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On the optimal size of legislatures: An illustrated literature review

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ABSTRACT

Several countries have voted reforms in order to reduce the number of national representatives and many others have debated about that possibility. There is, however, no commonly accepted rule for assessing the optimal number of seats in parliament. This article offers a review of the state-of-the-art, presenting the main contributions in political economy and related fields about the question of legislature sizes, their determinants and their impact. Based on a cross-sectional comparison of 139 countries, the review is accompanied with a set of figures and tables that illustrates a set of stylized facts.

1. Introduction

On September 20 and 21, 2020, a constitutional referendum on the reduction of the number of parliamentarians was held in Italy. The referendum, which regarded amendments to articles 56, 57 and 59 of the Italian Constitution, was intended to reduce the number of lower house legislators from 630 to 400 and those in the Senate from 315 to 200. The reason behind this cut, according to the supporters of the reform, was to reduce the amount of political spending and to increase the performance of the decision-making process. The detractors of the reform, mainly minor parties, were arguing that those gains would not compensate the loss in political representation and would, instead, weaken the parliament and democracy. The referendum passed with 69.96 percent of the formal vote.

In the past decades, several countries have voted similar reforms in order to reduce the number of national representatives (Jacobs and Otjes, 2015) – e.g., Ireland, the United Kingdom and Hungary – and many others have debated about that possibility (Farrell, 2014). In the United States, there is an old yet ongoing debate about the size of the parliament related to the fact that the population-to-representative ratio is the second-highest worldwide: only one representative for 607,450 citizens in 2017, both houses included (see Fig. 1 which offers a cross-country comparison). India holds the record with less than one national representative for 1.7 million inhabitants. Comparatively, some other countries, mostly with a smaller population size, have a much lower ratio – e.g., Luxembourg with one representative for ten thousand inhabitants.

So far, there is no commonly accepted rule for assessing the optimal size of legislatures. Taagepera's (1972) *cube root law* specifies the optimal number of seats in a legislature as the cube root of the population, but this normative result is subject to discussion (e.g., Auriol and Gary-Bobo, 2012; Godefroy and Klein, 2018; Margaritondo, 2021; Gamberi et al., 2021). In the same vein, a set of empirical contributions show that the number of parliament members (MPs, hereafter) increases with population size, but the estimates can deviate from the theoretical values (Gamberi et al., 2021). The heterogeneity of preferences is also

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(a) Bicameral legislatures (61 obs.)

Rank	Code	Ratio	Population (millions)
1	IND	1694505	1338.659
2	USA	607450	324.986
3	PAK	466136	207.897
4	NGA	406979	190.873
5	BRA	349889	207.834
6	PHL	327643	105.173
7	RUS	233059	144.497
8	MEX	198690	124.777
9	COL	182467	48.901
10	JPN	179329	126.786
11	COD	133880	81.399
12	ARG	133875	44.045
13	DEU	123924	82.657
14	KEN	120147	50.221
15	MDG	119489	25.571
16	KAZ	117128	18.038
17	ZAF	116327	57
18	RWA	113028	11.981
19	AUS	108858	24.602
20	MYS	106524	31.105
21	AFG	103409	36.296
22	TJK	91549	8.88
23	CHL	90100	18.47
24	CMR	87736	24.566
25	KHM	86537	16.009
26	SDN	84675	40.813
27	CAN	82491	36.543
28	NLD	76139	17.131
29	ESP	75638	46.593
30	FRA	72286	66.864
31	MAR	69090	35.581
32	DZA	68299	41.389
33	POL	67812	37.975
34	BOL	67427	11.193
35	BDI	66018	10.827
36	ITA	63656	60.537
37	PRY	54936	6.867
38	BLR	54588	9.498
39	BEL	54167	11.375
40	JOR	50150	9.779
41	DOM	47356	10.513
42	LBR	45653	4.702
43	GBR	45401	66.059
44	ROU	42123	19.587
45	ZWE	40676	14.237
46	CZE	37703	10.594
47	AUT	36056	8.798
48	JAM	34772	2.921
49	CHE	34357	8.452
50	OMN	27447	4.666
51	URY	26436	3.437
52	COG	22918	5.111
53	IRL	22052	4.807
54	MRT	21096	4.283
55	BHR	18676	1.494
56	NAM	16456	2.403
57	SVN	15895	2.066
58	LSO	13493	2.091
59	BTN	10355	0.746
60	GAB	9301	2.065
61	GNQ	7424	1.262

(b) Unicameral legislatures (78 obs.)

Rank	Code	Ratio	Population (millions)
1	IDN	472582	264.646
2	CHN	462132	1386.395
3	BGD	456202	159.671
4	IRN	278186	80.674
5	THA	276839	69.21
6	PER	241879	31.444
7	VNM	189193	94.597
8	KOR	171206	51.362
9	EGY	161816	96.443
10	BFA	151128	19.193
11	TUR	147458	81.102
12	TZA	139094	54.664
13	AGO	135531	29.817
14	BEN	134641	11.175
15	NER	126330	21.602
16	MLI	125935	18.512
17	ECU	122521	16.785
18	MOZ	114596	28.649
19	IRQ	114490	37.553
20	GHA	105896	29.121
21	GIN	105856	12.068
22	GTM	101819	16.087
23	UKR	99625	44.831
24	CIV	95833	24.437
25	LKA	95307	21.444
26	SEN	93451	15.419
27	MWI	91556	17.67
28	UGA	88521	41.162
29	CRI	86841	4.95
30	TGO	84599	7.698
31	TCD	79876	15.017
32	AZE	78832	9.854
33	SLV	76049	6.388
34	HND	73664	9.429
35	ISR	72611	8.713
36	NIC	69401	6.385
37	QAT	66457	2.725
38	KWT	62402	4.056
39	PAN	57842	4.107
40	SGP	55567	5.612
41	LBN	53218	6.812
42	TUN	52689	11.433
43	SLE	51291	7.488
44	HUN	49186	9.788
45	LAO	46665	6.953
46	TKM	46061	5.758
47	NPL	45969	27.627
48	PRT	44784	10.3
49	MNG	40971	3.114
50	NZL	39949	4.794
51	GMB	38171	2.214
52	SVK	36262	5.439
53	GRC	35849	10.755
54	BWA	35002	2.205
55	CAF	32829	4.596
56	DNK	32207	5.765
57	NOR	31225	5.277
58	BGR	29483	7.076
59	SWE	28819	10.058
60	SRB	28083	7.021
61	ARM	28046	2.945
62	FIN	27541	5.508
63	HRV	27315	4.125
64	MDA	27279	2.755
65	GEO	24853	3.728
66	COM	24663	0.814
67	ALB	20525	2.873
68	LTU	20060	2.828
69	LVA	19422	1.942
70	CUB	18743	11.339
71	MUS	18328	1.265
72	GNB	17923	1.828
73	CYP	14746	1.18
74	EST	13043	1.317
75	GUY	11235	0.775
76	LUX	9939	0.596
77	MNE	7684	0.622
78	CPV	7465	0.537

Fig. 1. Ratio of inhabitants to MPs: world ranking (2017). Note: own calculations (139 obs). Lower and upper houses are both included for bicameral systems. Population is displayed using a logarithmic scale. See Appendix for data description.

an important factor to account for, because a larger legislature (1) improves the representation of females, ethnic minorities and small-towns population (Brooks et al., 2011; Gerring and Veenendaal, 2020), (2) generates higher policy congruence between voters and representatives (Stadelmann et al., 2014), and (4) affect party representation (Taagepera, 2007; Lundell, 2012).

Another fraction of the literature investigates the link between the size of assemblies and public spending levels, expecting a positive relationship between the two variables. The tenet of the theory is that legislators act in their own interests and/or favor their constituents at the expense of the general community, e.g., through pork barrel spending and distributive policies (Buchanan and Tullock, 1962; Weingast et al., 1981). In that perspective, the number of representatives must be shaped in a way to avoid excessive spending levels.

The recent popular protests against national policies have drawn a lot of attention to the question of the efficiency of democracies. With the high rate of population growth, the question of the legislature size must be brought up to the table. In France, the number of seats in the lower house has barely evolved in 62 years (579 in 1958 versus 577 in 2020) while the population has increased by 75% (44 versus 67 millions). Despite this trend, most candidates for the 2017 French presidential elections were advocating a cut in the number of MPs. In the US, the ratio of citizens to MPs has more than tripled in one century (DeSilver, 2018). In 1850, an appropriation bill was introduced to enlarge the Capitol but, nowadays, the building cannot be easily expanded in order to accommodate more MPs (see, e.g., Kane et al., 2020). In India, the number of seats is fixed since 1976, yet a new building is expected to be completed by October 2022 in order to expand the parliament seating capacity.

The research question is also of interest at the subnational level. In the UK, the number of local elected representatives varies considerably and is, in large part, the result of historical accidents (Purdam et al., 2007). By way of contrast, the council size at the municipal level in France and Belgium is based on formulas that specify the number of seats as a function of population thresholds. Moreover, several studies address the question of the relationship between the size of local assemblies and local public expenditures (see, e.g., Meloche and Kilfoil, 2017; Höhmann, 2017; De Benedetto, 2018; Bel et al., 2018, for recent analyses).

This article offers a review of the current state of knowledge. We use a dataset of 139 countries to shed lights on the connections that exist between the size of national legislatures, their type (bicameral vs unicameral), their constitution (unitary republic, federal government, unitary monarchy), the population size, public spending and debt levels as well as several democracy indicators (control of corruption, voice and accountability, polity2, degree of political competition). This empirical work has an illustrative purpose only and will not address problems of causality among variables; but will, more simply, accompany the review with a set of stylized facts.

The outline of the review is as follows. Section 2 addresses the research question from an historical and fundamental perspective. Section 3 discusses the role of the population size. Sections 4 and 5 examine the effect on fiscal policies and quality of democracy. Last, Section 6 concludes.

2. Historical and fundamental perspectives

2.1. Philosophical background

The discussion around the sizes of legislatures goes back to the ancient Greeks. Plato was advocating the use of numbers that have convenient divisions: the ideal city should count 5040 citizens divided into four classes, and the council should consist of 360 members, who may be divided into four sections, yielding ninety councilors for each class (Plato, 2008, book VI). For Aristotle, the maximum size of a municipal unit (the *polis*) should be defined as the number of people who could assemble in one place and hear an unamplified human voice (Aristotle, 2009, book VII). Under that view, a negative relationship would exist between the size of a state and governability.

In modern age, several French thinkers warned against the presence of self-serving government members. For Montesquieu, it is natural for a republic to have only a small territory, in order to avoid men of large fortunes to oppress their fellow-citizens:

> *In an extensive republic, the public good is sacrificed to a thousand private views; it is subordinate to exceptions, and depends on accidents. In a small one, the interest of the public is more obvious, better understood, and more within the reach of every citizen; abuses have less extent, and of course are less protected.* (Montesquieu, 1748, book VII)

According to Rousseau, the nature of the state is to be determined endogenously according to the size of the territory to be governed:

> *If, in the different States, the number of supreme magistrates should be in inverse ratio to the number of citizens, it follows that, generally, [direct] democratic government suits small States, aristocratic government those of middle size, and monarchy great ones.* (Rousseau, 1762, book III)

Rousseau notes that each individual vote is being reduced to a fraction of the population and, thereby, has less influence, while the direct relation between the subject and the Sovereign decreases. It follows that small city-states are best to secure each individual liberty.

