Climate Change Agreements</u></i>   |
| CLIM | 95.2002  | <i>Banu BAYRAMOGLU LISE and Wietze LISE: <u>Climate Change, Environmental NGOs and Public Awareness in the Netherlands: Perceptions and Reality</u></i>  |
| CLIM | 96.2002  | <i>Matthieu GLACHANT: <u>The Political Economy of Emission Tax Design in Environmental Policy</u></i>  |
| KNOW | 97.2002  | <i>Kenn ARIGA and Giorgio BRUNELLO: <u>Are the More Educated Receiving More Training? Evidence from Thailand</u></i>   |
| ETA  | 98.2002  | <i>Gianfranco FORTE and Matteo MANERA: <u>Forecasting Volatility in European Stock Markets with Non-linear GARCH Models</u></i>  |
| ETA  | 99.2002  | <i>Geoffrey HEAL: <u>Bundling Biodiversity</u></i>   |
| ETA  | 100.2002 | <i>Geoffrey HEAL, Brian WALKER, Simon LEVIN, Kenneth ARROW, Partha DASGUPTA, Gretchen DAILY, Paul EHRlich, Karl-Goran MALER, Nils KAUTSKY, Jane LUBCHENCO, Steve SCHNEIDER and David STARRETT: <u>Genetic Diversity and Interdependent Crop Choices in Agriculture</u></i> |
| ETA  | 101.2002 | <i>Geoffrey HEAL: <u>Biodiversity and Globalization</u></i>  |
| VOL  | 102.2002 | <i>Andreas LANGE: <u>Heterogeneous International Agreements – If per capita emission levels matter</u></i>   |
| ETA  | 103.2002 | <i>Pierre-André JOUVET and Walid OUESLATI: <u>Tax Reform and Public Spending Trade-offs in an Endogenous Growth Model with Environmental Externalities</u></i>   |
| ETA  | 104.2002 | <i>Anna BOTTASSO and Alessandro SEMBENELLI: <u>Does Ownership Affect Firms' Efficiency? Panel Data Evidence on Italy</u></i>   |
| PRIV | 105.2002 | <i>Bernardo BORTOLOTTI, Frank DE JONG, Giovanna NICODANO and Ibolya SCHINDELE: <u>Privatization and Stock Market Liquidity</u></i>   |
| ETA  | 106.2002 | <i>Haruo IMAI and Mayumi HORIE (Iviii): <u>Pre-Negotiation for an International Emission Reduction Game</u></i>  |
| PRIV | 107.2002 | <i>Sudeshna GHOSH BANERJEE and Michael C. MUNGER: <u>Move to Markets? An Empirical Analysis of Privatisation in Developing Countries</u></i>   |
| PRIV | 108.2002 | <i>Guillaume GIRMENS and Michel GUILLARD: <u>Privatization and Investment: Crowding-Out Effect vs Financial Diversification</u></i>  |
| PRIV | 109.2002 | <i>Alberto CHONG and Florencio LÓPEZ-DE-SILANES: <u>Privatization and Labor Force Restructuring Around the World</u></i>   |
| PRIV | 110.2002 | <i>Nandini GUPTA: <u>Partial Privatization and Firm Performance</u></i>  |
| PRIV | 111.2002 | <i>François DEGEORGE, Dirk JENTER, Alberto MOEL and Peter TUFANO: <u>Selling Company Shares to Reluctant Employees: France Telecom's Experience</u></i>  |

|                                |          |   |
|--------------------------------|----------|---|
| PRIV                           | 112.2002 | <i>Isaac OTCHERE</i> : <u>Intra-Industry Effects of Privatization Announcements: Evidence from Developed and Developing Countries</u>   |
| PRIV                           | 113.2002 | <i>Yannis KATSOULAKOS and Elissavet LIKOYANNI</i> : <u>Fiscal and Other Macroeconomic Effects of Privatization</u>  |
| PRIV                           | 114.2002 | <i>Guillaume GIRMENS</i> : <u>Privatization, International Asset Trade and Financial Markets</u>  |
| PRIV                           | 115.2002 | <i>D. Teja FLOTHO</i> : <u>A Note on Consumption Correlations and European Financial Integration</u>  |
