POLITOMETRICS: Quantitative Models of Political Institutions

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Politometrics: Quantitative Models of Political Institutions 🆓

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Summary and Keywords

Logical models and statistical techniques have been used for measuring political and institutional variables, quantifying and explaining the relationships between them, testing theories, and evaluating institutional and policy alternatives. A number of cumulative and complementary findings refer to major institutional features of a political process of decision-making: from the size of the assembly to the territorial structure of the country, the electoral system, the number of parties in the assembly and in the government, the government's duration, and the degree of policy instability. Mathematical equations based on sound theory are validated by empirical tests and can predict precise observations.

Keywords: logical models, statistics, electoral system, political parties, federalism, policy change

"Politometrics" is a name for the application of mathematical forms and statistical techniques for measuring political variables, quantifying and explaining the relationships between them, testing theories, and evaluating institutional and policy alternatives. Its main object is to promote studies that aim at a unification of the theoretical and the empirical-quantitative approaches to political problems. Politometrics produces probabilistic, empirically testable models of simple relationships that can make sense of mountains of data. This type of study has long roots and old traditions, but they have been revived and become newly appealing in a recent period in reaction to a disagreeable breach in political science between inductive statistics and speculative formal models.

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A Search for Measurement, Explanation, and Prediction

It's interesting to note that the etymology of the word "statistics" is "the study of states," as it originated in data-based, causally oriented traditions of political analysis. Already in the 17th century, William Petty developed a "political arithmetic," which, in retrospect, was seen as a search for "causal relationships between quantitative variables" (Lazarsfeld, 1961; Petty, 1676/1899).

The necessary collaboration between quantitative empirical studies and explanatory theory was remarked by August Comte in a seminal work published about 200 years ago: "If it is true—he said—that every theory must be based upon observed facts, it is equally true that facts cannot be observed without the guidance of some theory. Without such guidance, our facts would be desultory and fruitless; we could not retain them: for the most part we could not even perceive them" (Comte, 1822).

In this respect, political studies didn't follow closely the methodological evolution of other social sciences, but they were rather dominated by narrative historical or normative juridical approaches for a very long time. "By the close of the 19th century none of the developments in modern statistics had been incorporated in the political science curricula of British or American colleges and universities…. The rapid developments that took place in mathematical statistics after 1900 hand little impact on political science" (Gow, 1985). There were some claims to building a science of politics that should "consist of a body of verifiable and systematic knowledge, gathered by observation and experiment" (Catlin, 1927). But still in the 1930s, Harold Gosnell confirmed that, while "statistical studies depend upon qualitative descriptive analyses for fruitful hypotheses and interpretations," "political scientists have not only lagged far behind the economists in the use of statistics but they have shown important resistance in some sections to following this general direction" (Gosnell, 1933).

A rather isolated effort was the work by Lewis Fry Richardson on arms races and armed conflicts (Richardson, 1949/1960). Initially a meteorologist, Richardson learned from the problems of weather forecast that events, which seem to be governed by chance, are in fact governed by laws and can be predicted if enough information can be processed. He then changed subject and spent 20 years studying the causes of war. Richardson quantified two basic, opposing components of interactions between states with rival ambitions: mutual stimulation of armaments buildup and cooperation in the form of trade. The solution of his equations determined the time course of the armaments expenditures.

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Richardson was able to obtain a good fit of the predicted time course for the armaments race of the rival European blocs in the years preceding World War I and World War II.

He, however, acknowledged that "the equations are merely a description of what people would do if they did not stop to think" (1960, p. 12). From the point of view of game-theorist Anatol Rapoport, "Richardson's quasi-deterministic view of international relations is complementary to the strategic view, which assumes rationality in the pursuit of 'interests' but leaves unanalyzed the genesis of the interests. The strategic view may inquire how nations conduct (or would conduct, if they were rational) a diplomatic-military game but says nothing about how the game got started, why enmities are built up between some states and not between others, or, of course, why states behave so frequently and so clearly against their own interests" (Rapoport, 1968).

These comments summarize the bulk of mutual criticisms that political scientists sitting at separate tables have thrown to each other for several decades. Macro-structuralists don't explain the "mechanisms" of micro-behavior that produce interactions and outcomes; micro-behavioralists and game-theorists take the structures and the subsequent constraints on interactions for granted.

In the 1960s and early 1970s, "politometrics" appeared as a possible focal term for theory driven, quantitative political science in parallel to biometrics, psychometrics, and econometrics (and journals such as *Pshycometrika*, *Econometrica*, *Sociometry*, *Technometrics*). The word "polimetrics" was possibly used for the first time by Hayward R. Alker, Jr. at the International Studies Association (Alker, 1969). In his contribution to the first encompassing *Handbook of Political Science*, he stated that "the key epistemological ideal was the search for equations with manipulative, politically productive significance" (Alker, 1975). As embedded in the so-called behavioralist period, the endeavor focused then on the study of "intentional action," including individual's political orientations, voting choices, and modes of political participation, for which some early game theory models were also adopted.

More institution-oriented was the work of Ted R. Gurr, as presented in his book *Politimetrics. An Introduction to Quantitative Macropolitics* (Gurr, 1972) (note the slightly different spelling of the leading words in the works cited). In contrast to the above-mentioned project, Gurr aimed at measuring and explaining regularities not on micropolitics or individual behavior, but rather on macropolitics or structures, basically "political groups, institutions, nations and international systems." He emphasized that scientific work requires that induction combine with and follow deduction. As he put it: "All processes for gaining knowledge require us to make some initial assumptions (axioms) and hypotheses (theorems) about the nature of social and political reality.... The procedures of politimetrics are suited to testing all kinds of conjectures, however they

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are derived. The future of political science will be brightest if politimetrics becomes as widely used for evaluating formal theories as it has been for testing ad hoc hypotheses." With this inspiration, Ted R. Gurr also initiated The Polity study, which profiles the democratic and autocratic traits of all regimes worldwide from 1800 to the present and has been further developed by some of his disciples (Gurr & Marshall, 2014).