A similar view is shared by Condorcet (1785) who suggests that, under specific conditions, closer assemblies are more likely to reach accurate outcomes. The analysis, also referred to as *jury theorem*, examines a pool of individuals who do not necessarily know what the best issue is. In reference to Bernoulli's theorem of large numbers, a random sample is drawn from that population. The final decision is made by majority vote. Assuming that the fraction of competent individuals exceeds 50%, the probability that

the assembly of representatives reaches a correct judgment would approach 100% as its size increases. The theorem can be used to justify direct democracy in the form of referenda (Mueller, 2003, p. 129).[1]

In the US, the role of the constitution was intensively debated after the publication of the *Federalist papers*. A discussion on the legislature size is offered in no.10:

> *It is to be remarked that, however small the republic may be, the representatives must be raised to a certain number, in order to guard against the cabals of a few; and that, however large it may be, they must be limited to a certain number, in order to guard against the confusion of a multitude.* (Madison, 1787)

Greater diversity and a higher number of factions in the government would avoid public decisions to be captured by a group that acts in its own interest. However, a balance must be found between political representation on the one hand, and the ability to govern on the other hand.

2.2. Fundamental issues

The question of the optimal legislature size has generated a rich literature in political science, economics and related disciplines. The following issues in particular have been the starting point of many studies.

First, a mismatch can exist between the distribution of votes in a population and the distribution of seats in a legislature. According to Kendall and Stuart (1950), the following equation applies in the case of a two-party competition:

$$\frac{S_A}{S_B} = \left(\frac{V_A}{V_B}\right)^{\alpha}, \tag{1}$$

where S_i and V_i respectively stand for the distribution of seats and votes in favor of party i, $i = A, B$. Depending on the voting system, elections could be unfair on small parties. According to Taagepera (1973), the exponent α depends on the number of voters ($V = V_A + V_B$) and of constituencies ($S = S_A + S_B$). If $S = V$, then $\alpha = 1$ (proportional representation). If $S = 1$, then $\alpha = \infty$ (direct presidential election). In this view, "*changes in the number of constituencies can be used to bring about a desired degree of minority representation*". As evidenced by Edgeworth (1898) with respect to the British elections and popularized by James Parker Smith in 1910, the exponent $\alpha = 3$ has been observed to apply empirically, a regular result known as the *cube law* (see also Taagepera, 1973; Jackman, 1950), which is not to be mistaken with the *cube root law* that is further developed in the next sections (see also Taagepera, 1986, who discusses the possible link between the *cube law* and the *cube root law*). Last, note that Eq. (1) can be extended to multiparty systems and derived as a function of both district magnitude and the number of districts (see, e.g., King, 1990, for a review).

Second, the number of seats for a party in a legislature does not necessarily reflect the effective voting power of that party (Banzhaf, 1965). This is first exemplified in Penrose (1946) who considers a committee that makes a decision by majority vote in favor of, or against, a given proposal. With $n = 3$ seats, the probability that one legislator is decisive when the other two legislators vote randomly is obtained when the votes split half and half, i.e., is computed as the probability to obtain 1 vote "Yes" out of 2, and amounts to 50%. The general formula approaches $\sqrt{2/(n\pi)}$ when n is large (see, e.g., Dniestrzański, 2016, for a proof).[2] It follows that the power of a legislator is inversely proportional to the square root of the legislature size (see also van Deemen and Rusinowska, 2003, for a review of voting power indices).

Third, according to Buchanan and Tullock (1962), there are extra costs to be accounted for: *external* and *internal*. External costs (C) are the costs that individuals have to bear as a result of others' decisions whenever an action is taken collectively. These costs are assumed to decrease with the size n of the legislature. The more inclusive is the decision-making rule, the smaller the harm that can be imposed on an individual. Internal costs (D) stem from an individual's participation in an organized activity, such as legislative bargaining. Those costs increase with n. If the problem is convex, the solution to $\min(C + D)$ yields the optimal legislature size.

Starting from these works, an extensive literature has emerged, addressing the question of the optimal legislature size from three different angles: (1) is there a statistical way to derive an optimum using cross-sectional comparisons and data about the population size? (2) Are larger legislatures less efficient than smaller ones and yield to higher public spending? (3) Is there a link between the size of assemblies and the quality of democracy? The following sections aim at summarizing the main contributions.

[1] Note that if the share of competent individuals does not exceed 50%, then the probability that the assembly reaches a correct judgment by majority vote would approach 0% as its size increases. This case, however, seems unlikely. A set of models and empirical contributions link voter participation to information (see, e.g. Larcinese, 2007; Boeri and Tabellini, 2012; Hogh and Larsen, 2016). Individuals who know that they have no expertise on a particular issue can rationally abstain to ensure that the legislature takes correct decisions.

[2] With $n = 3$, the votes of the other two legislators may be distributed as either (Y, Y), (Y, N), (N, Y) or (N, N). Assuming that the probability of each vote "Yes" is equal to $p = 1/2$, the probability that the votes split half and half is 50%. When $n = 5$, the votes split half and half in 6 out of the 16 possible cases, i.e., when we have either (Y, Y, N, N), (Y, N, Y, N), (Y, N, N, Y), (N, Y, Y, N), (N, Y, N, Y) or (N, N, Y, Y). In that case, the probability of a decisive vote is equal to $6/16 = 37.5\%$. Using a binomial distribution, B hereafter, those values are computed as $B(j, 2j, p)$ and denote the probability that the $2j$ other legislators vote j "Yes" given that the individual probability of voting "Yes" is $p = 1/2$. With a Stirling approximation, the formula amounts to $\sqrt{2/(n\pi)}$ where $n = 2j + 1$. The larger the legislature size n, the lower the probability that the votes split half and half, and the lower the likelihood of a decisive vote. The intuition behind this result thus relies on a purely probabilistic argument.

3. Population as a determinant of legislature sizes

3.1. Theoretical considerations

A seminal contribution to the theory can be found in the so-called *cube root law* developed by Taagepera (1972) and Taagepera and Shugart (1989). The model applies to "*those national assemblies which are genuinely representative and are based on one-assemblyman constituencies*" (Taagepera, 1972). The main hypothesis is that elected representatives communicate with both their constituents and their fellow assembly members. The number of single-seat constituencies and, therefore, the legislature size can be optimized accounting for the total number of communication channels. This optimal number, n^* hereafter, is shown to grow at a lower rate than the number of inhabitants N. Formally[3]:

$$n^* = N^{1/3}. \tag{2}$$

This finding is backed up by empirical evidence using data from a set of countries in two different years: 1965 (Taagepera, 1972) and 1985 (Taagepera and Shugart, 1989).[4]

Stigler (1976) provides another explanation to the marginally decreasing size of legislatures. The number of important interest groups and/or political preferences in a society does not increase as rapidly as its area or population. An example is offered: "*if Indiana and Ohio join, few important interest groups will be found in the joint state that were not in each component.*" For that reason, larger US states do not need substantial legislature sizes to be representative of their constituents. Stigler (1976) also hypothesizes that large societies delegate a higher share of the functions of states to local governments.

Another explanation lies in a purely statistical argument: the *law of large numbers* (Cooter, 2000; Stadelmann et al., 2014). As suggested in Condorcet's (1785) jury theorem, errors in factual judgments are minimized under large legislatures. Moreover, as the legislature size increases, the probability diminishes that the majority will be unrepresentative of the constituents (see Stadelmann et al., 2014, for empirical evidence). The *law of large numbers*, however, applies differently depending on how heterogeneous the population is (Stigler, 1976). To illustrate, let p and $1-p$ be the respective share of supports for two political parties in a given set of voters. If elections are characterized by randomness, a mismatch can exist between the distribution of legislative seats and the true population preferences. For instance, assuming a binomial draw (Stigler, 1976) and a normal approximation (Kendall and Stuart, 1950), the margin of error is:

$$e = z\sqrt{\frac{p(1-p)}{n}}, \tag{3}$$

where z is a critical value derived from a standard normal distribution. The potential mismatch e tend to be reduced as the legislature size n grows. However, the lower is the variance $p(1-p)$, i.e., the more homogeneous are the voters, the lower the need for a large legislature (see Godefroy and Klein, 2018, for empirical evidence).

Last, according to Auriol and Gary-Bobo (2012) and Godefroy and Klein (2018), the optimization problem can be formalized as a tradeoff between better political representation on the one hand and larger costs to society on the other hand. Because of randomness, assemblies can be unrepresentative of the population. While an increase in the number of MPs will solve that issue, it will also induce a rise in the costs of representation (decision-costs, interference in business, red tape, rent-seeking, etc.). Under some conditions (e.g., quadratic preferences), the optimal number of seats is found to be proportional to the square root of population:

$$n^* = N^{1/2} \tag{4}$$

This value is shown to be independent of the unicameral or bicameral structure of the legislature (Godefroy and Klein, 2018). The same exponent is suggested in Margaritondo (2021) who extends Taagepera's approach to other forms of communication channels, and in Gamberi et al. (2021) who propose a network model in which a population has to be partitioned into constituencies.[5]

[3] The *cube root law* is derived as follows. For an assembly of n members, the total number of intra-assembly communication channels is $C^i = \frac{1}{2}n(n-1)$. For instance, when $n=4$, legislator 1 is connected to legislators 2, 3 and 4; legislator 2 is also connected to legislators 3 and 4; and legislators 3 and 4 are connected. This yields a total of $6 = \frac{1}{2}(4\times 3)$ communication channels. Now, let $\bar{N}$ denote the population size. The $\bar{N}-n$ citizens who are not legislators must have contact with the assembly. This yields $C^e = (\bar{N}-n)/n$ extra-assembly communication channels per legislator. Assuming that an efficient legislature is characterized by equal numbers of channels, i.e., $C^i = C^e$, we obtain $\bar{N} = \frac{1}{2}n^2(n-1+2/n)$, which can be approximated by $\bar{N} \approx \frac{1}{2}n^3$ or, equivalently, $n \approx (2\bar{N})^{\frac{1}{3}}$. If about one half of the population is politically active, such that $N = \bar{N}/2$, we have $n^* \approx N^{\frac{1}{3}}$.

[4] See also (Taagepera and Recchia, 2002) for a discussion on bicameral legislatures and European assemblies.

[5] Following Taagepera (1972), Margaritondo (2021) considers $C^e = (\bar{N}-n)/n$ extra-assembly communication channels per legislator. However, the total number of inter-assembly channels, i.e., $C^i = \frac{1}{2}n(n-1)$, is replaced with the average number, i.e., C^i/n. Solving for $C^i/n = C^e$ yields $\bar{N} = \frac{1}{2}n^2(1+1/n)$ which can be approximated by $\bar{N} \approx \frac{1}{2}n^2$ or, equivalently, $n \approx (2\bar{N})^{\frac{1}{2}}$. Simply put, the fundamental difference lies in the lower weight that is assigned on inter-assembly communication channels and, consequently, the greater importance of extra-assembly channels, producing larger legislature sizes in Margaritondo (2021). Note that Auriol and Gary-Bobo (2012), Godefroy and Klein (2018), and Gamberi et al. (2021) consider different optimization problems and cannot be easily compared to Taagepera (1972).