| PRIV                           | 116.2002 | <i>Ibolya SCHINDELE and Enrico C. PEROTTI</i> : <u>Pricing Initial Public Offerings in Premature Capital Markets: The Case of Hungary</u>   |
| PRIV                           | 1.2003   | <i>Gabriella CHIESA and Giovanna NICODANO</i> : <u>Privatization and Financial Market Development: Theoretical Issues</u>   |
| PRIV                           | 2.2003   | <i>Ibolya SCHINDELE</i> : <u>Theory of Privatization in Eastern Europe: Literature Review</u>   |
| PRIV                           | 3.2003   | <i>Wietze LISE, Claudia KEMFERT and Richard S.J. TOL</i> : <u>Strategic Action in the Liberalised German Electricity Market</u>   |
| CLIM                           | 4.2003   | <i>Laura MARSILLANI and Thomas I. RENSTRÖM</i> : <u>Environmental Policy and Capital Movements: The Role of Government Commitment</u>   |
| KNOW                           | 5.2003   | <i>Reyer GERLAGH</i> : <u>Induced Technological Change under Technological Competition</u>  |
| ETA                            | 6.2003   | <i>Efrem CASTELNUOVO</i> : <u>Squeezing the Interest Rate Smoothing Weight with a Hybrid Expectations Model</u>   |
| SIEV                           | 7.2003   | <i>Anna ALBERINI, Alberto LONGO, Stefania TONIN, Francesco TROMBETTA and Margherita TURVANI</i> : <u>The Role of Liability, Regulation and Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers</u> |
| NRM                            | 8.2003   | <i>Elissaios PAPYRAKIS and Reyner GERLAGH</i> : <u>Natural Resources: A Blessing or a Curse?</u>  |
| CLIM                           | 9.2003   | <i>A. CAPARRÓS, J.-C. PEREAU and T. TAZDAÏT</i> : <u>North-South Climate Change Negotiations: a Sequential Game with Asymmetric Information</u>   |
| KNOW                           | 10.2003  | <i>Giorgio BRUNELLO and Daniele CHECCHI</i> : <u>School Quality and Family Background in Italy</u>  |
| CLIM                           | 11.2003  | <i>Efrem CASTELNUOVO and Marzio GALEOTTI</i> : <u>Learning By Doing vs Learning By Researching in a Model of Climate Change Policy Analysis</u>   |
| KNOW                           | 12.2003  | <i>Carole Maignan, Gianmarco OTTAVIANO and Dino PINELLI (eds.)</i> : <u>Economic Growth, Innovation, Cultural Diversity: What are we all talking about? A critical survey of the state-of-the-art</u>   |
| KNOW                           | 13.2003  | <i>Carole Maignan, Gianmarco OTTAVIANO, Dino PINELLI and Francesco RULLANI (lix)</i> : <u>Bio-Ecological Diversity vs. Socio-Economic Diversity. A Comparison of Existing Measures</u>  |
| KNOW                           | 14.2003  | <i>Maddy JANSSENS and Chris STEYAERT (lix)</i> : <u>Theories of Diversity within Organisation Studies: Debates and Future Trajectories</u>  |
| KNOW                           | 15.2003  | <i>Tuzin BAYCAN LEVENT, Enno MASUREL and Peter NIJKAMP (lix)</i> : <u>Diversity in Entrepreneurship: Ethnic and Female Roles in Urban Economic Life</u>   |
| KNOW                           | 16.2003  | <i>Alexandra BITUSIKOVA (lix)</i> : <u>Post-Communist City on its Way from Grey to Colourful: The Case Study from Slovakia</u>  |
| KNOW                           | 17.2003  | <i>Billy E. VAUGHN and Katarina MLEKOV (lix)</i> : <u>A Stage Model of Developing an Inclusive Community</u>  |
