

AMENDING THE CANADIAN CONSTITUTION: A MATHEMATICAL ANALYSIS

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On November 27, 1995, Prime Minister Jean Chrétien released a proposal designed to affect the workings of the constitutional amendment process. Under his draft legislation, the "general procedure" (7 provinces with 50% of the population of the provinces) would have remained in force, but the federal cabinet would have been barred from introducing a constitutional resolution into the House of Commons unless it already had the approval of at least Ontario, Québec, two provinces in the West having more than 50% of the population of that region, and two Atlantic provinces having more than 50% of the population of that region.¹ On December 7, responding to unhappiness in British Columbia, the Minister of Justice announced that this four-region veto would be changed to a five-region formula under which passage of an amendment would require approval by Ontario, Québec, British Columbia, two of three prairie provinces having more than 50% of the population of the prairies, and two of four Atlantic provinces having more than 50% of the population of that region.

Using party discipline and time allocation, the Liberal government passed its legislation quickly through Parliament. Although the bill was supposed to fulfill a promise made by Prime Minister Chrétien during the last week of the 1995 referendum campaign, public opinion in Québec seems unimpressed, and there has been heavy criticism in British Columbia and Alberta as well as by native leaders.

This short paper attempts to shed light on the controversy by using some simple mathematics to analyze the existing and proposed amending formulas. The first conclusion is that the regional veto will create tiers of provinces with very different and permanently unequal shares of amending power. Thus, if we regard even rough equality of the

provinces as a value to be protected, there is much to be said for the existing "7/50" formula. The second conclusion is that the regional veto is a negative-sum game which, even as it redistributes amending power from some provinces to others, also makes all provinces worse off in terms of their ability to obtain future changes to the constitution.

THE BANZHAF POWER INDEX (BPI)

The BPI is a method for comparing the relative decision-making power of participants in systems of weighted voting. Steven J. Brams defines the BPI as "the number of winning coalitions in which the member's defection from the coalition would render it losing — which is a critical defection — divided by the total number of critical defections for all members."² Winning coalitions that would be turned into losing coalitions by the defection of a single member are known as Minimum Winning Coalitions (MWCs). Thus the BPI is computed by enumerating all MWCs, counting the number of critical defections, or "pivots," for each player, and dividing by the total of pivots for all players.

As an example, consider a hypothetical system with four participants — A, B, C, and D. A has 3 votes, B has 2, and C and D each have 1. With 7 votes altogether, any MWC must have at least 4 votes if the decision rule is simple majority. All MWCs are tabulated below; members that are pivotal in a particular coalition are underlined.

n = 2	<u>AB</u> <u>AC</u> <u>AD</u>
n = 3	<u>ABC</u> <u>ABD</u> <u>BCD</u> <u>ACD</u>
n = 4	none

<u>Player</u>	<u>Number of Pivots</u>	<u>BPI</u>
A	6	.50
B	2	.17
C	2	.17
D	2	.17
	12	

It might seem obvious that A, with 3 votes, would have the greatest voting power; but it is not obvious that the power of B, which has 2 votes, should be equal to that of C and D, which have only 1 vote each. This surprising result is a function of the coalitional possibilities in the particular situation; it would not necessarily be true in a different configuration of voters and weights. The virtue of the BPI is that it focuses precisely on particular configurations and thus moves beyond generalities based on surface impressions.

The BPI can also be used to measure voting power where the decision rule is one of qualified majority, as in the "7/50" amending formula. For a simple illustration, leave everything the same in the previous example except the decision rule, which is now set at 5 votes out of 7.

n = 2	<u>AB</u>
n = 3	<u>ABC</u> <u>ABD</u> <u>ACD</u>
n = 4	<u>ABCD</u>

<u>Player</u>	<u>Number of Pivots</u>	<u>BPI</u>
A	5	.5
B	3	.3
C	1	.1
D	1	.1
	10	

As it happens, the winner in this move from simple to qualified majority is B, whose BPI increases from .17 to .3, while C and D fall from .17 to .1 and A remains unchanged at .5. This illustrates a fundamental principle of BPI analysis that will become strikingly evident in the discussion of constitutional amending formulae: because power is a relational concept, any change in the number of players, weighting of votes, or decision rule can have

major unanticipated and perhaps undesired consequences in the distribution of power in the system.