A more advanced second part of Gurr's book was published by Gordon Hilton with the title *Intermediate Politometrics* (Hilton, 1976). From the first page, Hilton stated that "while economics has econometrics, political science should develop politometrics. The desire in political science—Hilton asserted—is to be able to produce 'lawlike' relationships between sets of variables." In his extensive presentation of statistical regression techniques, he postulated to develop, first, theoretical simple models and then obtaining empirical estimators of the parameters. Most of Hilton's examples and applications went back to micro-behavioral problems, especially data analysis of voting and congressional behavior, plus a few excursuses into international relations.

Thus, politometrics was conceived for a while as the name for the right development of the scientific method for the study of politics in search of measurement, explanation, and evaluation in the fields of both micropolitics and macropolitics.[1]

Yet the word and part of its profile somewhat faded away. The APSA section in Political Methodology tried to subsume "the fragmented history of quantitative political analysis" and its "patchwork of names" under the bland label "political methodology" (King, 1991). For a few decades, the expansion of political science witnessed a widening separation between empirical uses of statistics techniques and theoretical formal modeling, the breach that politometrics and similar ventures should bear to seal. While a focus on micro-behavior had expanded the use of statistical techniques but neglected the role of theoretical hypothesis, the return to the traditional political science focus on macrostructures by the "new institutionalism" implied some loss regarding quantitative specification and empirical validation of formal models.

In the first encompassing review of the state of the political discipline sponsored by the American Political Science Association in the early 1980s, Christopher Achen sighted, "More than anything else, what would help are formal theories with measurement models built into them" (Achen, 1983). Ten years later, in the second edition of the survey, Larry Bartels and Henry Brady registered some progress in a few areas, but "in the field as a whole, there is still far too much data analysis without formal theory and far too much formal theory without data analysis" (Bartels & Brady, 1993). In the third review, nine years later, David Laitin pleaded for more interactions between statistics, formal theorists, and fieldworkers, although he acknowledged that "this hoped for interdependence is far more promise than reality" (Laitin, 2002). In the same volume,

Charles Cameron and Rebecca Morton reviewed new efforts to link theory and data in what they call "formal empirical (FE) work," but the endeavor was presented, rather than an achievement, as a "major challenge for the new century of political science" (Cameron & Morton, 2002).

The more recent *Oxford Handbook of Political Science* series created new occasions to replicate the pledge. In their overview of political methodology, Henry Brady, David Collier, and Janet Box-Steffensmeier acknowledged that behavioralism's "emphasis upon methodology is a good one, but its weaknesses included a neglect of theory" (Brady et al., 2009). The problem was also noted in the subfield of international relations, as "there has been an overemphasis recently on tools at the expense of reflection about which questions are more important for the human race and for the ecosystem" (Keohane, 2009).

In recent times, several initiatives increased awareness of existing methodological confusions and insufficiencies and developed more explicit initiatives. The Empirical Implications of Theoretical Models (EITM) project at the University of Michigan must be highlighted. The EITM organizes annual summer institutes to train graduate students and junior faculty in research strategies that integrate theoretical models and empirical research. The program aims at promoting research in the subfields of American politics, comparative politics, international relations, and political economy, although most of its projects have dealt so far with building databases and values surveys and with the study of attitudes and behavior, communication, entrepreneurship, elites and leadership, all topics more characteristic of "behavioralist" traditional interests (Aldrich, Alt, & Lupia, 2008).

In a relatively recent review of the long-term evolution of American political science, Lee Sigelman observed "growing attention to developing systematic methods for qualitative research and to testing the empirical implications of formal models" (Sigelman, 2006). In fact, like the Molière character who finds that he had been speaking prose all his life without knowing that this is what he has been doing, many political scientists have been trying to develop empirically testable theories and empirical studies in search of interpretation—as aptly observed by Bernard Grofman (2007, note 44).

Specifically, I will review below some major results of the project of building "quantitative logical models" with explanatory and predictive power that fit the politometrics approach particularly well. An initial training in physics provided Rein Taagepera with an outside point of view to existing political science, which helped identify relative weaknesses and to point out fruitful ways to pursue further research. He has also remarked the links between solid theory and practicability. On the one side, he emphasizes the importance of thinking and imagining logical connections among variables before using mathematical tools, as is more usual in other normal sciences. On

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the other side, he calls the attention about the necessary link between high scientific rigor and practical relevance, against irrelevant ivory towers.

Rein Taagepera was awarded the Johan Skytte prize (which pretends to be the little Nobel in political science), especially for his work on the relations between party systems and electoral systems and the consequences for government stability (as culminating in Taagepera, 2007). He, however, has also constructed and tested models for population growth, arms races, and the importance of the issue of size to explain historical empires, countries, cities, trade, and other relevant phenomena. The rest of this article focuses on some of Taagepera's recent authored, coauthored, or inspired "quantitative logical models" dealing with macropolitics and, particularly, with quantifiable structural or institutional variables such as population, seats, parties, territorial units, governments, and policy. Many other contributions should be reviewed along these lines and connected or compared with the findings presented below.

Quantitative Models of Political Institutions

Beginning with a major example of successful research can serve to illustrate not only some interesting substantial contents of politometrics, but also some basic characteristics of its methodological approach. The topic is classical: the relationships between party systems and electoral systems.