| KNOW                           | 18.2003  | <i>Selma van LONDEN and Arie de RUIJTER (lix)</i> : <u>Managing Diversity in a Globalizing World</u>  |
| Coalition<br>Theory<br>Network | 19.2003  | <i>Sergio CURRARINI</i> : <u>On the Stability of Hierarchies in Games with Externalities</u>  |
| PRIV                           | 20.2003  | <i>Giacomo CALZOLARI and Alessandro PAVAN (lx)</i> : <u>Monopoly with Resale</u>  |
| PRIV                           | 21.2003  | <i>Claudio MEZZETTI (lx)</i> : <u>Auction Design with Interdependent Valuations: The Generalized Revelation Principle, Efficiency, Full Surplus Extraction and Information Acquisition</u>  |
| PRIV                           | 22.2003  | <i>Marco LiCalzi and Alessandro PAVAN (lx)</i> : <u>Tilting the Supply Schedule to Enhance Competition in Uniform-Price Auctions</u>  |
| PRIV                           | 23.2003  | <i>David ETTINGER (lx)</i> : <u>Bidding among Friends and Enemies</u>   |
| PRIV                           | 24.2003  | <i>Hannu VARTIAINEN (lx)</i> : <u>Auction Design without Commitment</u>   |
| PRIV                           | 25.2003  | <i>Matti KELOHARJU, Kjell G. NYBORG and Kristian RYDQVIST (lx)</i> : <u>Strategic Behavior and Underpricing in Uniform Price Auctions: Evidence from Finnish Treasury Auctions</u>  |
| PRIV                           | 26.2003  | <i>Christine A. PARLOUR and Uday RAJAN (lx)</i> : <u>Rationing in IPOs</u>  |
| PRIV                           | 27.2003  | <i>Kjell G. NYBORG and Ilya A. STREBULAIEV (lx)</i> : <u>Multiple Unit Auctions and Short Squeezes</u>  |
| PRIV                           | 28.2003  | <i>Anders LUNANDER and Jan-Eric NILSSON (lx)</i> : <u>Taking the Lab to the Field: Experimental Tests of Alternative Mechanisms to Procure Multiple Contracts</u>   |
| PRIV                           | 29.2003  | <i>TangaMcDANIEL and Karsten NEUHOFF (lx)</i> : <u>Use of Long-term Auctions for Network Investment</u>   |
| PRIV                           | 30.2003  | <i>Emiel MAASLAND and Sander ONDERSTAL (lx)</i> : <u>Auctions with Financial Externalities</u>  |
| ETA                            | 31.2003  | <i>Michael FINUS and Bianca RUNDSHAGEN</i> : <u>A Non-cooperative Foundation of Core-Stability in Positive Externality NTU-Coalition Games</u>  |
| KNOW                           | 32.2003  | <i>Michele MORETTO</i> : <u>Competition and Irreversible Investments under Uncertainty</u>  |
| PRIV                           | 33.2003  | <i>Philippe QUIRION</i> : <u>Relative Quotas: Correct Answer to Uncertainty or Case of Regulatory Capture?</u>  |
| KNOW                           | 34.2003  | <i>Giuseppe MEDA, Claudio PIGA and Donald SIEGEL</i> : <u>On the Relationship between R&amp;D and Productivity: A Treatment Effect Analysis</u>   |
| ETA                            | 35.2003  | <i>Alessandra DEL BOCA, Marzio GALEOTTI and Paola ROTA</i> : <u>Non-convexities in the Adjustment of Different Capital Inputs: A Firm-level Investigation</u>   |



|      |         |   |
|------|---------|---|
| GG   | 36.2003 | <i>Matthieu GLACHANT</i> : <u>Voluntary Agreements under Endogenous Legislative Threats</u>   |