Finally, note that for any configuration there are not only Minimum Winning Coalitions but also Minimum Blocking Coalitions (MBCs). That is, if it takes 5 votes to pass a measure under a qualified majority rule, 3 votes can block it. The BPI will be the same whether the analysis is done in terms of MWCs or MBCs, as illustrated below.

n = 1	<u>A</u>
n = 2	<u>AB</u> <u>AC</u> <u>AD</u> <u>BC</u> <u>BD</u>
n = 3	<u>ACD</u> <u>BCD</u>
n = 4	none

<u>Player</u>	<u>Number of Pivots</u>	<u>BPI</u>
A	5	.5
B	3	.3
C	1	.1
D	1	.1
	10	

Depending on the situation, it is sometimes more practical to compute the BPIs in terms of MBCs rather than MWCs; but it is always possible to do it both ways and get the same results.

THE "SEVEN/FIFTY" FORMULA

The "7/50" rule was analyzed by D. Marc Kilgour in 1983, using population statistics from the 1981 census. Kilgour proceeded by way of MBCs. In his words:

- (1) No province acting alone can block an amendment.
- (2) Of the 45 possible coalitions of two provinces, only the coalition of Ontario and Québec can block an amendment.
- (3) Of the 120 possible coalitions of three provinces, only 12 have the power to block an amendment. These are the eight which include both Ontario and Québec, and the four consisting of Ontario and British Columbia together with one of Alberta, Saskatchewan, Manitoba, Nova Scotia.

- (4) Every coalition of four or more provinces can block an amendment.³

Using this approach, Kilgour calculated the following BPIs for the provinces:⁴

Ontario	.1234
Québec	.1132
British Columbia	.1031
Alberta	.0954
Saskatchewan	.0954
Manitoba	.0954
Nova Scotia	.0954
New Brunswick	.0929
Newfoundland	.0929

The 7/50 rule treated the provinces in a relatively equal fashion, giving Ontario, the strongest province, only 33% more power than each of the three weakest provinces (.1234/.0929). Moreover, it did not classify provinces into permanent categories differentiated by possession or non-possession of a veto. No province had a veto by itself, and all provinces could exercise a veto by becoming pivotal partners in a variety of MBCs. Provinces' BPIs might change over time as population changed, but these would be gradual adjustments registered in every decennial census, not sudden realignments of power.⁵

THE FIVE-REGION VETO

The five-region veto found in the amended version of the Liberals' legislation always requires a MWC of size 7. A successful amendment must have the support of Ontario, Québec and British Columbia, as well as Alberta with either Saskatchewan or Manitoba, plus two out of three of Nova Scotia, New Brunswick, and Newfoundland. Three initial observations are that:

- (1) The five-region veto completely supersedes the 7/50 rule inasmuch as any coalition of seven provinces that meets the five-region test will also have more than 50% of the population of Canada. Thus the five-region formula can be analyzed on its own without worrying about interaction with the still constitutionally valid general procedure.
- (2) Prince Edward Island becomes a dummy player, deprived of all power under this formula. Its population is so small that it can never be pivotal in the Atlantic region; and since any MWC under this formula already contains 7 provinces, PEI can never be pivotal in that sense. The disenfranchisement of PEI was probably not intended, but it is nonetheless complete.
- (3) In the 1991 census, Alberta had 2.5 million people, against 1.09 million for Manitoba and .99 million for Saskatchewan. Alberta thus has a de facto veto because it has more than half the population of the three prairie provinces; and because its population is growing, that veto is likely to persist for the foreseeable future. On the other hand, Saskatchewan and Manitoba do not become powerless dummies like PEI. Alberta can veto an amendment by itself, but it cannot pass an amendment without the support of either Manitoba or Saskatchewan. The two smaller prairie provinces share a veto, so to speak.

The mathematical analysis is straightforward. There are only 6 possible MWCs of size 7. Ontario, Québec, British Columbia and Alberta are always pivotal; Saskatchewan and Manitoba are each pivotal 3 times; and Nova Scotia, New Brunswick, and Newfoundland are each pivotal 4 times. For $n = 8$, there are 18 MWCs, produced by adding one or another of the three left-out provinces to one of the MWCs of size 7. There are only 6 MWCs of size 9 because the four veto-wielding provinces must always be included, and of course there is only one MWC of size 10.

Summing the pivots for MWCs of all sizes yields the following results:

<u>Province</u>	<u>BPI</u>	<u>Ratio over 7/50 BPI</u>
Ontario	.1667	135
Québec	.1667	147
British Columbia	.1667	162
Alberta	.1667	175
Saskatchewan	.0538	56
Manitoba	.0538	56
Nova Scotia	.0753	79
New Brunswick	.0753	81
Newfoundland	.0753	81
Prince Edward Island	.0000	0

As mentioned above, Prince Edward Island is the big loser under this scheme, becoming a powerless dummy. The other Atlantic provinces and the two smaller prairie provinces also incur significant losses compared to their status in the 7/50 rule, while the four veto-wielding provinces make big gains. Ironically for a measure which was supposed to respond to demands from Québec, the biggest winner is Alberta (75% increase) and the second-biggest is British Columbia (62% increase).