First, the question was addressed with some reasonable hypothesis on interrelations and causality. As expressed by Maurice Duverger since the early 1950s, the electoral system effects can be formulated by two major "laws: 1) a majority vote on one ballot is conducive to a two-party system; 2) proportional representation is conducive to a multiparty system" (Duverger, 1950, 1951, as summarized in 1972).

Second, broad quantitative tests were applied to the hypotheses by using standard statistical techniques. As found by Arend Lijphart, "the total amount of explained variance [in the number of parties] is explained almost entirely by a single variable: the effective threshold," which is taken as a proxy for the electoral system and equals 75%/M +1, being M the average magnitude or number of seats per electoral district. The prediction was that "each percentage increase in the effective threshold reduces the effective number of elective parties by 0.06." Yet the quantification of the effects was further neglected. It was retained only that "all of the coefficients of the regressions of the dependent variables on the effective threshold … are statistically significant, usually at the 1 per cent level" (Lijphart, 1994).

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Third, a quantitative logical model refining both Duverger's hypothesis and Lijphart's and others' empirics was produced. The number of parties, P, depends on the number of seats of the assembly, S, and the number of seats to be elected in the district, M. This gives way to the "seat-product." According to Rein Taagepera: "When an assembly of S seats is elected in districts of M seats, the most likely number of seat-winning parties P is:

$$P = (SM)^{1/4}$$

This means that, with a large number of cases, we expect one-half of them to fall above and one-half below the value P" (Taagepera, 2007; also Taagepera, 2001; Taagepera & Shugart, 1993).

A further refinement was introduced regarding the measurement of the number of parties. The "effective" number weights the absolute number of parties with their relative size, according to the formula: $EP = 1/\Sigma p_i 2$, where p_i is each party's proportion of all seats (Laakso & Taagepera, 1979).

Obviously, the effective number of parties is usually lower than the absolute number, as small parties count for much less than one. Therefore, with this fine-tuning the "seat-product" must be raised to a higher root. It becomes:

$$EP = (SM)^{1/6}$$

where,

EP: Effective number of parties

S: Total number of seats in the assembly

M: Average district magnitude or number of seats per district.

(Taagepera, 2009).

As can be seen, the basic elements of this approach, as were accumulated by successive research contributions on the specific problem, are accurate measurement of the variables considered, logical hypotheses about their relations and deductive reasoning, statistical treatment of empirical data, and mathematical design of the equation. Also, the direction of the relationship or probabilistic causal explanation has been discussed, as we'll see later on.

The most important difference of the politometrics approach regarding previous contributions is that models supported by quantitative measurements of the main variables considered can define relationships and trade-offs among variables in terms of "how much" one can depend on another and the expected variance of values. The

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equations need to include not only the sign and statistical significance of presumed associations between different alternatives, but gradations of effects.

Following this orientation, several of the contributions reviewed below have produced cumulative and complementary findings. They have contributed to a better understanding of the choices and consequences of political institutions and the regularities that are observed and can be predicted at several successive stages of the political process. Focusing on major choices of democratic institutions, I review the following:

- First, the size of the assembly regarding the country's population.
- Second, the relation between the size of the assembly, decentralized territorial governments, and the electoral system.
- Third, the relation between the electoral system and the party system.
- Fourth, the relations between the party system, the size of the largest party, and the number of parties in government.
- Fifth, the influence of the number of parties in government on the government's duration.
- Sixth, the effects of the number of parties in government on the degree of policy instability.

These six basic relations can account for most major stages of a state-based political process of decision-making, from the size of the country in population to the policy outcomes. International and global institutional matters have also been explored.

Let's proceed step by step. The following results are not presented in the chronological order in which they were found, but by pointing out a succession of logical and quantitative relations between major institutional variables.

Assembly Size

In order to estimate the size of a directly elected lower chamber of the assembly in a democratic country, it was hypothesized that two motivations could counterweight each other: broad representation of the population may require a high number of seats, while communication between legislators and effectiveness in decision-making may be favored by a low number.

Accordingly, it was found that the best approximation is to take the cube root of the population. For most countries the number of inhabitants amounts to millions—that is,

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some figures with six zeroes—and so the cube root must be in the hundreds—or some figure with two zeroes. The equation is:

$$\text{Pop}^{1/3} \rightarrow S$$
where,

Pop: Population

S: Assembly size in seats.

The arrow indicates causal direction.

(Taagepera, 1972; Taagepera & Shugart, 1989).

For example, as Spain has about 45,000,000 inhabitants, the cube root of this number closely approaches the 350 seats of its lower chamber of parliament ($45,000,000^{1/3}$= 355). As Mexico has about 120,000,000 inhabitants, its lower chamber has 500 seats ($120,000,000^{1/3}$= 493). For most democratic countries, this is the best fit, as can be seen in Figure 1.

Major deviations occur in two old democracies whose assembly sizes have been frozen for a long period. The British House of Commons, which is the largest assembly of all democratic countries (S = 659), is oversized regarding the country's population and the cube root law. In fact, it has maintained almost the same size as the so-called Imperial Parliament established in the early 19th century (actually following the pattern of its predecessors the parliaments of Britain and of England), apparently to give room to a complex set of representatives from counties, boroughs, towns, universities, and other types of districts. Formal proposals to reduce the size of the House of Commons have been included in the government's program for institutional reform since 2010.