| PRIV | 37.2003 | <i>Narjess BOUBAKRI, Jean-Claude COSSET and Omrane GUEDHAMI</i> : <u>Postprivatization Corporate Governance: the Role of Ownership Structure and Investor Protection</u>                        |
| CLIM | 38.2003 | <i>Rolf GOLOMBEK and Michael HOEL</i> : <u>Climate Policy under Technology Spillovers</u>   |
| KNOW | 39.2003 | <i>Slim BEN YOUSSEF</i> : <u>Transboundary Pollution, R&amp;D Spillovers and International Trade</u>  |
| CTN  | 40.2003 | <i>Carlo CARRARO and Carmen MARCHIORI</i> : <u>Endogenous Strategic Issue Linkage in International Negotiations</u>   |
| KNOW | 41.2003 | <i>Sonia OREFFICE</i> : <u>Abortion and Female Power in the Household: Evidence from Labor Supply</u>   |
| KNOW | 42.2003 | <i>Timo GOESCHL and Timothy SWANSON</i> : <u>On Biology and Technology: The Economics of Managing Biotechnologies</u>   |
| ETA  | 43.2003 | <i>Giorgio Busetti and Matteo MANERA</i> : <u>STAR-GARCH Models for Stock Market Interactions in the Pacific Basin Region, Japan and US</u>   |
| CLIM | 44.2003 | <i>Katrin MILLOCK and Céline NAUGES</i> : <u>The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness</u>   |
| PRIV | 45.2003 | <i>Bernardo BORTOLOTTI and Paolo PINOTTI</i> : <u>The Political Economy of Privatization</u>  |
| SIEV | 46.2003 | <i>Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH</i> : <u>Burn or Bury? A Social Cost Comparison of Final Waste Disposal Methods</u>  |
| ETA  | 47.2003 | <i>Jens HORBACH</i> : <u>Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany</u>   |
| CLIM | 48.2003 | <i>Lori SNYDER, Nolan MILLER and Robert STAVINS</i> : <u>The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing</u>                                |
| CLIM | 49.2003 | <i>Lori SNYDER, Robert STAVINS and Alexander F. WAGNER</i> : <u>Private Options to Use Public Goods. Exploiting Revealed Preferences to Estimate Environmental Benefits</u>                     |
| CTN  | 50.2003 | <i>László Á. KÓCZY and Luc LAUWERS (Ixi)</i> : <u>The Minimal Dominant Set is a Non-Empty Core-Extension</u>  |
| CTN  | 51.2003 | <i>Matthew O. JACKSON (Ixi)</i> : <u>Allocation Rules for Network Games</u>   |
| CTN  | 52.2003 | <i>Ana MAULEON and Vincent VANNETELBOSCH (Ixi)</i> : <u>Farsightedness and Cautiousness in Coalition Formation</u>  |
| CTN  | 53.2003 | <i>Fernando VEGA-REDONDO (Ixi)</i> : <u>Building Up Social Capital in a Changing World: a network approach</u>  |
| CTN  | 54.2003 | <i>Matthew HAAG and Roger LAGUNOFF (Ixi)</i> : <u>On the Size and Structure of Group Cooperation</u>  |
| CTN  | 55.2003 | <i>Taiji FURUSAWA and Hideo KONISHI (Ixi)</i> : <u>Free Trade Networks</u>  |
| CTN  | 56.2003 | <i>Halis Murat YILDIZ (Ixi)</i> : <u>National Versus International Mergers and Trade Liberalization</u>   |
| CTN  | 57.2003 | <i>Santiago RUBIO and Alistair ULPH (Ixi)</i> : <u>An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements</u>  |
| KNOW | 58.2003 | <i>Carole MAIGNAN, Dino PINELLI and Gianmarco I.P. OTTAVIANO</i> : <u>ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research</u>                                  |
| KNOW | 59.2003 | <i>Giorgio BELLETTINI and Gianmarco I.P. OTTAVIANO</i> : <u>Special Interests and Technological Change</u>  |
| ETA  | 60.2003 | <i>Ronnie SCHÖB</i> : <u>The Double Dividend Hypothesis of Environmental Taxes: A Survey</u>  |