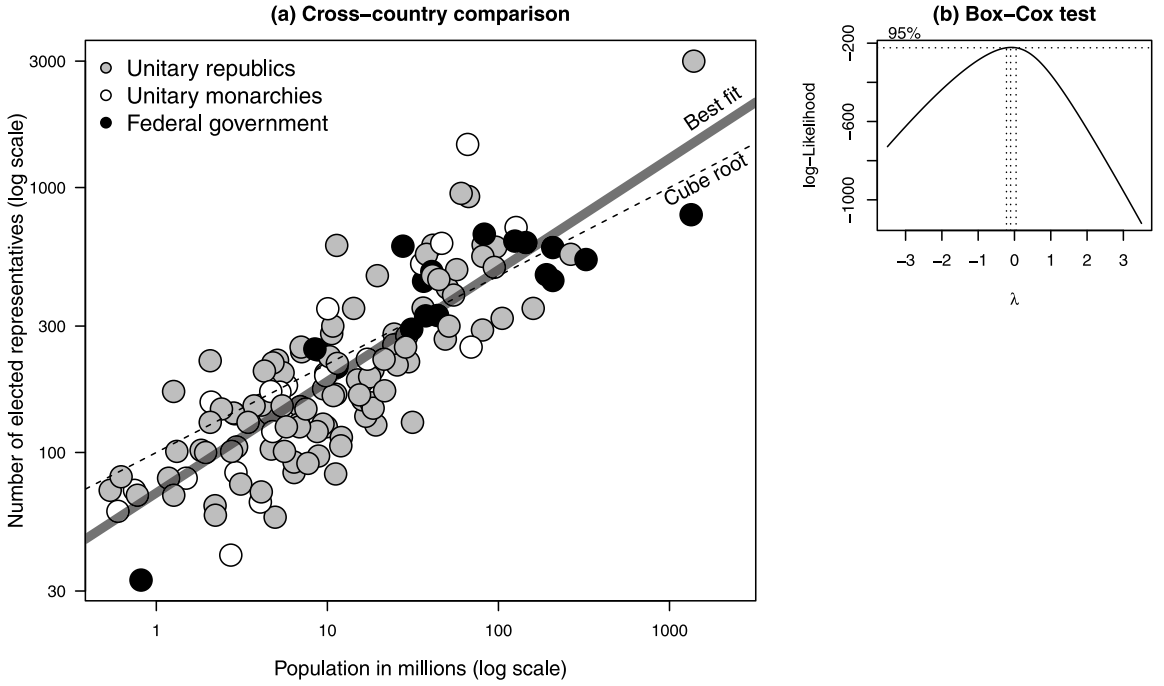

Fig. 2. Population size and number of seats in parliament (2017). Note: Own estimations based on 139 observations. The gray line and dashed line stand for Eqs. (5) and (2), respectively. See Appendix for data description.

3.2. Cross-sectional comparisons

As far as we are aware, Taagepera (1972) is the first empirical study that investigates the explanations behind legislature sizes. The analysis suggests that assembly sizes depend strongly and positively on the size of the population. The relationship appears to be linear in logarithms. Several studies have followed the same approach. Focusing on a set of 135 countries, Tufte (1974) estimates the population elasticity to be 0.396. In Stigler (1976), the population size is shown to be a strong predictor of both the number of representatives and senators in the US states: elasticities amount to 0.234 and 0.117, respectively.

Auriol and Gary-Bobo (2012) focus on a sample of more than 100 countries while controlling for the heterogeneity of the population (population density, ethno-linguistic fractionalization index, GINI index). They also approximate the costs of representation (GDP per capita, the national tax revenue, and the average government wage). Overall, the results are in line with their theory: population elasticities range from 0.41 to 0.44. In the same vein, Godefroy and Klein (2018) show that the type of legislature (bicameral or unicameral) does not affect the relationship.

Using a dataset covering 51 assemblies from 1800 to 2014, Jacobs and Otjes (2015) find a strong empirical link between population size and assembly size in the design phase. The population elasticity is equal to 0.36. Discrepancies between population and assembly size are then found to affect increases in the number of MPs, but play no role in explaining decreases. Increases are furthermore influenced by the effective number of parties.

In line with this literature, panel (a) of Fig. 2 offers a cross-country comparison for year 2017. The legislature size is plotted against the population using a natural logarithmic scale. The line of best fit amounts to:

$$\ln(n^*) = -1.560 + 0.421 \times \ln(N) \quad \text{(F-test: p-value} < 2.2\text{e}{-16}), \tag{5}$$

which is equivalent to $n^* = 0.210 \times N^{0.421}$ where N is the number of inhabitants and n^* the legislature size. In accordance with previous findings, the 95% confidence interval for the slope is $(0.374, 0.468)$. The number of representatives thus increases less than proportionately with the population size. Panel (b) of Fig. 2 performs a Box–Cox test for power transformation and confirms that the Log–Log form is best suited.

The corresponding number of inhabitants per MP is:

$$\frac{N}{n^*} = \frac{1}{0.210} N^{(1-0.421)} = 4.762 N^{0.579}, \tag{6}$$

which is a positive function of N, so that larger countries are characterized by higher population-to-representative ratios (as already suggested in Fig. 1). Eq. (6) also implies that the assembly size would be reduced to one representative when population is reduced to $N = \frac{1}{0.210}^{\frac{1}{0.421}} \approx 41$ persons, and to below one for smaller populations. In contrast, the *cube root law* would have assembly reduced to one representative when population is reduced to one person, so that this person is his/her own representative.

Table 1
Excess number of representatives: outliers (2017).

	Country	Population (millions)	Legislature size	Bicameral legislature	Federal government	Excess number
	Top 5 overrepresented countries					
1	China	1386	3000	N	N	1522
2	United Kingdom	66	1455	Y	N	1045
3	Italy	60	951	Y	N	555
4	France	66	925	Y	N	512
5	Cuba	11	605	N	N	409
	MEAN (71 obs)	46.17	376.51	52.11%	14.08%	128.40
	Top 5 underrepresented countries					
1	India	1339	790	Y	Y	−666
2	USA	325	535	Y	Y	−267
3	Bangladesh	160	350	N	N	−245
4	Pakistan	208	446	Y	Y	−218
5	Philippines	105	321	Y	N	−178
	MEAN (68 obs)	55.27	192.47	35.29%	13.24%	−76.34
	Chi-2 test (139 obs)			3.336*	1.052e−31	
	p-value			(0.067)	(1)	

Note: based on 139 observations. Symbol * indicates a significant dependence at the 10% level.

Table 2
Bicameral vs. unicameral legislatures: comparison of estimates.

	Dependent variable (in natural logarithm):				
	Total legislature size		Upper chamber (U)	Lower chamber (L)	Ratio of sizes (L/U)
	(1)	(2)	(3)	(4)	(5)
Constant	−1.560***	−1.770***	3.525***	4.068***	0.543***
	(0.388)	(0.510)	(0.165)	(0.114)	(0.151)
ln(pop)	0.421***	0.427***	0.269***	0.410***	0.140***
	(0.024)	(0.032)	(0.049)	(0.034)	(0.045)
Bicameral		1.218			
		(0.772)			
Bicameral ∗ ln(pop)		−0.058			
		(0.047)			
Observations	139	139	61	61	61
R^2	0.699	0.728	0.335	0.711	0.140
Adjusted R^2	0.697	0.722	0.323	0.706	0.126
Residual Std. Error	0.423	0.405	0.583	0.401	0.533
F Statistic	318.070***	120.654***	29.684***	145.072***	9.623***

Note: *, **, and *** indicate significance at the 0.1, 0.05 and 0.01 level, respectively; standard errors in brackets.

A spurious relationship is observed between the type of constitution (unitary republic, federal government, unitary monarchy) and legislature size, with federal states being mostly represented on the right-hand side of Fig. 2(a). The reason is that the size of the population acts as a confounding factor which affects both the legislature size (as in Eq. (5)) and the type of constitution. In our sample, federal states represent only 19% of the countries, yet they account for 41% of the total population.

Our estimates describe an average impact, both chambers being included. Some countries with particular condition may be characterized by a different relationship. Several examples are provided in Taagepera (2007), p. 188–190. For instance, communist regimes tended to have twice the related assembly size, yet most postcommunist democracies have reduced their legislature. In addition, there is a tendency for assemblies to be smaller than $n^* = N^{1/3}$ when literacy is low and populations is less than 1 million. Subnational assemblies and small island countries could also fall below the cube root of population. Last, in 1913, the US House size was frozen, and now represents only two-thirds of the cube root of population.

Following Auriol and Gary-Bobo (2012), values of actual legislature sizes above (resp. below) the fitted values, n^*, will result in a positive (resp. negative) residual value, hence offering a relative measure of over-representativeness (resp. under-representativeness) while controlling for the population size. Table 1 identifies the main outliers. China, UK, Italy, France and Cuba are strongly over-represented, compared to other countries of equivalent population size. In contrast, India, USA, Bangladesh, Pakistan and Philippines have a strong and negative excess number of representatives. On average, there is weak evidence that over-represented countries are more likely to present a bicameral legislature (chi-2 test: p-value = 0.067). Moreover, there is no evidence that they are more likely to present a federal constitution (chi-2 test: p-value = 1).

As discussed in Taagepera and Recchia (2002), the sizes of upper and lower chambers in bicameral legislatures derive particular attention. Table 2 offers a comparison. Column 1 stands for the aggregated model as described in Eq. (5). Column 2 estimates those coefficients separately on bicameral and unicameral legislatures. As can be seen, the population elasticity is larger for unicameral

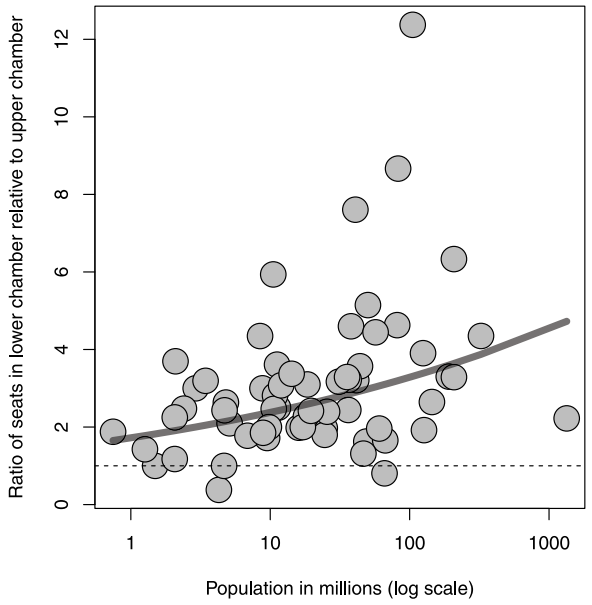

Fig. 3. Population size and relative size of chambers in bicameral systems (2017). Note: Based on 61 observations. The gray curve represents the line of best fit as estimated in column 5 of Table 2. See Appendix for data description.

legislatures (0.427 vs. 0.369, where 0.369 is computed as 0.427–0.058), but those differences are not statistically significant (interaction term: p-value = 0.214). Importantly, the effect of the population size in bicameral systems is lower on upper chambers (column 3 of Table 2, elasticity = 0.269), the size of lower chambers being more elastic (column 4, elasticity = 0.410). A possible explanation is that lower chambers "*usually represent people as individuals*", while upper chambers "*tend to be constituted on different grounds ranging from heredity and appointment to elections with rules deviating from those of the [lower chamber]*" (Taagepera and Recchia, 2002). As a result, the ratio of seats in lower chamber relative to upper chamber mechanically increases with population size (column 5). This also explains why lower chambers are generally larger than upper chambers in our dataset, especially in populated areas (Fig. 3). In our sample, only two countries have a ratio of chamber sizes strictly below one: Mauritania and Great Britain.

Last, following Auriol and Gary-Bobo (2012), we have examined other potential determinants of legislative sizes (Gini index, population density, ethnic fractionalization index, GDP per capita). When significant, those variables have the expected signs (see Appendix A.2). Importantly, despite the lower number of observations, coefficients on the population size are barely affected.

4. Impacts of legislature size on fiscal policies

4.1. The fragmentation hypothesis

Theories that are described in this section explicitly formalize the policy-making process. A fundamental result is that higher government fragmentation will lead to higher public spending, deficits and debt. By higher fragmentation, we mean both an increase in legislature size and number of parties (see, also, Ashworth and Heyndels, 2005; Schaltegger and Feld, 2009; Baskaran, 2013). The intuition relies on a common pool problem: having their own agenda, self-interested legislators will opt for public spending levels that are higher than efficient.