In the opposite direction, the U.S. House of Representatives is undersized. During the 19th century, the size of the House was regularly increased to account for population growth, but in spite of the increase in the country's population it has remained frozen since it was fixed at 435 seats in 1911. At that moment this was an almost exact fit with the cube root of the population. Proposals to increase the number of seats in the House to the cube root of the population have been repeatedly raised (see, e.g., Ladewig & Jasinski, 2008; Lijphart, 1998). As we'll see, however, other institutional devices have compensated for the federal House's relatively small size.

The size of the democratic assembly is also relatively low for very small countries with less than one million inhabitants, such as some islands in the Caribbean or the Pacific Ocean, as well as for regional or local legislatures. This might reflect these units'

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relatively high homogeneity and simplicity of political demands, as well as the relatively lesser role of those assemblies within larger alliances, unions, or states.
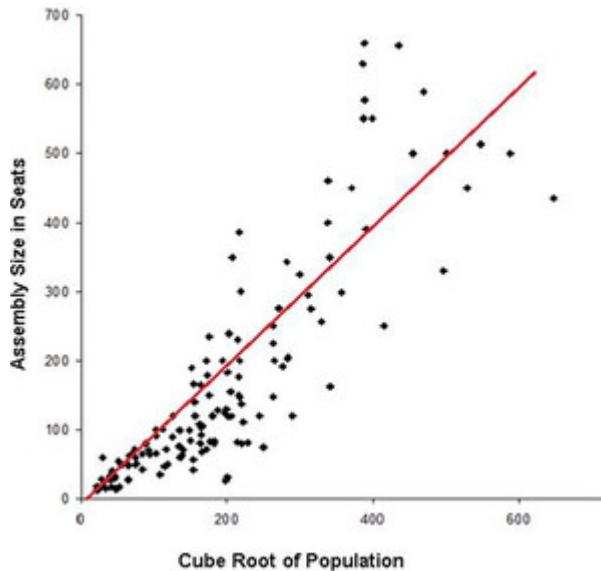
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Figure 1. Size of the Assembly in Seats.

A closely related topic is the size of the second or upper chamber. About one-third of currently existing democratic countries have bicameral parliaments, especially in large, federal countries in order to lend a voice to the territorial units

The size of second chambers in seats tends to increase with increasing population and, therefore, with the size of the first chambers just reviewed.

But when the second chamber represents the territorial units of a federal-like state, the number of units also affects the size of the upper chamber. Every territorial unit elects at least one seat, while larger units elect higher numbers of seats. In result, the number of seats of the upper chamber is smaller than the number of seats of the lower chamber but larger than the number of territorial units. The equation that best fits the empirical observations equals the size of the second chamber to the geometric mean of the size of the first chamber, S, and the number of territorial or "regional" units, R:
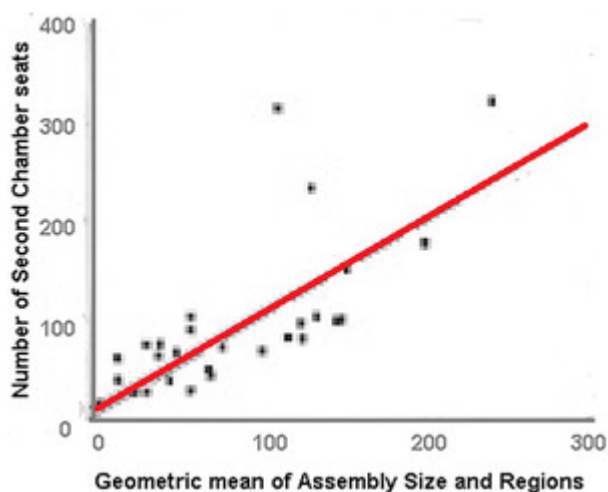
$S_2 = (SR)^{1/2}$

where,

S_2: Second chamber size in seats

S: First chamber of the Assembly size in seats

R: Number of Regions or territorial units.

(Taagepera & Recchia, 2002).

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Figure 2. Size of the Second Chamber in Seats.

Federalism and the Electoral System

It was a traditional conjecture among political scientists that both federalism and the electoral rules can favor institutional stability in large and heterogeneous countries. Territorial governments could be considered as kinds of intermediate, aggregative, nonideological "parties," while political parties may play the role of aggregative, non-territorial "administrations." A large number of territorial political units in a federal structure can be the basis for a large, aggregative "union," while a large assembly based on proportional representation and multipartism can also be aggregative because it can lead to the formation of some broad government multiparty "coalition." Both "union" and "coalition" can keep a large and varied country together by using democratic means of governance. For the same kind of reason, simple institutional configurations such as a unitary state and plurality rule elections with a single-party winner can support durable democracy in small and homogeneous polities, but they tend to be recipes for conflict and democratic failure in large and heterogeneous countries.

Thus, it could be presumed that the territorial structure of the country and the electoral system are institutional devices able to be exchanged with each other to some extent. Yet different institutions may produce effects that cannot be exchangeable. It has been found that different combinations of unitary or federal arrangements with majority or proportional electoral rules can be appropriate for countries of different sizes. Specifically, the larger the country, the more important is federalism in comparison to proportional representation for the durability of democratic institutions. The equation is:

$S \leftarrow \rightarrow 62R^{1/2}M^{1/4}$
where,

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S: Assembly size in seats

R: Number of territorial units or regions with elected assembly and political power

M: Number of seats of the average electoral district.

(Colomer, 2014A).

The placement of S in the function should not be confusing. Actually the model can accept bidirectional lines of causality, as all variables are to some extent interdependent, rather than independent or dependent. All the variables are manipulable and for each country size there can be multiple equilibrium sets of democratic institutions. But each institutional combination involves a certain trade-off between alternative elements.

