APPENDIX

Online Appendix for Cesar Zucco Jr. and Timothy J. Power, "Fragmentation Without Cleavages? Endogenous Fractionalization in the Brazilian Party System"

This Appendix includes additional analysis and information that is referred to in the main body of the article, but that could not be included due to space limitations.

On Alternative Indices of Fragmentation

The sharp increase in fragmentation described in the article is not an artefact of our using the conventional Laakso and Taagepera ENP index.[1] Dunleavy and Boucek performed a very thorough analysis[2] of the behavior of several indices over the full range of possible party size configurations and demonstrated that that ENP and several of its variants share numerical properties that are not substantively interesting.[3] However important, these criticisms are not very relevant for our study because the main "pathologies" of ENP are to produce "implausibly high scores for party systems where the largest party is in a strong governing position" and a "kink effect" around the point in which the largest party has about 50% of seats or votes.[4] No party in Brazil has been in such a "strong governing position" in the lower house for 30 years.[5]

Alternative measures to the ENP include simply an examination of the share of the largest party (V1), or Dunleavy and Boucek's proposal of averaging the ENP with 1/V1 (an index they refer to as N_b). As we show below, the trajectory of fragmentation in Brazil is no less explosive under these alternative measures.

Table A1: Alternative Indicators of Fragmentation by Legislature

Legislatures		Ideology Estimates Coverage (BLS)			Fragmentation (Chamber Seats)		
#	Elected	Wave	Seats (%)	Parties	ENPP	V1	Nb
48	1986	1	97.37	13	3.29	0.35	3.07
49	1990	2	97.43	14	7.08	0.22	5.82
50	1994	3	98.32	11	8.47	0.21	6.59
51	1998	4	97.14	11	6.70	0.21	5.73
52	2002	5	95.62	11	7.70	0.18	6.63
53	2006	6	95.45	13	9.40	0.19	7.31
54	2010	7	92.93	14	10.10	0.17	7.99
55	2014	8	96.46	20	11.40	0.14	9.28

Source: compiled by authors from TSE and BLS data.

As expected given the configuration of Brazilian party system, the N_b correction of ENPP is almost irrelevant, as the two indices correlate almost perfectly (r=0.99, p-value <0.001), so we focus on ENPP in the main body of the paper. In both we see the constant expansion of the number of parties, especially in the beginning and the end of the period.

Table A2: Fragmentation (Subset of 11 Leading Parties, 1986-2014)

Legislatures		Relevance of Subset		Fragmentation (within subset)		
#	Election	BLS Wave	Seats (%)	ENPP	V1	Nb
48	1986	1	90.18	4.48	0.35	3.66
49	1990	2	86.13	6.30	0.22	5.43
50	1994	3	98.32	6.36	0.21	5.54
51	1998	4	97.14	6.33	0.21	5.54
52	2002	5	95.62	7.95	0.18	6.75
53	2006	6	92.42	7.93	0.19	6.57
54	2010	7	82.15	7.64	0.17	6.76
55	2014	8	73.99	8.41	0.14	7.78

Source: compiled by authors from TSE and BLS data.

On Mapping the Issue Space with BLS Survey Data

We start out with 20 questions that we grouped a priori into five issue sets (see next section of the Appendix for question wording).[6] First, we adjusted the polarity of answer scales so that higher values reflected "more conservative" positions on each question. Then, for each of these clusters of issues, we combined items using principal component analysis to produce a single score. Diagnostics suggest that each of the issue sets was clearly one-dimensional.

Our main criterion to evaluate the consistency of each issue set was parallel analysis, a technique that compares the scree of factors of the observed data with that of a random data matrix of the same size as the original.[7] The variance explained by the first dimension of the PCA analysis was 0.38 for the International issue set, but close to or higher than 0.5 for all other sets.