A first explanation lies in what is known as the "law of 1/n". The theory is based on the intuition of Buchanan and Tullock (1962) that elected representatives logroll to bring pork barrel projects to their constituency because the costs are distributed evenly across all districts (Lee, 2015). Inefficiencies will increase with the number of constituencies and, therefore, with the legislature size (Weingast et al., 1981).[6] According to Primo and Snyder (2008), the effect might depend on several factors, such as the degree of publicness and congestion in the goods being distributed. A *reverse law of 1/n* could hold if the members of a larger legislature

[6] For instance, let $b_i(x)$ stand for the growing benefit that flaws from spending x euros in district i and let $c(x)$ represent the resulting increasing cost, with $b'' < 0$ and $c'' > 0$. The efficient level of spending, x^e, is obtained when $b_i'(x) = c'(x)$. If there are n districts, and if the costs are equally shared, the optimal solution, x^n, is the spending level that solves $b_i'(x) = c'(x)/n$. Using the implicit function theorem, we obtain:

$$\frac{dx^n}{dn} = -\frac{\frac{1}{n^2}c'(x)}{b_i'' - \frac{1}{n}c''(x)},$$

which is positive. Hence the difference $x^n - x^e$ grows with the number of districts.

Table 3
Effects of legislature size on national fiscal policies: summary of the literature (listed by alphabetical order).

Name of the study	Sample	Endogenous variable	Exogenous variable	Results	Causal design
Bradbury and Crain (2001)	24 democratic countries (1971-1989).	Government spending as a percent of GDP.; government spending per capita terms.	Size of the chamber/s.	Positive relationship, the effect being far greater in unicameral legislatures.	No.
Kontopoulos and Perotti (1999)	Panel of 20 OECD countries (1960–1995).	General government primary deficit.	Number of Parties in Coalition; Number of Spending Ministers.	Positive relationships.	No.
Maldonado (2013)	92 democracies (1975 and 2000).	Government share of real GDP.	Size of the chamber/s.	The relationship between legislative chamber size and government spending is linear in unicameral countries but nonlinear in bicameral countries.	No.
Mukherjee (2003)	100 countries (1978/1980–1996).	Central Government Expenditure as a Percentage of GDPs.	Seats in lower chamber.	Positive relationship.	No.
Ricciuti (2003)	23 OECD countries (1975–1996).	Central Government Expenditure as a Percentage of GDPs.	Legislature size (defined as the sum of lower and upper house); constituency size.	Positive relationship for the lower house and a negative for the upper one.	No.
Ricciuti (2004)	75 countries (1990–1998).	General government and welfare spendings.	Legislature size (defined as the sum of lower and upper house); type of legislature (bicameralism).	No significant effects.	No.

do not wish to cooperate on larger projects. A negative relationship is also expected if a larger legislature size offers better control of a budget maximizing bureaucracy (Pettersson-Lidbom, 2012).

A second explanation lies in the fact that political power will be dispersed in larger legislatures. Coalition governments will find it more difficult to hold to the budget than do one-party, majoritarian governments (Roubini and Sachs, 1989a,b). Refinements of this so-called "weak government hypothesis" have been developed. Alesina and Drazen (1991) formalize the policy-making process as a *war of attrition*, where each political group attempts to block the others. Reversely, cooperation could be easier to secure the fewer the number of parties involved in the negotiations (e.g., Aumann, 1959; Stigler, 1972; Baron and Ferejohn, 1989; Le Maux et al., 2011; Le Maux and Rocaboy, 2016).

The presence of two legislative chambers, which reciprocally limit each others' policy decisions, could mitigate those common pool problems (Buchanan and Tullock, 1962; Bradbury and Crain, 2001, 2002). Outcomes in bicameral legislatures are also likely to depend on the ratio of seats in one chamber relative to seats in the other (Crain, 1979; Chen and Malhotra, 2007; Lee, 2016). For instance, an increase in the size of one assembly relative to the size of the other reduces the similarity or homogeneity of the constituencies between the two respective bases, which raises the decision-making costs (Crain, 1979).

4.2. Empirical evidences on national fiscal policies

Roubini and Sachs (1989a, 1989b) test the fragmentation hypothesis on a set of 14 OECD countries. The public debt/GDP ratio is regressed on the following index of power dispersion:

$$\text{POL} = \begin{cases} 0 & \text{if the number of parties } = 1, \\ 1 & \text{if the number of parties } = 2, \\ 2 & \text{if the number of parties } \geq 3, \\ 3 & \text{if it is a minority government .} \end{cases} \tag{7}$$

Their study leads to the conclusion that the more parties involved in a coalition, the higher the fiscal debt. Edin and Ohlsson (1991) replicate the approach using separate dummies and find that the POL index actually captures the effects of minority government rather than the number of parties. de Haan and Sturm (1994, 1997) and de Haan et al. (1999) find support for neither the Roubini–Sachs hypothesis nor the position expressed by Edin and Ohlsson (1991). Mukherjee (2003) uses panel data on central government expenditure from 110 countries and find that an increase in the number of represented parties leads to higher government spending on subsidies and transfers but to lower spending on public goods.

To our knowledge, six studies have explicitly used the number of assembly members as explanatory variables in the context of cross-country comparisons (see Table 3). With the exception of Ricciuti (2004), all of them confirm the expected positive link. Specifically, the relationship between the lower chamber size and government share of real GDP is cubic while the relationship between upper chamber size and government share is quadratic (Maldonado, 2013), or possibly negative (Ricciuti, 2003). The

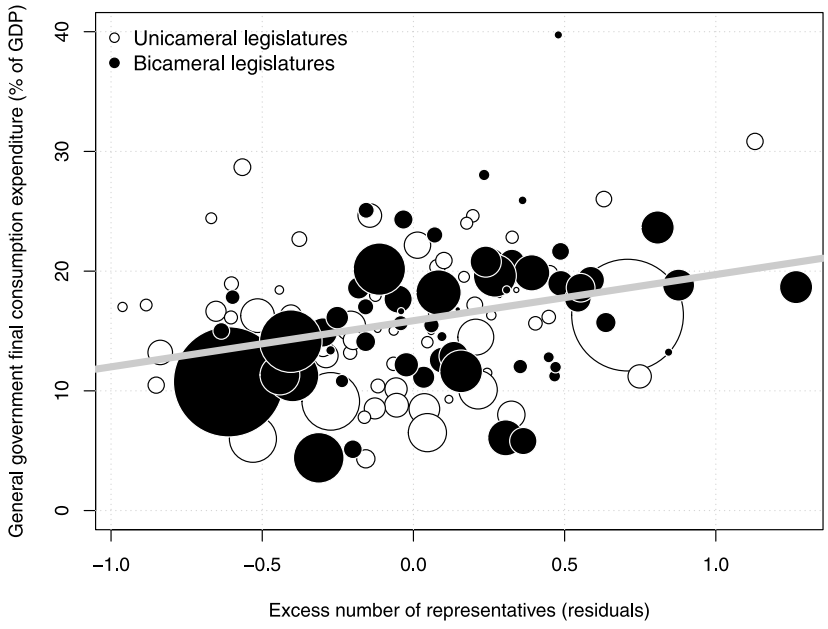

Fig. 4. Excess number of representatives and general government final consumption. Note: based on 139 observations. Large-scale countries are depicted with larger circles. See Appendix for data description.

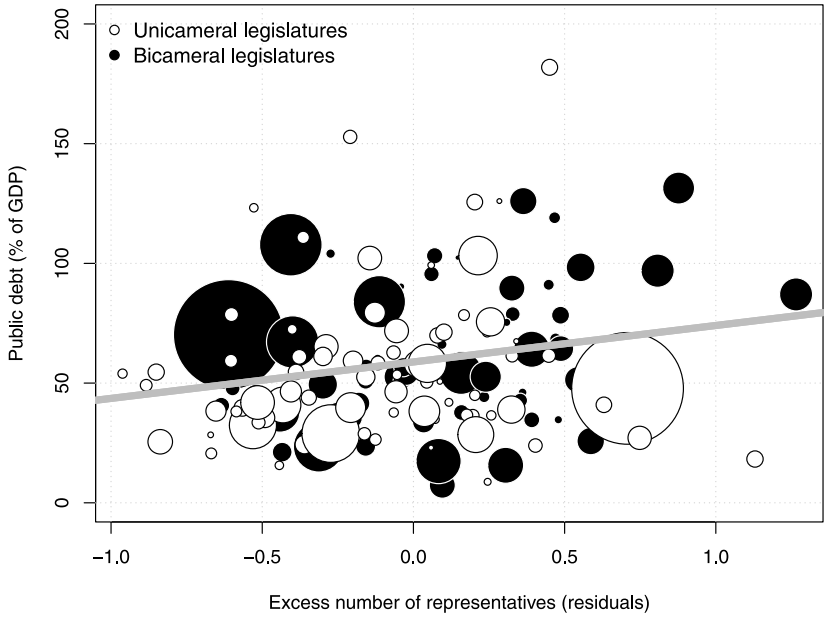

Fig. 5. Excess number of representatives and public debt. Note: based on 139 observations. Large-scale countries are depicted with larger circles. See Appendix for data description.

relationship between unicameral chamber size and government share of real GDP seems linear (Bradbury and Crain, 2001; Maldonado, 2013).

Because a larger assembly is likely to have a higher number of represented political parties, Kontopoulos and Perotti (1999) and Mukherjee (2003) introduce the legislature size when testing for the weak government hypothesis and find it to be positively correlated with government expenditure. Moreover, legislature size seems more powerful than constituency size (number of voters per legislator) in explaining the size of government (Ricciuti, 2003).

Figs. 4 and 5 offer a simple cross-country comparison and depict the link between the excess number of representatives (as computed in Section 3.2, in order to control for the population size) and public spending and debt in 2017, respectively. We do

not control for various institutional and economic features that differ among countries (electoral rules, political institutions, level of development, among others) and, therefore, we acknowledge that this is a rudimentary way to test for the relationship. Yet, our figures offer illustrations which do not infirm the predictions. Positive and significant associations are evidenced (correlation test: p-value = 0.001 and 0.025, see Appendix A.1, Table 10). The estimated slopes were slightly larger for bicameral legislatures but those differences were not statistically significant. Last, as evidenced in Appendix A.1 (Table 10), the number of parties does not show any significant correlation with public spending levels and debt (correlation test: p-value = 0.566 and 0.564).

4.3. Empirical evidences on local fiscal policies

The small number of observations and the little variation through time in legislature sizes make it difficult to provide a causal test of the fragmentation hypothesis at the national level. To circumvent that issue, a significant set of studies has investigated the relationship at a sub-national level. This set is large and involves various results and methodologies. Table 4 offers a summary of this literature.

On the one hand, several studies show evidence of the fragmentation hypothesis. Using data about state and local governments in the US (1960–1990), Gilligan and Matsusaka (1995) find that larger legislatures have larger spending levels (see also Chen and Malhotra, 2007; Lee, 2015). Senate and House sizes, however, do not exhibit uniformly positive effects on spending (see also Gilligan and Matsusaka, 2001; Matsusaka, 2005; Primo, 2006; Chen and Malhotra, 2007; Lee, 2016; Lee and Park, 2018; Crowley, 2019). Similarly, MacDonald (2008) and Coate and Knight (2011) show that US cities with larger councils are associated with greater spending levels per capita while controlling for population size and other possible determinants of expenditures. Additional evidence can be found in Ashworth and Heyndels (2005) (Flemish municipalities), Fiorino and Ricciuti (2007) (Italian regions), Schaltegger and Feld (2009) (Swiss cantons) and Drew and Dollery (2017) (Australian municipalities).