The equation above shows that the larger the country, the more effective and durable federalism can be, to the point of being compatible with very diverse electoral systems for the lower chamber. Large federal countries include, for instance, proportional Argentina, Brazil, Germany, and South Africa, as well as majoritarian Australia, Canada, India, and the United States. In contrast, in medium-sized countries, a democratic regime may rather rely upon proportional representation of multiple parties to obtain greater endogenous support. In fact, proportional representation began to be adopted for parliamentary elections in the early 20th century in a few medium-sized European countries, such as Belgium, Finland, Norway, and Sweden, soon followed by Austria, Denmark, Ireland, and Switzerland, and has spread widely among new democracies in medium-sized countries across the world in recent decades.

Some examples of varied institutional combinations follow. Cases of small countries with a unitary structure and a majoritarian electoral system are Botswana (where the model predicts S = 62 and actually S = 63) or Jamaica (model S = 62, actual S = 60). Medium-size countries with a unitary structure and a proportional representation electoral system include Benin (M = 3.5, model S = 85, actual S = 83), Bulgaria (M = 240, model S = 241, actual S = 240) or Estonia (M = 8.4, model S = 105, actual S = 101). Large countries with a federal structure are compatible with varied electoral systems, whether majoritarian (Australia, R = 8, model S = 175, actual S = 150), proportional (Poland, R = 16, M = 10.7, model S = 449, actual S = 460), or mixed (Mexico, R = 32, weighted M = 16.6, model S = 498, actual S = 500).

An extreme case is the United States, which has the maximum value of R in the world (50) and the minimum value of M (1). The very high number of states somehow compensates for the smallness of single-seat districts. According to the model, the House of Representatives should have S = 438 seats; the very close actual value is 435, which,

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in spite of being undersized regarding the population, as mentioned above, makes a satisfactory fit with the other two major institutional variables.

Which one of the multiple equilibrium sets of institutions exists largely depends on actors' strategies. If in a large country multiple territorial governments are established, as it was from the very beginning in the United States, much political action tends to focus on those local institutions; it is then less likely that multiple political parties will be formed at the federal level, and as a consequence there will be less pressure to adopt a large assembly and an electoral system of proportional representation. In contrast, in a medium-sized, high-density country with a variety of economic interests or cultural allegiances, such as, for example, the Netherlands, the formation of multiple political parties may push for a sufficiently inclusive assembly elected by proportional electoral rules, rather than for territorial governments. The relationships between institutional variables are always established through the intermediation of collective action.

If the existing institutional regime fits an equilibrium solution, it can provide incentives and constraints for actors to behave in ways that can reinforce its stability. This can also explain the success or failure of some recent attempts of institutional reforms. Several initiatives to introduce proportional representation rules failed in federal countries, mainly in Canada and the United States, while successful reforms in the same direction took place in unitary countries, like New Zealand and Japan.

The Electoral System and the Party System

We have already presented the main politometric finding on this classic political science topic, the "seat-product": $P = (SM)^{1/4}$

More recently, the direction of causality was also discussed. Duverger's laws were broadly understood as if the number of parties were dependent on the electoral system. Yet, although he didn't elaborate much on it, he had already pointed out the reverse effect: "It is also clear that the relationship between electoral and party systems is not a one-way phenomenon; if a one-ballot vote tends toward a two-party system, a two-party system also favors the adoption of a single ballot voting system" (Duverger, 1972).

Stein Rokkan went further: "In most cases it makes little sense to treat electoral systems as independent variables and party systems as dependent. The party strategists will generally have decisive influence on electoral legislation and opt for the systems of aggregation most likely to consolidate their position" (Lipset & Rokkan, 1967).

A more explicit hypothesis regarding the actors' motives and choices was presented. According to the "Micro-mega rule," the large prefer the small and the small prefer the

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large. This postulates that a few large parties may tend to prefer small assemblies, small electoral districts, and small thresholds (the smallest being plurality rule, which does not require anyone), in order to exclude others from competition, while multiple small parties tend to prefer large assemblies and large districts with proportional representation in order to enter the system and have an influence within (Colomer, 2004).

Statistical calculations were developed in order to give the reversal hypothesis empirical support. It was found that the probability of change from plurality or majority rule in single-seat districts to proportional representation in multi-seat districts is higher than 50% when the effective number of parties is higher than four (Colomer, 2005).

But the reversed quantitative logical model above presented was also validated. The electoral system, summarized by M, can be derived from the number of parties, whose leaders and members are likely to be the designers and choosers of the electoral system, and from the number of seats in the assembly, which is a structural variable depending on the country's population:

$$P^4/S \to M$$

The equation also shows that the number of previously existing parties, which is the result of human collective action, is more influential than the structurally determined size of the assembly for the choice of the electoral system.

Number of Parties in Government

The number of parties with seats in the assembly is clearly related with the number of parties in the cabinet. There is an obvious direct relation between the two variables in parliamentary regimes, as either there is a majority party in the assembly or a multiparty coalition is formed in support of the prime minister. But the relation is also highly relevant in presidential regimes. When the president's party does not have an absolute majority of seats, multiparty coalitions tend to be formed in similar ways as in parliamentary regimes, with the only restriction that the president's party must be a coalition partner (as long as the president's party is the largest party, the two processes work in a very similar ways).