| CLIM | 61.2003 | <i>Michael FINUS, Ekko van IERLAND and Robert DELLINK</i> : <u>Stability of Climate Coalitions in a Cartel Formation Game</u>   |
| GG   | 62.2003 | <i>Michael FINUS and Bianca RUNDSHAGEN</i> : <u>How the Rules of Coalition Formation Affect Stability of International Environmental Agreements</u>   |
| SIEV | 63.2003 | <i>Alberto PETRUCCI</i> : <u>Taxing Land Rent in an Open Economy</u>  |
| CLIM | 64.2003 | <i>Joseph E. ALDY, Scott BARRETT and Robert N. STAVINS</i> : <u>Thirteen Plus One: A Comparison of Global Climate Policy Architectures</u>  |
| SIEV | 65.2003 | <i>Edi DEFRANCESCO</i> : <u>The Beginning of Organic Fish Farming in Italy</u>  |
| SIEV | 66.2003 | <i>Klaus CONRAD</i> : <u>Price Competition and Product Differentiation when Consumers Care for the Environment</u>  |
| SIEV | 67.2003 | <i>Paulo A.L.D. NUNES, Luca ROSSETTO, Arianne DE BLAEIJ</i> : <u>Monetary Value Assessment of Clam Fishing Management Practices in the Venice Lagoon: Results from a Stated Choice Exercise</u> |
| CLIM | 68.2003 | <i>ZhongXiang ZHANG</i> : <u>Open Trade with the U.S. Without Compromising Canada's Ability to Comply with its Kyoto Target</u>   |
| KNOW | 69.2003 | <i>David FRANTZ (Ixi)</i> : <u>Lorenzo Market between Diversity and Mutation</u>  |
| KNOW | 70.2003 | <i>Ercole SORI (Ixi)</i> : <u>Mapping Diversity in Social History</u>   |
| KNOW | 71.2003 | <i>Ljiljana DERU SIMIC (Ixi)</i> : <u>What is Specific about Art/Cultural Projects?</u>   |
| KNOW | 72.2003 | <i>Natalya V. TARANOVA (Ixi)</i> : <u>The Role of the City in Fostering Intergroup Communication in a Multicultural Environment: Saint-Petersburg's Case</u>                                    |
| KNOW | 73.2003 | <i>Kristine CRANE (Ixi)</i> : <u>The City as an Arena for the Expression of Multiple Identities in the Age of Globalisation and Migration</u>   |
| KNOW | 74.2003 | <i>Kazuma MATOBA (Ixi)</i> : <u>Glocal Dialogue- Transformation through Transcultural Communication</u>   |
| KNOW | 75.2003 | <i>Catarina REIS OLIVEIRA (Ixi)</i> : <u>Immigrants' Entrepreneurial Opportunities: The Case of the Chinese in Portugal</u>   |
| KNOW | 76.2003 | <i>Sandra WALLMAN (Ixi)</i> : <u>The Diversity of Diversity - towards a typology of urban systems</u>   |

|      |         |   |
|------|---------|---|
| KNOW | 77.2003 | <i>Richard PEARCE</i> (Ixii): <u>A Biologist's View of Individual Cultural Identity for the Study of Cities</u>   |
| KNOW | 78.2003 | <i>Vincent MERK</i> (Ixii): <u>Communication Across Cultures: from Cultural Awareness to Reconciliation of the Dilemmas</u>   |
| KNOW | 79.2003 | <i>Giorgio BELLETTINI, Carlotta BERTI CERONI and Gianmarco I.P. OTTAVIANO</i> : <u>Child Labor and Resistance to Change</u>   |
| ETA  | 80.2003 | <i>Michele MORETTO, Paolo M. PANTEGHINI and Carlo SCARPA</i> : <u>Investment Size and Firm's Value under Profit Sharing Regulation</u>  |
| IEM  | 81.2003 | <i>Alessandro LANZA, Matteo MANERA and Massimo GIOVANNINI</i> : <u>Oil and Product Dynamics in International Petroleum Markets</u>  |
| CLIM | 82.2003 | <i>Y. Hossein FARZIN and Jinhua ZHAO</i> : <u>Pollution Abatement Investment When Firms Lobby Against Environmental Regulation</u>  |