On the other hand, several studies have contrasted results. Baskaran (2013) explores panel data covering all 16 German States over the period 1975–2005. Neither coalition governments nor large cabinets result in significantly higher public expenditures. Meloche and Kilfoil (2017) show that the impact of council size on local expenditures is very limited in Quebec's municipalities. They show, however, that a fewer elected officials may increase the level of professionalization required to conduct council activities, which induces larger costs. Hankins (2015) find little evidence that US States with larger lower or upper chambers experience a larger change in spending per capita. The estimated effect can also be negative, as suggested in Bjedov et al. (2014) (Swiss cantons), or non-linear, as evidenced in Berry and Gersen (2009) (US local governments) and Bel et al. (2018) (Portuguese local governments). Last, Lee (2016) suggests that what matters is the degree of bicameralism, i.e., the ratio of House-to-Senate seats.

To avoid a selection bias, six studies use a regression discontinuity design and exploit discontinuities in the legal rules that relate population size of a jurisdiction in order to council size. Focusing on Finland and Sweden, Pettersson-Lidbom (2012) brings evidence of a negative relationship between legislature size and government spending. Höhmann (2017), De Benedetto (2018) and Lewis (2019) confirm this negative relationship on Italian, German and Indonesian local data, respectively. Egger and Koethenbuerger (2010) and Hirota and Yunoue (2012) on the other hand find a positive relationship. As an alternative, Baqir (2002) and Kessler (2010) use an instrumental variable strategy to address the endogeneity of legislature sizes and evidence a positive relationship on US municipalities.

In their meta-analysis, Alptekin et al. (2020) take into account a sample of 29 articles to build their analysis. They conclude that there is no strong evidence for a positive relationship between the number of legislators and public expenditures. If the effect exists, it is more likely to concern upper houses. They find better evidence for a *reverse law of 1/n*, i.e., larger legislatures are associated with lower government spending.

5. Effects on the quality of democracy

5.1. Theoretical considerations

The size of legislatures may affect democracy in many qualitative aspects. With a large assembly, elected officials better represent their constituents (Brooks et al., 2011; Taebel, 1978). Preferences are more accurately acknowledged and accounted for (Denters et al., 2014; Stadelmann et al., 2014), which improves policy responsiveness (Ferrara, 2010).

More specifically, Brooks et al. (2011) assume that larger city councils are more representative of the populations they serve. If preferences are correlated with geography, and council districts are geographic, then more districts implies a broader representation of tastes. Welch and Karnig (1979) discuss the impact of council size on women's representation and hypothesize that the larger the legislature, the less prestigious and less attractive is council membership to males, thus leaving more room for females. Gender gaps are thus reduced with larger council sizes (see, e.g., Alozie and Manganaro, 1993, for a review). As discussed in Muzzio and Tompkins (1989) and Lyytikäinen and Tukiainen (2019), a larger assembly could also affect voter turnout, since people's feeling that their actions could influence government might increase.

The question of the optimal legislature size also relates to the particular question of district magnitude, i.e., the number of seats that should be available in each electoral district. As discussed in Carey and Hix (2011), single-member district systems are likely to produce a small number of parties and simpler government coalitions while multi-member district systems are likely to yield higher party fragmentation (see also Taagepera and Shugart, 1993 and Person and Tabellini, 2004). Concurrently, in accordance with the *cube law*, the degree of disproportionality between the distribution of seats and the distribution of votes is expected to be affected by district magnitude (Taagepera, 1973, 1986; King, 1990; Lundell, 2012). Stadelmann et al. (2014) use an argument

Table 4
Effects of legislature size on local fiscal policies: summary of the literature (listed by alphabetical order).

Name of the study	Sample	Endogenous variable	Exogenous variable	Results	Causal design
Ashworth and Heyndels (2005)	Flemish local governments (1989–1996).	Public expenditures per capita.	Cabinet size and coalition size.	Positive and significant effects.	No.
Baskaran (2013)	German States (1975–2005).	Public expenditures per capita.	Cabinet size and coalition size.	Insignificant effects.	No.
Baqir (2002)	US cities (1990).	Government spending per capita; government spending as a share of total city income; government employment per capita.	City council size.	Positive relationship.	Instrumental variable strategy.
Bel et al. (2018)	278 local governments of Continental Portugal (2009–2013).	Local government total expenditures per capita.	Total number of councilors; district councilors.	S-shaped relationship.	No.
Berry and Gersen (2009)	Local Governments in the United States (1987, 1992).	General own-source revenue per capita; direct general expenditures per capita; expenditures on specific budget line items.	Number of elected offices per capita and per general purpose government.	U-shaped relationship.	No.
Bjedov et al. (2014)	Swiss cantons (2003-2010).	Total spending per capita or as % of GDP.	Number of seats in the cantonal parliament.	Insignificant or negative relationship.	No.
Bradbury and Stephenson (2003)	Georgia counties (1992, 1997).	County total government expenditures.; government expenditures net of interest payments.	The number of county commissioners.	Positive relationship.	No.
Chen and Malhotra (2007)	US States (1964/1992–2004).	Per capita total state expenditure.	Sizes of the lower and upper chamber.	Senate size has a significantly positive relationship with spending, whereas House size exhibits a negative effect.	No.
Coate and Knight (2011)	Sample of US cities (1982, 1987, 1992, 1997, and 2002).	Government spending per capita.	Council size.	Significant effect.	No.
Crowley (2019)	US states (1962–2014).	Real per capita state construction expenditure, education expenditure, direct expenditure on hospitals, welfare expenditure, highway expenditure, police and fire expenditure, sanitation expenditure, and expenditure on employee retirement benefits.	Sizes of the lower and upper chamber.	Significant for the upper chamber, insignificant for the lower chamber. Some categories of expenditure are more likely to be consistent with the Law of 1/n than others.	No.
De Benedetto (2018)	6576 Italian municipalities (2001–2007).	Italian municipal budgets.	Council size.	Negative effect.	Regression discontinuity design.
Drew and Dollery (2017)	79 Victorian municipalities in Australia (2009–2012).	Per capita expenditure.	Number of representatives.	Positive relationship.	No
Egger and Koethenbuerger (2010)	2056 municipalities in the German state of Bavaria (1984–2004).	Current expenditure categories; investment expenditure.	Council size.	Positive relationship on current expenditures.	Regression discontinuity design.
Erler (2007)	47 US states (1977–2001).	General spending (per capita, % of GDP).	Number of seats in the lower house.	Positive relationship.	No

(*continued on next page*)

that is similar to Condorcet's (1785) jury theorem and further establish that higher district magnitude increases the quality of political representation in the context of majority decisions. Hence, the legislature size should not be considered in isolation from district magnitude. Specifically, the legislature size $n = d \times m$ mechanically increases with the number of districts d and the average

Table 4 (*continued*).

Name of the study	Sample	Endogenous variable	Exogenous variable	Results	Causal design
Fiorino and Ricciuti (2007)	Italian regions (1980–2000).	Per capita regional expenditures.	Number of regional legislators.	Positive relationship.	No.
Gilligan and Matsusaka (1995)	State and local governments in the US (1960–1990).	State and local direct general expenditure per capita.	Sizes of the lower and upper chamber.	Positive relationships.	No.
Gilligan and Matsusaka (2001)	State and local governments in the US (1902, 1913, 1932, and 1942).	State and local direct general expenditure and revenue per capita.	Sizes of the lower and upper chamber.	Legislature size has a positive and significant effect on state and local expenditure and revenue.	No.
Hankins (2015)	48 US States (1978–2008).	Total spending per capita.	Sizes of the lower and upper chamber.	No significant effect.	No.
Hirota and Yunoue (2012)	13,989 Japanese municipalities (6 years).	Local government expenditure.	Local council size.	Positive effect.	Regression discontinuity design.
Höhmann (2017)	9325 German municipalities (2008–2010).	Per capita gross expenditure.	Size of the councils.	Negative relationship.	Regression discontinuity design.
Kessler (2010)	US municipalities (2001 mainly).	Per capita government expenditures in municipality.	Number of councilors.	Positive effect.	Instrumental variable strategy.
Lee (2015)	US states (1970–2007).	Total tax revenue, government expenditures.	Sizes of the lower and upper chamber.	The marginal effects of legislature size are mostly positive and larger in the presence of a supermajority rule.	No.
Lee (2016)	US states (1970–2008).	The average number of bills passed per session day by the legislative assembly.	Sizes of the lower and upper chamber, the size of the upper house divided by the size of the lower house.	Insignificant for the sizes, positive and significant for the ratio.	No.
Lee and Park (2018)	US states (1962–2008).	Total expenditure and four types of spending: capital outlays, current expenditures, current operations, and wage expenditures.	Sizes of the lower and upper chamber.	Insignificant for the upper chamber, positive and significant for the lower chamber.	No.
Lewis (2019)	390 local governments in Indonesia (2005–2012).	Local government fiscal and service outcomes.	Council size.	Negative relationships.	Regression discontinuity design.
MacDonald (2008)	Thousands of US cities (1980–2000).	Per capita government general expenditure.	Number of city councilors.	Positive relationship.	No.
Matsusaka (2005)	US States (1960–1990).	Expenditure per capita.	Legislature size (number of seats in both legislative chambers).	Positive relationship.	No.
Meloche and Kilfoil (2017)	Quebec municipalities with at least 20,000 residents (2006-2008).	Total municipal council expenditures.	Council size.	No effect, yet each elected official is found to cost more in a smaller council.	No.
Pettersson-Lidbom (2012)	Municipalities of Finland and Sweden (1977-2002).	Government per capita spending.	Council size.	Negative effect.	Regression discontinuity design.
Primo (2006)	47 US States (1969–2000).	Per capita real direct general expenditures (state and local).	Sizes of the lower and upper chamber.	Positive for the upper chamber, negative for the lower chamber.	No.
Schaltegger and Feld (2009)	26 Swiss cantons (1980–1998).	Public spending; tax revenues.	Cabinet size and coalition size.	Positive relationship for the number of ministers; weaker effects for the number of parties.	No.

district magnitude m. An increase in m, however, is more likely to favor the representation of small parties, reducing the degree of disproportionality (Lundell, 2012).

Furthermore, the effect of district magnitude m on the effective number of parties is expected to be contingent on electoral formula (e.g. majoritarian vs. proportional representation systems) as discussed in Taagepera (1973), Lijphart (1990, 1994) and Benoit (2001). Relatedly, the effect of legislature size n should be less pronounced in proportional representation systems since those systems already favor the representation of minor parties (Lundell, 2012). Reversely, a change in legislature size is likely to be decisive in single-member district systems, since smaller parties will strongly benefit from an increase in the number of constituencies.

Last but not least, the proportionality of electoral rules can increase the ideological homogeneity of the candidates within each party. Simply put, the more proportional is an electoral rule, the higher the chances that a small party get seats, and the lower its incentives for proposing ideologically diversified candidates (Matakos et al., 2018). Incentives to form pre-electoral coalitions are reduced (Golder, 2005, 2006; Hortala-Vallve et al., 2021). The low degree of competition also reduces the need for platform convergence (Matakos et al., 2016).

To sum up, the number of running candidates is expected to raise in larger districts, hence affecting the structure of political competition, inducing political heterogeneity, and improving policy responsiveness (Stadelmann et al., 2014). Importantly, if legislature size and/or district magnitude affect political competition, this may in turn affects the quality of the running candidates (Galasso and Nannicini, 2011; De Paola and Scoppa, 2011; Gavoille and Verschelde, 2017; Dal Bó et al., 2017). On the cons side, larger legislatures could imply weaker monitoring of elected officials who could more easily satisfy their own interests (Bergh et al., 2017). In line with Section 4.1, inefficiencies are also expected if policy-makers are uncooperative. This is exemplified in the veto players' theory which suggests that a large number of agents involved in the policy-making process reduces the ability of an assembly to produce significant laws when an agreement by majority rule is required (Tsebelis, 1995, 1999).