There is a long tradition of both formal models and empirical studies of coalition formation in parliaments and congresses (Laver & Schofield, 2003; Pereira & Melo, 2012). But the quantitative approach can be very simple. The average number of parties with seats in democratic assemblies is about six, while the average number of parties in governments is about two. The best fit is given by the equation:

$$P/3 \to PG$$

where,

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P: Number of parties with seats

PG: Number of parties in government.
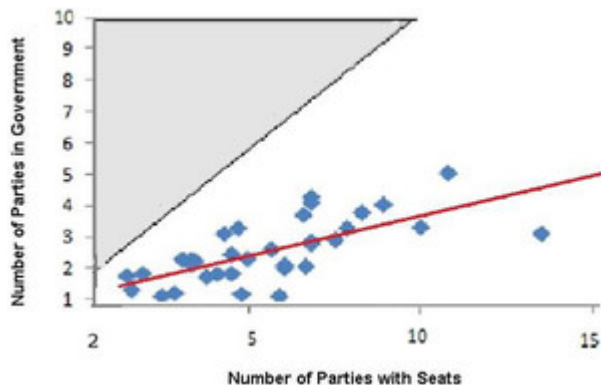
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Figure 3. Size of Government in Parties.

More sophisticated is the calculation of the relative size of the largest party, which may also determine whether the government is going to be formed by one, two, or a higher numbers of parties. The reasonable hypothesis is that the larger the number of parties, the smaller the seat share of the largest party. The best fit was found with the equation: $P_{-1/2} \rightarrow p_1$

where,

P: Number of parties with seats

p_1: Seat-share of the largest party.

(Taagepera, 2007, ch. 8)

For example, in an assembly with 4 parties, it should be expected that the largest party would have about 50% of the seats and most likely be able to form a single-party government. For the world average value of 6 parties, the largest party would have 40% of the seats and most likely be able to form a majority coalition with only one junior partner, as is actually the average empirical observation.

Cabinet Duration

The advantages and drawbacks of the duration of cabinets has been debated. For some, short-lived cabinets are unlikely to provide effective policy-making and may over the longer run affect the legitimacy of the political system. For others, overly durable cabinets imply executive dominance and may go stale. For any of the normative judgments, nevertheless, it may be interesting to be able to explain and predict the duration of cabinets in parliamentary regimes.

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A cabinet may be considered to last as long as its partisan composition does not change and the prime minister remains the same. With this criterion, the total range of mean cabinet durations for 35 countries observed extends from 1.5 years (in Finland) to 40 years (in Botswana). In order to explain this variance, several studies have focused on either structural factors (including rules for appointing and dismissing governments, electoral volatility, party system polarization, and other elements) or the effects of unpredictable, critical events. But those studies have not offered specific quantitative predictions (See reviews by Grofman & van Roozendaal, 1997; Laver, 2003).

A quantitative logical model drawing from some of the findings above reviewed has focused on the number of parties with seats. It is assumed that the higher the number of parties, the more potential for channels of conflict, which can lead to party shifts among those initially sharing or supporting a coalition cabinet. It's not only the number of parties in the coalition that counts, as parties in the opposition can also have ways to affect its duration. The relative sizes of the parties may also be relevant, as, for example, party systems with a large, dominant party may have more durable cabinets. This leads to take the effective number of parties as, as reported above; it weights the number of parties by their relative sizes. The best fit was found for the equation:

$$C = 42\text{years}/EP^2$$
where,

C: Cabinet duration in years

EP: Effective number of parties with seats.

(Taagepera, 2002, 2007, ch. 10).

Again, this means that the actual duration has an equal probability of being above or below 42 years/EP^2. For every specific case, the deviation from the prediction of the model leaves room for other explanatory, whether structural or eventful factors mentioned above.

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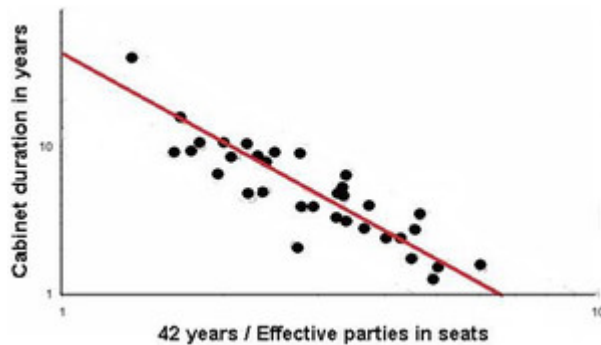
Click to view larger

Figure 4. Cabinet Duration in Years.

Policy Change

Policy change or instability has been valued differently by different authors depending on whether they praise more clear-cutting electoral promises and executive effectiveness or broad consensus in decision-making. Several studies have considered whether policy instability can depend on a variety of economic, social, political, and institutional factors, but no quantitative measurement was provided. (See, e.g., Lijphart, 1999; Persson & Tabellini, 2003; Schmidt, 1996). Following the politometrics approach, the degree of policy change or instability was modeled and quantified in relation to the number of parties in government. Since the relationships between the number of parties in government and other variables, such as the number of parties with seats and the electoral system, are well established, as we have seen above, it was possible to simplify the question into only two variables.

Actually, it was traditionally observed that single-party governments, such as those formed in the United Kingdom for several decades, tend to produce very high levels of policy changes and reversals, whereas multiparty coalition governments, such as the ones in Switzerland or Israel, tend to produce a high degree of stability and little policy change. In order to quantify this relationship, policy change was measured on the basis of the data for policies and preferences of parties and governments in a few dozen countries since World War II produced by the Party Manifesto project (Budge et al., 2001; Kim & Fording, 2002, 2010; Klingemann et al., 2006). As they are standardized on a scale of 0–100, they permit intra-country, cross-country and long-term comparisons. For each country, policy change is measured as the average difference between the government's policy scores in each pair of successive elections.