| CLIM | 83.2003 | <i>Giuseppe DI VITA</i> : <u>Is the Discount Rate Relevant in Explaining the Environmental Kuznets Curve?</u>   |
| CLIM | 84.2003 | <i>Reyer GERLAGH and Wietze LISE</i> : <u>Induced Technological Change Under Carbon Taxes</u>   |
| NRM  | 85.2003 | <i>Rinaldo BRAU, Alessandro LANZA and Francesco PIGLIARU</i> : <u>How Fast are the Tourism Countries Growing? The cross-country evidence</u>                                  |
| KNOW | 86.2003 | <i>Elena BELLINI, Gianmarco I.P. OTTAVIANO and Dino PINELLI</i> : <u>The ICT Revolution: opportunities and risks for the Mezzogiorno</u>                                      |
| SIEV | 87.2003 | <i>Lucas BRETSCGHER and Sjak SMULDERS</i> : <u>Sustainability and Substitution of Exhaustible Natural Resources. How resource prices affect long-term R&amp;D investments</u> |
| CLIM | 88.2003 | <i>Johan EYCKMANS and Michael FINUS</i> : <u>New Roads to International Environmental Agreements: The Case of Global Warming</u>  |
| CLIM | 89.2003 | <i>Marzio GALEOTTI</i> : <u>Economic Development and Environmental Protection</u>   |
| CLIM | 90.2003 | <i>Marzio GALEOTTI</i> : <u>Environment and Economic Growth: Is Technical Change the Key to Decoupling?</u>   |
| CLIM | 91.2003 | <i>Marzio GALEOTTI and Barbara BUCHNER</i> : <u>Climate Policy and Economic Growth in Developing Countries</u>  |
| IEM  | 92.2003 | <i>A. MARKANDYA, A. GOLUB and E. STRUKOVA</i> : <u>The Influence of Climate Change Considerations on Energy Policy: The Case of Russia</u>                                    |
| ETA  | 93.2003 | <i>Andrea BELTRATTI</i> : <u>Socially Responsible Investment in General Equilibrium</u>   |
| CTN  | 94.2003 | <i>Parkash CHANDER</i> : <u>The <math>\gamma</math>-Core and Coalition Formation</u>  |
| IEM  | 95.2003 | <i>Matteo MANERA and Angelo MARZULLO</i> : <u>Modelling the Load Curve of Aggregate Electricity Consumption Using Principal Components</u>                                    |
| IEM  | 96.2003 | <i>Alessandro LANZA, Matteo MANERA, Margherita GRASSO and Massimo GIOVANNINI</i> : <u>Long-run Models of Oil Stock Prices</u>   |
| CTN  | 97.2003 | <i>Steven J. BRAMS, Michael A. JONES, and D. Marc KILGOUR</i> : <u>Forming Stable Coalitions: The Process Matters</u>   |

- (l) This paper was presented at the Workshop “Growth, Environmental Policies and Sustainability” organised by the Fondazione Eni Enrico Mattei, Venice, June 1, 2001
- (li) This paper was presented at the Fourth Toulouse Conference on Environment and Resource Economics on “Property Rights, Institutions and Management of Environmental and Natural Resources”, organised by Fondazione Eni Enrico Mattei, IDEI and INRA and sponsored by MATE, Toulouse, May 3-4, 2001
- (lii) This paper was presented at the International Conference on “Economic Valuation of Environmental Goods”, organised by Fondazione Eni Enrico Mattei in cooperation with CORILA, Venice, May 11, 2001
- (liii) This paper was circulated at the International Conference on “Climate Policy – Do We Need a New Approach?”, jointly organised by Fondazione Eni Enrico Mattei, Stanford University and Venice International University, Isola di San Servolo, Venice, September 6-8, 2001
- (liv) This paper was presented at the Seventh Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Venice, Italy, January 11-12, 2002