Note that legislature sizes and electoral district boundaries can be subject to strategic manipulation in order to influence the relative weights of members (Muzzio and Tompkins, 1989). Under intentional gerrymandering, the disproportionality between the distribution of seats and the distribution of votes is likely to increase (Cox and Katz, 1999; Gilligan and Matsusaka, 1999, 2006; Coate and Knight, 2007; Gul and Pesendorfer, 2010). The effect, however, is expected to be lower in proportional-voting systems (King, 1990). Reversely, Gilligan and Matsusaka (1999) show that a proportionate increase in both voting population and the number of single-member districts decreases partisan bias. Another potential source of disproportionality is unintentional gerrymandering, whereby "*one party's voters are more geographically clustered than those of the opposing party due to residential patterns and human geography*" (Chen and Rodden, 2013). For instance, Gilligan and Matsusaka (2006) show that random districting does not necessarily eliminate policy bias on average.

5.2. Empirical evidence

There is little consensus about how quality of democracy can be defined (for a literature review, see Pickel et al., 2016). For instance, Diamond and Morlino (2005) identify eight dimensions that deserve special attention (freedom, the rule of law, vertical accountability, responsiveness, equality, participation, competition, and horizontal accountability). Studies which are described in this section are more or less in line with this definition, focusing on one single dimension at a time.

The literature generally evidences a positive association between council size and citizen representation. Seminal works include Jones (1976), Welch and Karnig (1979) and Taebel (1978), among others. Confirming those results on 7062 US cities, Alozie and Manganaro (1993) show that the size of the legislative body has a significant effect which, except among district election cities, largely improves the likelihood of electing a woman to the council. Brooks et al. (2011) use a 30-year panel data of US cities and bring evidence that women and minorities are better represented in larger councils. Muzzio and Tompkins (1989) examine over a century of changes in New York City's council size and note, however, that the evolution is mostly incremental, with little impact on the organization and composition of the body.

Further qualitative effects are evidenced. Using exogenous variation arising at population cutoffs, which determine council sizes in Finnish municipal elections, Lyytikäinen and Tukiainen (2019) find that larger council size increases both pivotal probabilities (likelihood that one vote changes the election outcome) and voter turnout. Bergh et al. (2017) test the connection between local council size and corruption (bribes, threats of violence, and blackmail) in Swedish municipalities and suggest, however, a positive association between those two variables.

District magnitude is shown to matter. The empirical literature evidences a relationship between district magnitude and party fragmentation (Taagepera and Shugart, 1993; Benoit, 2001; Clark and Golder, 2006; Singer and Stephenson, 2009; Singer, 2015; Lucardi, 2017; Singer and Gershman, 2018; Lewis, 2018) with sometimes mitigated results (Silva, 2021).[7] Using data about 550 elections in democratic countries, Lundell (2012) shows that assembly size negatively affects the degree of disproportionality of election results and positively influences party system fragmentation only in systems with single-member districts (see also Taagepera and Shugart, 1989, Lijphart, 1994 and Taagepera and Ensch, 2006). Based on a dataset of 125 referenda in Switzerland, Stadelmann et al. (2014) find that the congruence between the majority of constituents and the majority of their representatives increases mechanically with the number of representatives per district. Reversely, using data from Argentina and Latin America, Lucardi and

[7] Electoral rules are also shown to affect the ideological composition of the legislative body. Using data from twenty countries from 1946 to 1998, Golder (2005) and Golder (2006) show that post-electoral coalitions are more likely to form when electoral rules are disproportional. Similar results are found in the case of Finland (Hortala-Vallve et al., 2021). Last, using data from 23 countries over a 50-year period, Matakos et al. (2016) find that electoral rule disproportionality is a major determinant of polarization. Electoral institutions are shown to matter for party cohesion (Matakos et al., 2018).

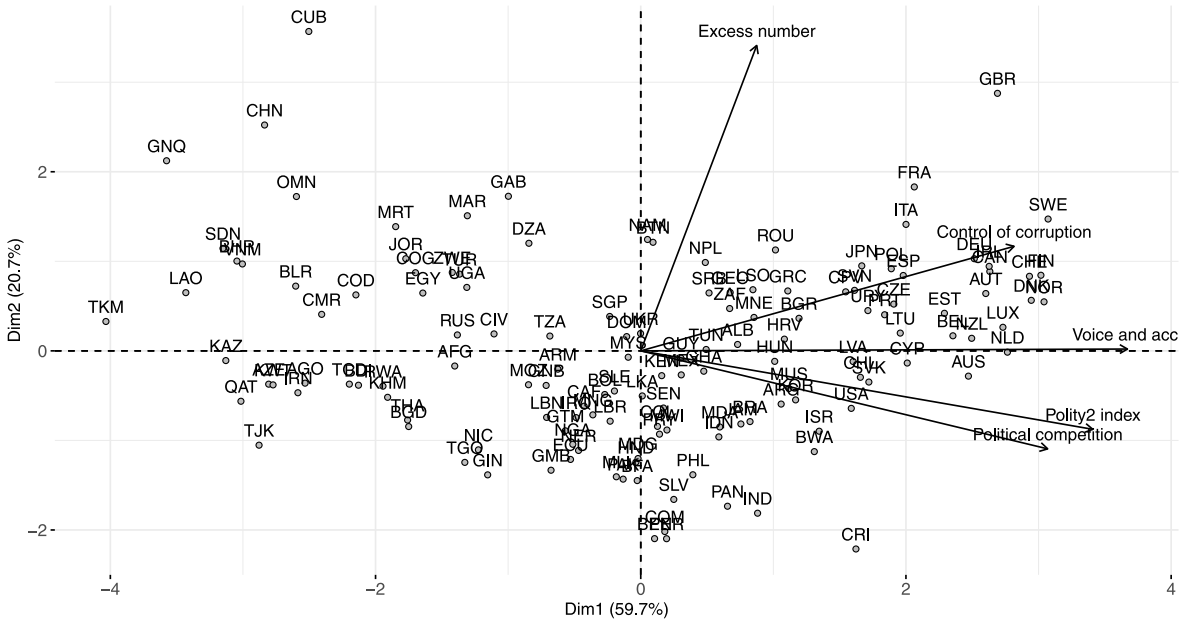

Fig. 6. Excess number of representatives and quality of democracies (2017). Note: principal component analysis based on 139 observations. See Appendix for definitions and data description.

Micozzi (2022) find a weak effect of district magnitude on female representation. The reason is that parties' lists are overwhelmingly headed by men. Last, using data from a field experiment covering 250 villages across Afghanistan, Beath et al. (2016) show that at-large elections result in the election of more competent council members, as proxied by their level of education.

In this review, we also provide an attempt at capturing some of these associations. Our methodology is mainly descriptive and makes use of qualitative variables which have been commonly employed (and yet debated) in the political economy literature. We implement a principal component analysis (see Fig. 6) which offers a convenient way of summarizing the information when dealing with multiple correlations.

Our analysis includes a measure for the integrity of politicians, "Control of corruption", which combines different data sources and thus offers a reliable index (Kotera et al., 2012). Variable "Voice and accountability" captures perceptions of the extent to which citizens are able to participate in selecting their government, the freedom of expression and association, and the presence of free media. Variable "Polity2" defines on a scale from −10 to 10 the concomitant democracy and autocracy qualities of national governing institutions. Last, "Political competition" considers the electoral success of smaller parties, that is, the percentage of votes gained by those parties in parliamentary and/or presidential elections. Summary statistics and sources are described in Appendix.

In Fig. 6, the cosine of the angle between two variables can be interpreted in terms of correlation: an angle of 0, 90 and 180 degrees indicate a correlation of 1, 0 and −1, respectively. As can be seen, the four indicators of democracy are pointing in the same direction. Countries that present a higher control of corruption, better political competition, and higher levels of democracy (Polity 2 index, Voice and accountability) are depicted on the right-hand side of the figure. As shown in Fig. 6 and confirmed in Table 10 (see Appendix), those indicators are poorly associated with the excess number of representatives: only "control of corruption" appears with a significant yet weak correlation coefficient.[8] This is exemplified with Cuba (CUB) and China (CHN) versus the United Kingdom (GBR), France (FRA) and Italy (ITA) that are characterized by a large excess number of representatives, and are displayed on either side of the map. Similarly, countries which present a relatively low number of representatives, such as the USA and Bangladesh (BGD), differ in the quality of their democracy.[9]

Note that the causality that is investigated, i.e., whether the excess of legislature size impacts the quality of democracy, could be the other way around. For instance, we have seen in Table 1 that China has a relatively large legislature while India has a small

[8] Note that the *p*-values of the correlation tests that are presented in Table 10 (see Appendix) are equivalent to a *t*-test of the null hypothesis that a coefficient equals zero in a simple linear regression.

[9] Due to data availability, we have restricted this analysis to four measures of democracy. Other widely-used measures can be used, yet at the expense of sample size. For instance, we tried to include "Checks and Balances", which ranges from 0 to 100 and accounts for budget transparency, judicial independence, efficiency of legal framework in challenging regulations, freedom of the press (source: Global Competitiveness Index 4.0) and "government effectiveness", which ranges from −2.5 to 2.5 and captures perceptions of the quality of the public sector (source: Worldwide Governance Indicator). The correlation coefficient between these two indexes and the excess number of representatives amounts to 26% (N obs = 117) and 21% (N obs = 138), respectively. While significant (p.value = 0.004 and 0.013), those values again indicate a weak relationship. Importantly, in our dataset, these two extra measures are highly correlated with "control of corruption" (coef = 85% and 92%).

Table 5
Population elasticities: summary of results.

	Best fit	95% confidence intervals	
		Constant	Elasticity
Unicameral and bicameral legislatures (139 observations)			
Aggregated model	$0.210N^{0.421}$	(0.097,0.453)	(0.374,0.468)
Unicameral legislatures	$0.170N^{0.427}$	(0.062,0.467)	(0.365,0.490)
Bicameral legislatures (both chambers)	$0.575N^{0.368}$	(0.183, 1.811)	(0.301,0.437)
Bicameral legislatures only (61 observations)			
Upper chambers (U)	$33.950N^{0.269}$	(24.399,47.242)	(0.170,0.368)
Lower chambers (L)	$58.452N^{0.410}$	(46.569,73.368)	(0.341,0.478)
Ratio of sizes (L/U)	$1.721N^{0.140}$	(1.051,1.259)	(0.050,0.230)

one. The political system (e.g. autocracy vs. democracy as measured by Polity 2) could explain those differences. In other words, democracy measures may affect the size of legislature. Fig. 6, however, deals with correlations and does not assume any causal direction. Since no obvious link is evidenced between our variables, the PCA also rules out the possibility of an inverse relationship.

6. Conclusion

Already the ancient Greeks understood that a change in the size of a legislature will not only affect governability but also policy responsiveness. Philosophers of that time had their own recommendations. In modern age, several thinkers warned against self-serving government members and, for that reason, argued that small city-states were best to secure each individual liberty. In the last decades, the question of the optimal structure of governance came back on the political agenda and several countries have implemented reforms regarding their parliament size or have debated about it. This article offers a review of what could possibly motivate those reforms, and confirms a set of stylized facts:

- **Stylized fact 1.** Population is a strong determinant of legislature sizes: a change of one percent in population induces a change of 0.421 percent in the number of MPs.
- **Stylized fact 2.** Larger countries are characterized by higher population-to-representative ratios: a change of one percent in population induces a change of 0.579 percent in the number of inhabitants per MPs.
- **Stylized fact 3.** Compared to the average, several countries are identified as outliers, being either over-represented (e.g., China, UK, Italy, France and Cuba) or under-represented (e.g., India, USA, Bangladesh, Pakistan and Philippines).
- **Stylized fact 4.** The type of legislature (bicameral or unicameral) does not affect the relationship, yet the size of lower chambers in bicameral systems is shown to be more elastic to population (0.410) compared to upper chambers (0.269).
- **Stylized fact 5.** The ratio of seats in lower chamber relative to upper chamber increases with population size.