There is a strong negative correlation between the number of parties in government and the degree of policy change. The fewer parties in government, the more changes, and vice versa. An equation with quantitative values indicates that in comparison with the

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high levels of policy instability in certain systems with single-party governments, such as the United Kingdom (which is about 30% of the policy-ideology spectrum); a series of two-party coalition governments, such as those in Germany, can reduce policy instability to about half (so about 15%); while three, four or more parties in government, as in Israel, the Netherlands or Switzerland, reduce policy instability to about one-third (10%). This is summarized by the equation:
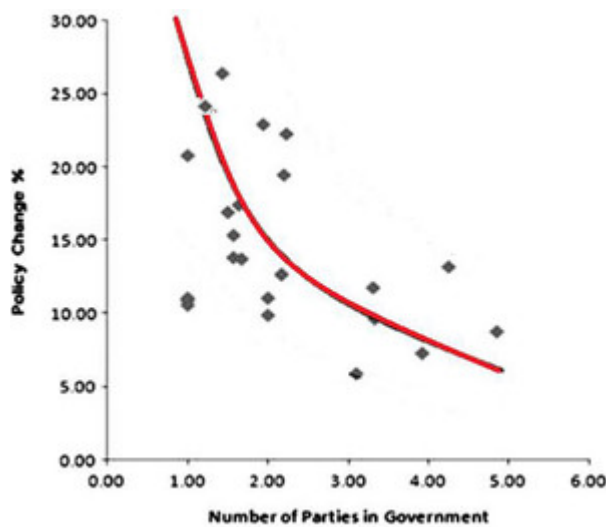
$30\% \; /PG \rightarrow Ch$
where,

PG: Number of parties in government.

Ch: Average percentage of policy change between two successive elections,

which is calculated by the difference between the weighted average of policy positions of each government for all k election-years t: $Ch/k = \Sigma|GovtId_t - GovtId_{t+1}|$.

(Colomer, 2012).

Click to view larger

Figure 5. Policy Change.

Analogous calculations for the separation-of-powers system of the United States gave a provisional estimate of policy change of 7%, which somehow confirms the so-called gridlock, deadlock, or paralysis effect of a regime with institutional "checks and balances" and frequent situations of divided government.

Institutional Design

The package of accumulated politometric findings also suggests indirect relations between different variables, which can be used for forecasting probable effects of institutional changes and for supporting institutional advice and design.

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For example, from the measurement of cabinet duration one could move backward to its directly or indirectly causal variables, first to the number of parties with seats and the size of the largest party; then to the factors of the seat-product, that is, the electoral district magnitude and the size of the assembly in seats; and from the latter to the country's population. In the notation given above, the chain would be:

$$\text{Pop} \to \text{S,M} \to P_1 \to P \to C$$

In this presumed causal chain, the mean cabinet duration is directly connected to the number of parties and more and more indirectly to the other variables. Hence one should expect the electoral system, as operationalized with S and M, to be less precise than the number of parties in predicting the cabinet duration. But this is the relationship that matters for institutional engineering. According to the model it can be predicted, for example, that doubling the electoral district magnitude would reduce the mean cabinet duration by about 20% (Taagepera & Sikk, 2010).

Another example is the hypothetical formation of a worldwide elected assembly, which could work for check and accountability of the global institutions. As it is estimated that the world population in 2025 will be about 8 billion, the size of a world assembly in seats, according to the cube root law, should be about 2,000.

$$\text{Pop}^{1/3} = 8,000,000,000^{1/3} = S = 2,000$$

For the number of territorial units, as the size of the countries is so hugely varied, a possible arrangement could be to count both states and regions in federal-like countries. Rounding numbers, there are in the world about 200 states and about 500 political regions (including 50 states in the United States, 26 in India, and so on), which would make about 700 territorial units.

Then the equation that relates the size of the assembly, the number of regional or territorial units and the average district magnitude produces M ≈ 3. This could reasonable imply a combination of single-member districts and medium-size multimember districts.

$$S = 62R^{1/2}M^{1/4}; 2,000 = 62 \times 700^{1/2} \times M^{1/4}; M \approx 3$$

Then the size of the upper chamber would be about 1,000, certainly smaller than the size of the lower chamber and larger than the number of territorial units.

$$S_2 = (SR)^{1/2} = (2,000 \times 700)^{1/2} \approx 1,000$$

(adapted from Colomer, 2014B).

The politometric models here recollected can provide a parsimonious and consistent explanation of the variety of combinations of some basic institutional alternatives in durable democratic countries. In future research, additional variables could be added to refine the models, including, in particular, the density of the population and

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measurements of its economic and cultural heterogeneity, which could qualify the size of the country in population that has been taken so far as a proxy of social complexity. Other institutional variables may refer to the relations between presidents and assemblies, which may involve a gradation of relative powers, checks, and balances. (For an early attempt to measure separate institutional powers with quantitative values, see Shugart & Carey, 1992.) The models should also provide predictive capacity able to support forecasts and practical advice, especially for the success of attempts at constitutional reforms, new democratizations, or state-, nation-, and federation-building.

Methodological Discussion

The pertinent presumption for all the previously reviewed works is that the political outcomes of human interactions can produce regularities amenable to being captured by mathematical formulas similar to those used by physicists or by economists. Political scientists may expect a set of relevant postulates, if they are captured by a few stylized formulas, to be the foundations of a deductive method of inquiry. Well-modeled hypothesizes, if expressed as mathematical relationships between well-defined variables, can be subjected to empirical testing, and are capable of being used to develop specific predictions. This should open doors toward theoretically driven, empirically grounded political analysis.

To make further progress and develop cumulative scientific knowledge, politometric models should fulfill a few specific methodological traits that have been briefly mentioned on the way in the above review. They include a small number of measurable variables, logical hypothetical relationships, varied forms of mathematical equations, results focused on the numerical values of quantitative coefficients, and directionality of causal relationships.