- (lv) This paper was presented at the First Workshop of the Concerted Action on Tradable Emission Permits (CATEP) organised by the Fondazione Eni Enrico Mattei, Venice, Italy, December 3-4, 2001
- (lvi) This paper was presented at the ESF EURESCO Conference on Environmental Policy in a Global Economy “The International Dimension of Environmental Policy”, organised with the collaboration of the Fondazione Eni Enrico Mattei, Acquafredda di Maratea, October 6-11, 2001
- (lvii) This paper was presented at the First Workshop of “CFEWE – Carbon Flows between Eastern and Western Europe”, organised by the Fondazione Eni Enrico Mattei and Zentrum für Europäische Integrationsforschung (ZEI), Milan, July 5-6, 2001
- (lviii) This paper was presented at the Workshop on “Game Practice and the Environment”, jointly organised by Università del Piemonte Orientale and Fondazione Eni Enrico Mattei, Alessandria, April 12-13, 2002
- (lix) This paper was presented at the ENGIME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002
- (lx) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by the Fondazione Eni Enrico Mattei, Milan, September 26-28, 2002
- (lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003
- (lxii) This paper was presented at the ENGIME Workshop on “Communication across Cultures in Multicultural Cities”, The Hague, November 7-8, 2002

### 2002 SERIES

|             |   |
|-------------|---|
| <b>CLIM</b> | <i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti )                   |
| <b>VOL</b>  | <i>Voluntary and International Agreements</i> (Editor: Carlo Carraro)                   |
| <b>SUST</b> | <i>Sustainability Indicators and Environmental Valuation</i><br>(Editor: Carlo Carraro) |
| <b>NRM</b>  | <i>Natural Resources Management</i> (Editor: Carlo Giupponi)                            |
| <b>KNOW</b> | <i>Knowledge, Technology, Human Capital</i> (Editor: Dino Pinelli)                      |
| <b>MGMT</b> | <i>Corporate Sustainable Management</i> (Editor: Andrea Marsanich)                      |
| <b>PRIV</b> | <i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)               |
| <b>ETA</b>  | <i>Economic Theory and Applications</i> (Editor: Carlo Carraro)                         |

### 2003 SERIES

|             |   |
|-------------|---|
| <b>CLIM</b> | <i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti )                   |
| <b>GG</b>   | <i>Global Governance</i> (Editor: Carlo Carraro)  |
| <b>SIEV</b> | <i>Sustainability Indicators and Environmental Valuation</i><br>(Editor: Anna Alberini) |
| <b>NRM</b>  | <i>Natural Resources Management</i> (Editor: Carlo Giupponi)                            |
| <b>KNOW</b> | <i>Knowledge, Technology, Human Capital</i> (Editor: Gianmarco Ottaviano)               |
| <b>IEM</b>  | <i>International Energy Markets</i> (Editor: Anil Markandya)                            |
| <b>CSRM</b> | <i>Corporate Social Responsibility and Management</i> (Editor: Sabina Ratti)            |
| <b>PRIV</b> | <i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)               |
| <b>ETA</b>  | <i>Economic Theory and Applications</i> (Editor: Carlo Carraro)                         |
| <b>CTN</b>  | <i>Coalition Theory Network</i>   |