The *cube root law* described in this review is often advocated as a desirable rule of thumb for further reforms. According to Kane et al. (2020), the optimal number of seats in the US House of representatives should be computed as the cubed root of the population, minus 100 (to account for the 100 Senators). This approach would add a significant number of seats to the existing ones. According to our 2017 estimates, the legislature size in Italy would require a reduction by 555 seats, while the reform induced a lower reduction by 345 seats, both houses included. In France, the total number of senators and deputies should be reduced by 512 seats, which represents a notable change.

Can we infer that our estimates provide a suitable normative rule for designing optimal assemblies? Caution is required. First, the estimated coefficients slightly differ from the theoretical values that are described in the *cube root* and *square root laws*, i.e., 0.333 and 0.50 respectively. The related tests do reject those theoretical values in most cases at the 5% significance level, as summarized in Table 5, last column. As a matter of fact, the *cube root law* seems best suited to describe the size of upper chambers in bicameral systems.

Second, the literature is still unclear about the impacts of potential reforms. At the country level, only five studies out of six support the fragmentation hypothesis, that is, a positive relationship between legislature size and public spending levels (Kontopoulos and Perotti, 1999; Bradbury and Crain, 2001; Mukherjee, 2003; Maldonado, 2013; Ricciuti, 2003). This link is evidenced in our dataset, but the set of confounding factors could be potentially large; and the question remains about whether the higher spending levels signal a less efficient public sector. Reversely, a lower legislature size may induce multiple adverse effects, be it in terms of citizen and party representation, political competition, or policy responsiveness. However, in our data, no obvious association is highlighted between the excess number of representatives and the quality of democracies as measured with a set of four indicators. Last, the literature is highly heterogeneous and mitigated when it comes to local jurisdictions. While several studies find support for the fragmentation hypothesis, several others find either no effect or a negative one. This is best exemplified in the meta-analysis of Alptekin et al. (2020) which suggests that there is no strong evidence for a positive relationship between the number of MPs and public expenditures.

To end this discussion, we may wonder why the fragmentation hypothesis finds so little consensus at the local level. Several methodological issues have been raised. As discussed in Boll and Sidki (2020), the “law of 1/n” (the number of representatives) and the ‘‘weak government hypothesis’’ (party competition) could be working in opposite directions, yielding nonlinear or complex

impacts on public spending levels. To circumvent that issue, several studies relate political strength to the fragmentation of an assembly as measured with the Herfindahl–Hirschman Index[10] or Penrose–Banzhaf index.[11] Bel et al. (2018) argue that the population size also acts as a confounding factor since smaller jurisdictions are more homogeneous in terms of preferences and, in the meantime, are facing a higher degree of political representation. Pettersson-Lidbom (2012) warns against a possible reverse causality: greater spending levels require more legislators in order to deal with budget management. In addition, increases in assembly size are shown to be influenced by the effective number of parties (Jacobs and Otjes, 2015).

Simply put, the size of legislatures is likely to be endogenous, which requires quasi-experimental methods to identify causal effects (Lewis, 2019; Kessler, 2010). There are, however, additional threats to identification that are worth being mentioned. Baskaran (2013) notes that a condition for using a diff-in-diff approach is to have enough over-time variation in legislature sizes (see also Mukherjee, 2003). When using a regression discontinuity design, the council size must be the only variable that varies discontinuously around the population thresholds, yet Mayors and Executive Committee members' wages may change around the same cutoffs (De Benedetto, 2018). Using evidence from France, Germany, and Italy, Eggers et al. (2018) show that the range of competencies is also affected by population thresholds and that the municipalities can strategically manipulate population figures to end up on the desired side of relevant thresholds.

Last but not least, the spending structure could be affected in many ways. However, only a few papers analyze more than one spending category (Alptekin et al., 2020). The degree of decentralization and the institutional rules which are used to limit public spending at the local level also differ among countries. Controlling for these different factors surely offer a formidable challenge to researchers in the field. The question of the optimal legislature size thus remains a research question that is worth investigating further.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix

A.1. Definitions and data description

The analysis makes use of data about 139 countries for year 2017. The complete list of countries along with their ISO codes can be found in Table 6. Table 7 defines the variables while Tables 8 and 9 offer summary statistics for unicameral and bicameral legislatures, respectively. Last, Table 10 shows the correlation matrix and the related tests of significance.

Note that a distinction is made between the statutory and the current number of members in a legislature. The statutory number indicates the number of MPs as defined in the constitution or other fundamentals laws; while the current number is the actual size of the parliament, i.e., the number of representatives who currently hold a seat in parliament. In our database (year 2017), 100 countries show the exact same values; while 39 countries show differences that resulted mostly from peculiar electoral or political circumstances. For these reasons, our empirical analysis makes use of the statutory number only.

Below are also presented some specific situations that are worth being mentioned in relation with the number of statutory members in the Parline Database:

- **Cote d'Ivoire.** In 2016 a referendum was held, approving the creation of a Senate of 99 members and establishing a bicameral system. However, the Senate seated for the first time in 2018.[12] The single chamber was thus considered in our empirical work.
- **Mauritania.** In August 2017, the abolition of the Senate was approved by referendum. Before this decision, Mauritania had a bicameral system made of a National Assembly (147 members) and a Senate (56 members). After the referendum, the unicameral system was composed of 157 members.[13] However, the first election for the new parliamentarian system was held in autumn in 2018. The now old bicameral system was considered in our analysis.

[10] See, e.g., Borge (1995), Falch and Rattsø (1999), Tovmo and Falch (2002) and Le Maux et al. (2011) or Le Maux and Rocaboy (2016), among others.
[11] See, e.g., Pommerehne (1978) and Padovano and Venturi (2001), or Huber et al. (2003).
[12] See https://freedomhouse.org/country/cote-divoire/freedom-world/2021.
[13] See section "Elections", note 1 from https://data.ipu.org/node/108/elections?chamber_id=13463.

Table 6
List of countries and ISO codes.

Country	Code	Country	Code	Country	Code
Afghanistan	AFG	France	FRA	Nepal	NPL
Albania	ALB	Gabon	GAB	Netherlands	NLD
Algeria	DZA	Gambia, The	GMB	New Zealand	NZL
Angola	AGO	Georgia	GEO	Nicaragua	NIC
Argentina	ARG	Germany	DEU	Niger	NER
Armenia	ARM	Ghana	GHA	Nigeria	NGA
Australia	AUS	Greece	GRC	Norway	NOR
Austria	AUT	Guatemala	GTM	Oman	OMN
Azerbaijan	AZE	Guinea	GIN	Pakistan	PAK
Bahrain	BHR	Guinea-Bissau	GNB	Panama	PAN
Bangladesh	BGD	Guyana	GUY	Paraguay	PRY
Belarus	BLR	Honduras	HND	Peru	PER
Belgium	BEL	Hungary	HUN	Philippines	PHL
Benin	BEN	India	IND	Poland	POL
Bhutan	BTN	Indonesia	IDN	Portugal	PRT
Bolivia	BOL	Iran, Islamic Rep.	IRN	Qatar	QAT
Botswana	BWA	Iraq	IRQ	Romania	ROU
Brazil	BRA	Ireland	IRL	Russian Federation	RUS
Bulgaria	BGR	Israel	ISR	Rwanda	RWA
Burkina Faso	BFA	Italy	ITA	Senegal	SEN
Burundi	BDI	Jamaica	JAM	Serbia	SRB
Cabo Verde	CPV	Japan	JPN	Sierra Leone	SLE
Cambodia	KHM	Jordan	JOR	Singapore	SGP
Cameroon	CMR	Kazakhstan	KAZ	Slovak Republic	SVK
Canada	CAN	Kenya	KEN	Slovenia	SVN
Central African Republic	CAF	Korea, Rep.	KOR	South Africa	ZAF
Chad	TCD	Kuwait	KWT	Spain	ESP
Chile	CHL	Lao PDR	LAO	Sri Lanka	LKA
China	CHN	Latvia	LVA	Sudan	SDN
Colombia	COL	Lebanon	LBN	Sweden	SWE
Comoros	COM	Lesotho	LSO	Switzerland	CHE
Congo, Dem. Rep.	COD	Liberia	LBR	Tajikistan	TJK
Congo, Rep.	COG	Lithuania	LTU	Tanzania	TZA
Costa Rica	CRI	Luxembourg	LUX	Thailand	THA
Cote d'Ivoire	CIV	Madagascar	MDG	Togo	TGO
Croatia	HRV	Malawi	MWI	Tunisia	TUN
Cuba	CUB	Malaysia	MYS	Turkey	TUR
Cyprus	CYP	Mali	MLI	Turkmenistan	TKM
Czech Republic	CZE	Mauritania	MRT	Uganda	UGA
Denmark	DNK	Mauritius	MUS	Ukraine	UKR
Dominican Republic	DOM	Mexico	MEX	United Kingdom	GBR
Ecuador	ECU	Moldova	MDA	United States	USA
Egypt, Arab Rep.	EGY	Mongolia	MNG	Uruguay	URY
El Salvador	SLV	Montenegro	MNE	Vietnam	VNM
Equatorial Guinea	GNQ	Morocco	MAR	Zimbabwe	ZWE
Estonia	EST	Mozambique	MOZ		
Finland	FIN	Namibia	NAM		

- **Nepal.** Following the end of a decade-long civil war between the government and Maoist rebels, the country was operating under an interim unicameral system (601 seats) created in 2007 to transition the country from a constitutional monarchy to a republic.[14] In 2017, the elections for the House of representatives (275 members) and the National assembly (59), for a total of 334, were held. Our data makes use of the unicameral body that was in place during most of year 2017.
- **Thailand.** Due to a military coup in 2017, Thailand was in a transitional period, with a National Legislative Assembly made of 250 members.[15] In 2017, a new constitution re-established the old bicameral system, yet the constitution allowed the military National Legislative Assembly to remain in place until the House of Representatives was formed following the 2019 general election.[16]

A.2. Bicameral vs. unicameral legislatures: estimates with additional covariates

In line with Auriol and Gary-Bobo (2012), four additional covariates are considered:

[14] See https://www.justice.gov/file/411506/download.
[15] See https://data.ipu.org/compare?field=country%3A%3Afield_structure_of_parliament#map; https://data.ipu.org/node/170/elections?chamber_id=13541.
[16] See https://data.ipu.org/node/170/elections?chamber_id=13541.

Table 7
List of variables.