First, a simple and relevant equation should include a small number of well-defined variables. Physics works with a few, clearly defined, precisely measurable variables, such as distance, time, mass, energy, temperature. Economics, on its own, operationalizes population, product, money, employment, trade. Politometrics, in turn, needs to focus on measurable parameters such as arms, votes, seats, parties, offices, governments, policy distance, ethnic distance, and so on.

Second, the format of the functional relationship must be established on logical grounds, which usually requires assumptions regarding actors' motives and choices. As in physics, economic theorems are not generalizations induced from experience, in contrast to still common uses in political science. They postulate logical hypothetical relationships among

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variables that should enable us to explain and predict observations. Economists began following this path several generations ahead of mainstream political scientists, but a few decades ago they still encountered difficulties and objections that were similar to those faced more recently within political science.

Third, the mathematical equations that establish relations among variables may have a nonlinear form, but include multiplication, division, power or derivative (or have an additive linear format for the logarithms of the variables). Most basic equations in mature sciences are not linear and very few are simply sums; nonlinear forms of equations are also widely used in economics (Colomer, 2007; Crease, 2004). Warnings regarding the narrowness of the traditional linear, additive regression model were raised in economics several decades ago (see Malinvaud, 1970). Similar alarms regarding the possibility of both finding spurious linear relationships or overlooking true nonlinear relationships were also raised in political science (McGregor, 1993). This is also a current concern in psychology (Nisbett, 2015).

Fourth, quantitative coefficients should be taken seriously. Further progress with new data and observations should not start from scratch or focus only on statistical significance, but start from the quantitative results of previous analyses.

Fifth, the directionality of the relationship should be specified (perhaps using "arrows" instead of "equal" signs, as in some equations above). This is because the mechanisms that can explain relationships between structural or institutional variables typically include human action with some intentional direction. Human decisions may alter any of the variables and make it exogenous or independent, as was discussed regarding the reverse relationship between electoral systems and party system, and it is valid for any choice of institutional formulas.

Certain warnings that were already raised in economics should also be taken into account. In particular, it has been argued that the depth and precision of scientific knowledge acquired in physics may not be achieved in the social sciences for two reasons. One has to do with the range of validity of theorems. Kenneth Arrow remarked that while physical laws are "true for all time," economics (and for that matter, political science) is more constrained by given circumstances. Accordingly, each historical or contemporary episode should "be interpreted as the application of general principles to unique contexts" (Arrow, 1985). Economists and other social scientists typically suspect that the human world changes more than the natural one, thus imposing more constraining territorial and temporal limits on the validity of hypotheses and postulates that should be specified.

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Nevertheless, it can be observed that the laws of physics are also valid only under specified conditions. Galileo's law of falling bodies, for instance, implies an idealized "perfect vacuum," but to measure and predict each specific episode, the resistance of air or "friction" and other circumstances have to be estimated. Actually, physical laws do not predict the future in an unconditional sense. They merely say that if certain conditions are fulfilled, then certain outcomes can be expected. Whether this implies a difference of degree or of quality in the kind of knowledge that can be developed in the natural sciences and in the social sciences, is something open to discussion. To use Arrow's own comparison, it is likely that the social sciences should be able to develop, in proportion, more "geology" than "physics" or "chemistry," that is, more study of specific events than standard laws. But no geology is feasible without solid foundations in physics and chemistry, as the study of business or public administration should be based on solid economics and political science.

A second objection is that in the social sciences there is a greater degree of influence of the observer on the subject being observed. Specifically, knowledge of economic phenomena may itself become an economic variable, since people with such knowledge can change the economic situation to which they refer. Again, influence of the observer on the observed has also been claimed for any science using laboratory experiments, since observation always means interaction. In quantum mechanics, for instance, "seeing" particles requires bombarding with photons, which does not affect large objects, but alters subatomic particles. It is clear, nevertheless, that this objection is more relevant to the development of testable postulates and predictions in the social sciences. An implication is that the "mechanisms" or decisions likely to be made by human beings given specific constraints and incentives may also be specified in order to account for expected outcomes—as developed in game theory, prospect theory, and related approaches.

None of this diminishes, however, the potential for the development of politometrics. With the above-mentioned properties, mathematical equations based on sound theory can be validated by empirical tests, and can predict precise observations. They can provide not only knowledge and understanding of political phenomena, but also the best foundations for applied research in fields such as public administration, policy-making, electioneering, diplomacy, conflict resolution, and others with a wide professional projection.

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Notes:

(1.) There has been some hesitation about the exact conformation of the appropriate names for the approach. As the name for a subfield of political science or polito-logy, polito-metrics is derived from the Greek roots "politika" and "metrics" or measurement. This is analogous to the use of econo-metrics as derived from "oikonomus" or economics and "metrics." In contrast, the previously used name polimetrics would be analogous to the nonexisting and narrower ecometrics; and, in addition, "poli" could be confused with "poly" or "many" (see self-revision and discussion by Alker, 1996). Other uses include a numerical Computation Laboratory at Ohio State University that was named Polimetrics from 1969 to 1996, when it was renamed the Political Research Lab. A related book title is Daniel T. Osabu-Kle, *Introduction to Polimetrics* (1997). Polimetrics has also remained as the name for quantitative-oriented courses in Arizona State, Virginia State, Carleton, and other universities.

The distinction between micro- and macropolitics, which is, of course, imported from micro- and macroeconomics, was adopted for volumes 2 and 3 of the *Handbook of Political Science* edited by Greenstein and Polsby (1975) and promoted as an organizational criterion by Harry Eckstein, whose colleagues at the University of California, Irvine, have kept it for their core courses (Grofman, 2005).

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