A NEGATIVE-SUM GAME

Even though the four big provinces are all "winners" under the five-region formula, they are winners primarily in the negative sense of being able to prevent changes that might be desired by others. Their increased BPI does not imply an increased ability to secure changes that they might wish. BPI analysis shows that the four big provinces are now more powerful relative to the six small provinces in the constitutional amendment process, but all provinces are less powerful in an absolute sense of being able to constructively change Canada in the future. That is, regional-veto formulas are a negative-sum game that decrease the horizon of possibilities for all players even as they reallocate power from player to player.

We can measure the contraction of the horizon by enumerating the number of winning coalitions (all winning coalitions, not just MWCs) for any amendment formula and dividing by the total number of possible coalitions. With 10 provinces able to vote yes or no, the total number of possible coalitions is,

according to the binominal expansion, $2^{10} = 1024$, ranging from 10 yes and 0 no to 10 no and 0 yes. The least restrictive formula that anyone would recommend for amending a constitution would be a simple majority, in Canada's case 6 of 10 provinces. Under that rule, 386 coalitions, 37. % of the total, would become winning coalitions — 210 of size 6, 120 of size 7, 45 of size 8, 10 of size 9 and 1 of size 10. Using a similar approach, the number of winning coalitions for other rules is given below.

<u>Definition</u>	<u>Number</u>	<u>Percentage of Total</u>
All	1024	100.0%
Simple majority (6 of 10 or better)	386	37.7
7/50 rule (1981 census)	163	15.9
7/50 rule (1991 census)	161	15.7

The general procedure, allowing positive results in about 16% of cases, was certainly more restrictive than a simple majority; indeed, as a qualified-majority rule, it was designed to be so. However, it still held out a realistic possibility of achieving amendments. The five-region veto, on the other hand, is much closer in practice to unanimity than it is to the general procedure; it allows only 31 provincial coalitions, 3% of the total, to be winning coalitions.

A measure of each province's positive power to achieve a desired constitutional amendment can be derived by multiplying its relative share of power (BPI) under a particular formula times the probability of all participants acting together to achieve an amendment. The table below compares each province's positive power in 1981 under the 7/50 formula against its power under the five-region veto, using 1991 census figures.

POSITIVE POWER INDEXES		
Province	7/50 (1981)	Five-Region Veto (1991)
Ontario	.0196	.0050
Québec	.0180	.0050
British Columbia	.0164	.0050
Alberta	.0152	.0050
Saskatchewan	.0152	.0016
Manitoba	.0152	.0016
Nova Scotia	.0152	.0023
New Brunswick	.0148	.0023
Newfoundland	.0148	.0023
Prince Edward Island	.0148	.0000

The table shows that even provinces, like Alberta, that have more *relative* power under the five-region veto now have less *absolute* power to achieve desired constitutional amendments.

The effect of the five-region veto is to freeze the constitutional order around the status quo. This is bound to be unpopular in the West, where ideas such as Senate reform, property rights, and a Canadian common market still have many adherents. The five-region veto may be more popular in Québec if it assuages fears of a repetition of 1981, in which the constitution was amended without Québec's approval. However, politicians in Québec, federalists as well as separatists, have positive constitutional aspirations that go beyond forestalling changes desired by others.

If done under the rule law, a transfer of jurisdictions from Ottawa to Québec City, as well as the separation of Québec from Canada, will involve constitutional amendments, which will now be harder to obtain than they were previously. Ironically, therefore, it may be Québec, as the province least satisfied with the constitutional status quo, that loses most from the five-region veto. □

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Endnotes

1. Office of the Prime Minister, press release, November 27, 1995.
2. Steven J. Brams, *Rational Politics: Decisions, Games, and Strategy* (Boston: Academic Press, 1985) 99.
3. D. Marc Kilgour, "A Formal Analysis of the Amending Formula of Canada's Constitution Act, 1982" (1983) 16 Canadian Journal of Political Science 773.
4. *Ibid.*, 772.
5. For example, based on 1991 census figures, Ontario and British Columbia could combine with six provinces other than Quebec (Alberta, Saskatchewan, Manitoba, Nova Scotia, New Brunswick, and Newfoundland) to exercise a veto, rather than just four according to the 1981 census. But small changes like this would only affect the BPI at the third or fourth decimal place.

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