Variable	Type	Source	Definition
Bicameral	Categorical	Parline Database	Type of legislature: takes value of 1 when the parliamentary system is bicameral and 0 otherwise.
Population size	Quantitative, Continuous	World Databank	Total number of inhabitants, expressed in millions.
Legislature size	Quantitative, Continuous	Parline Database	Statutory number of national representatives, i.e., total number of full membership positions in the legislature as specified by law. Both lower and upper chamber are considered for bicameral systems.
Upper chamber	Quantitative, Continuous	Parline Database	Statutory number of national representatives in upper chambers (bicameral systems only).
Lower chamber	Quantitative, Continuous	Parline Database	Statutory number of national representatives in lower chambers (bicameral systems only).
Ratio of chamber sizes (L/U)	Quantitative, Continuous	Own computation	Ratio of seats in lower chamber relative to seats in upper chamber.
MPs per capita	Quantitative, Continuous	Own computation	Number of national representatives for one million inhabitants.
Number of parties	Quantitative, Continuous	Party Facts	The number of parties active and relevant in the electoral scene of each country considered (in 2017).
Public consumption	Quantitative, Continuous	World Development Indicators	General government final consumption expenditure (expressed as a % of GDP), i.e., all government current expenditures for purchases of goods and services (including compensation of employees).
Public debt	Quantitative, Continuous	International Monetary Fund (IMF)	Public debt expressed in percentage of GDP.
Control of corruption	Quantitative, Continuous	Worldwide Governance Indicators	Measures the extent to which public power is exercised for private grain and measures the strength and effectiveness of a country's policy and institutional framework to prevent and combat corruption (see, e.g. Denters, 2002, for similar use).
Political competition	Quantitative, Continuous	Quality of Governance database	Measures the electoral success of smaller parties, that is, their percentage of votes gained in parliamentary and/or presidential elections.
Voice and accountability	Quantitative, Continuous	Worldwide Governance Indicators	Captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
Polity2	Quantitative, Discrete	Polity IV project database	Autocracy–democracy index ranging between −10 (total autocracy) and 10 (total democracy) from the Polity IV dataset.
Constitution	Categorical	Own computation	Takes value 1 when the country is a unitary republic. Takes value 2 when it is a federal government. Takes value 3 when it is a unitary monarchy.
Excess number	Quantitative, Continuous	Own computation	Residuals of Eq. (5) based on Log–Log estimations. Positive (resp. negative) residuals indicate excess (resp. lack) of representatives.

Table 8
Unicameral legislatures: summary statistics.

	n	mean	sd	min	max	range	se
Pop.	78	39,257,967.000	159,305,754.000	537,497	1,386,395,000	1,385,857,503	18,037,825.000
Legisl. size	78	231.974	347.932	33	3000	2967	39.396
MPs per capita	78	26.085	26.405	2.116	133.954	131.838	2.990
Nb parties	78	13.359	9.815	1	51	50	1.111
Public consump.	78	15.413	5.299	4.325	30.838	26.513	0.600
Public debt	78	55.722	31.079	8.772	181.906	173.134	3.519
Control of corrupt.	78	−0.128	0.944	−1.563	2.241	3.804	0.107
Polity2	78	4.782	5.745	−10	10	20	0.650
Political comp.	78	47.226	20.278	0	70	70	2.296
Voice and account.	78	−0.050	0.892	−2.159	1.692	3.851	0.101
Excess number	78	−0.107	0.407	−0.962	1.130	2.092	0.046

- **GDP per capita (gdppc).** Constant 2017 international dollars. Datasource: World Bank - World Development Indicators.
- **Population density (density).** Midyear population divided by land area in square kilometers. Datasource: World Bank - World Development Indicators.

Table 9
Bicameral legislatures: summary statistics.

	n	mean	sd	min	max	range	se
Pop.	61	65,155,473.000	176,920,602.000	745,568	1,338,658,835	1,337,913,267	22,652,362.000
Legisl. size	61	356.164	259.637	72	1455	1383	33.243
Upper chamber	61	102.115	114.234	21	805	784	14.626
Lower chamber	61	254.049	172.390	40	650	610	22.072
Ratio of chamber sizes (L/U)	61	3.062	1.955	0.381	12.375	11.994	0.250
MPs per capita	61	23.392	26.259	0.590	134.707	134.117	3.362
Nb parties	61	13.443	9.097	1	42	41	1.165
Public consump.	61	16.430	5.928	4.403	39.734	35.330	0.759
Public debt	61	62.805	36.903	7.346	236.388	229.042	4.725
Control of corrupt.	61	0.001	1.096	−1.826	1.989	3.815	0.140
Polity2	61	4.590	5.982	−10	10	20	0.766
Political comp.	61	45.553	20.632	0	70	70	2.642
Voice and account.	61	−0.008	1.041	−1.974	1.569	3.544	0.133
Excess number	61	0.136	0.404	−0.635	1.265	1.901	0.052

Table 10
Correlation matrix.

Coefficient of correlation

	Pop. (ln)	Legisl. size (ln)	MPs per capita (ln)	Nb parties (ln)	Public consump.	Public debt	Control of corrupt.	Polity2	Political comp.	Voice and account.	Excess number
Pop. (ln)	1	0.836	−0.903	0.121	−0.207	0.019	−0.155	−0.100	−0.009	−0.122	0
Legisl. size (ln)	0.836	1	−0.518	0.125	−0.014	0.120	−0.006	−0.037	0.032	−0.013	0.549
MPs per capita (log)	−0.903	−0.518	1	−0.090	0.312	0.064	0.237	0.126	0.039	0.180	0.430
Nb parties (ln)	0.121	0.125	−0.090	1	0.049	0.049	0.214	0.568	0.604	0.505	0.044
Public consump.	−0.207	−0.014	0.312	0.049	1	0.056	0.391	0.163	0.118	0.291	0.291
Public debt	0.019	0.120	0.064	0.049	0.056	1	0.167	0.108	0.001	0.156	0.190
Control of corrupt.	−0.155	−0.006	0.237	0.214	0.391	0.167	1	0.439	0.327	0.787	0.225
Polity2	−0.100	−0.037	0.126	0.568	0.163	0.108	0.439	1	0.773	0.840	0.084
Political comp.	−0.009	0.032	0.039	0.604	0.118	0.001	0.327	0.773	1	0.673	0.072
Voice and account.	−0.122	−0.013	0.180	0.505	0.291	0.156	0.787	0.840	0.673	1	0.162
Excess number	0	0.549	0.430	0.044	0.291	0.190	0.225	0.084	0.072	0.162	1

p-values

	Pop. (ln)	Legisl. size (ln)	MPs per capita (ln)	Nb parties (ln)	Public consump.	Public debt	Control of corrupt.	Polity2	Political comp.	Voice and account.	Excess number
Pop. (ln)		0	0	0.156	0.014	0.822	0.068	0.243	0.918	0.153	1
Legisl. size (log)	0		0	0.142	0.874	0.158	0.941	0.664	0.708	0.880	0
MPs per capita (ln)	0	0		0.290	0	0.452	0.005	0.139	0.649	0.034	0
Nb parties (log)	0.156	0.142	0.290		0.566	0.564	0.011	0	0	0	0.608
Public consump.	0.014	0.874	0	0.566		0.511	0	0.056	0.165	0.001	0.001
Public debt	0.822	0.158	0.452	0.564	0.511		0.050	0.205	0.987	0.066	0.025
Control of corrupt.	0.068	0.941	0.005	0.011	0	0.050		0	0	0	0.008
Polity2	0.243	0.664	0.139	0	0.056	0.205	0		0	0	0.325
Political comp.	0.918	0.708	0.649	0	0.165	0.987	0	0		0	0.400
Voice and account.	0.153	0.880	0.034	0	0.001	0.066	0	0	0		0.056
Excess number	1	0	0	0.608	0.001	0.025	0.008	0.325	0.400	0.056	

- **Historical ethnic fractionalization index (HIEF).** Probability that two randomly drawn individuals within a country are not from the same ethnic group. Datasource: Harvard Dataverse (most recent year available: 2013).
- **Gini index (gini).** Ranges from 0, indicating perfect equality, to 1, perfect inequality. Datasource: World Bank - World Development Indicators.

Sample size is strongly affected by the inclusion of those additional covariates. We provide the estimation results both with the Gini index (Table 11 – 118 observations) and without the Gini index (Table 12 – 83 observations). We can see from these tables that the population estimates are barely impacted: except for column 5 in Table 12, the coefficient on ln(pop) is always significant with magnitudes that are similar to those seen in Table 2. Relatedly, when significant, the signs on the new covariates are in accordance with Auriol and Gary-Bobo's (2012) expectations. The coefficient on gdppc is positive, suggesting that wealthier countries are more likely to maintain a large assembly. When significant, the population density has a negative coefficient, which supports the intuition that "*people who leave far apart do not interact much, and may differ more*". Similarly, the Gini index shows a negative sign in columns (1) and (2) of Table 12, suggesting again that population heterogeneity matters for legislature sizes. The ethnic fractionalization index, however, does not appear as a significant determinant.

Table 11
Estimations without Gini index.

	Dependent variable (in natural logarithm):				
	Total legislature size		Upper chamber (U)	Lower chamber (L)	Ratio of sizes (L/U)
	(1)	(2)	(3)	(4)	(5)
Constant	−2.832***	−2.175***	−1.771	−2.921***	−1.150
	(0.552)	(0.635)	(1.097)	(0.710)	(1.060)
ln(pop)	0.455***	0.402***	0.284***	0.438***	0.155***
	(0.028)	(0.041)	(0.060)	(0.039)	(0.058)
Bicameral		0.372**			
		(0.160)			
Bicameral ∗ ln(pop)		0.066			
		(0.056)			
ln(gdppc)	0.088***	0.083***	0.152***	0.102***	−0.050
	(0.029)	(0.029)	(0.057)	(0.037)	(0.055)
density	−0.0001*	−0.0001*	−0.0002	−0.0003*	−0.0002
	(0.0001)	(0.00005)	(0.0003)	(0.0002)	(0.0003)
HIEF	−0.109	−0.103	−0.016	−0.015	0.001
	(0.163)	(0.159)	(0.333)	(0.215)	(0.321)
Observations	118	118	52	52	52
R^2	0.706	0.727	0.408	0.763	0.168
Adjusted R^2	0.695	0.712	0.358	0.743	0.097
Residual Std. Error	0.408	0.397	0.562	0.364	0.543
F Statistic	67.702***	49.248***	8.098***	37.822***	2.376*

Note: *, **, and *** indicate significance at the 0.1, 0.05 and 0.01 level, respectively; standard errors in brackets.

Table 12
Estimations with Gini index.

	Dependent variable (in natural logarithm):				
	Total legislature size		Upper chamber (U)	Lower chamber (L)	Ratio of sizes (L/U)
	(1)	(2)	(3)	(4)	(5)
Constant	−2.108***	−1.422*	−2.013	−2.203**	−0.191
	(0.641)	(0.731)	(1.608)	(0.975)	(1.325)
ln(pop)	0.448***	0.402***	0.320***	0.398***	0.078
	(0.031)	(0.047)	(0.085)	(0.051)	(0.070)
Bicameral		0.333*			
		(0.177)			
Bicameral ∗ ln(pop)		0.061			
		(0.060)			
ln(gdppc)	0.088**	0.074*	0.170*	0.103*	−0.067
	(0.036)	(0.038)	(0.097)	(0.059)	(0.080)
density	−0.0005*	−0.0005*	−0.001	−0.0002	0.0005
	(0.0003)	(0.0002)	(0.001)	(0.001)	(0.001)
HIEF	−0.290	−0.302	−0.125	−0.299	−0.174
	(0.209)	(0.208)	(0.516)	(0.313)	(0.425)
gini	−0.013**	−0.014**	−0.014	0.001	0.014
	(0.007)	(0.006)	(0.016)	(0.010)	(0.014)
Observations	83	83	34	34	34
R^2	0.742	0.758	0.449	0.735	0.170
Adjusted R^2	0.725	0.736	0.350	0.688	0.022
Residual Std. Error	0.371	0.363	0.613	0.372	0.505
F Statistic	44.210***	33.631***	4.556***	15.564***	1.151

Note: *, **, and *** indicate significance at the 0.1, 0.05 and 0.01 level, respectively; standard errors in brackets.

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