The second step was to examine the resulting a matrix of estimated positions on the five issue-sets covering 268 legislators.[8] The policy space defined by these five bundles of issues is unambiguously one-dimensional. This conclusion is based on several commonly used criteria to analyze the dimensionality of data matrices. Indicators ranging from the simple examination of the scree-plots to "very simple structure" (VSS) analysis and parallel analysis support this claim. More substantively, the linear associations between the scores and our independently derived estimate of left-right ideology—discussed later in this Appendix—are all positive. This correlation is strongest for Traditional issues (r=0.5) and weakest for classical Liberalism (r=0.23), but in all cases the association is statistically significant (p-value <0.01).

In fact, if we analyze BLS7 and BLS8 separately, we see that the scores on the five issues have become more strongly correlated with each other and with the ideology estimates between 2013 and 2017. This "alignment" was particularly pronounced for Liberalism and International

issues. Hence, politics, if anything, has become more one-dimensional and more structured along ideological lines even if fragmentation has continued to increase.

Table A3: Linear Correlations Between Issue Scores (2013 and 2017)

	Wave 7 (2013)					Wave 8 (2013)				
	Trad	Fiscal	New	Liber	Int	Trad	Fiscal	New	Liber	Int
Ideo	0.54	0.37	0.44	0.05	0.13	0.58	0.53	0.53	0.37	0.38
Trad		0.23	0.43	0.04	0.26		0.41	0.46	0.39	0.46
Fiscal			0.29	0.22	0.25			0.27	0.37	0.18
New				0.16	0.26				0.35	0.46
Liber					-0.01					0.30

On The Two "Optimal Parties" in the Cluster Analysis

In the article, we described the methodological procedure of "partitioning around medoids." Table A4 below reports how the membership in the parties in our sample would be split across the two "optimal" parties generated by cluster analysis.

A majority of our sample is placed in what we can classify as the right-leaning cluster (close to 60%).[9] Of the 15 parties for which we have at least five respondents across the two waves, only PT, PCdoB, and PSOL on the left, and PSC on the right, would not be split. The PT is clearly the most cohesive large party, with all 34 respondents forming a single left-leaning cluster. The PMDB, PSD, and DEM are also quite coherent, with more than 80% of their respondents placed in the right-leaning party. The PSDB (26% on the left) is fairly divided, while the PSB is the most divided of the "major" parties, being almost evenly split. The only surprise here is the large share of the PDT (65%) that is placed in the right-of-center optimal party.

Table A4: Membership Composition of "Optimal" Parties

Abbreviation	Full Name	Left Cluster	Right Cluster
DEM	Democratas	3	16
PC do B	Partido Comunista do Brasil	10	0
PDT	Partido Democrático Trabalhista	6	11
PHS	Partido Humanista da Solidariedade	0	2
PMDB	Partido Movimento Democrático Brasileiro	7	32
PMN	Partido da Mobilização Nacional	0	2
PODE	Podemos	1	1
PP	Partido Popular	6	11
CID	Cidadania (ex-Partido Popular Socialista)	5	2
PL	Partido Liberal (ex-Partido Republicano)*	3	11
PRB	Partido Republicano Brasileiro	2	4
PROS	Partido Republicano da Ordem Social	1	0
PSB	Partido Socialista Brasileiro	10	10
PSC	Partido Social Cristão	0	7
PSD	Partido Social Democrático	2	18
PSDB	Partido da Social Democracia Brasileira	9	25
PSL	Partido Social Liberal**	1	0
PSOL	Partido Socialismo e Liberdade	4	0
PT	Partido dos Trabalhadores	34	0
PTB	Partido Trabalhista Brasileiro	1	7
PV	Partido Verde	0	2
REDE	Rede Sustentabilidade	2	0
SD	Solidariedade	2	1
	Sum	109	162
	Share (%)	40	60

* The Partido Republicano (PR) returned to its old name of Partido Liberal (PL) in May 2019, and we refer to this party as PL throughout the article. **The PSL had only one deputy at the time of BLS8 in 2017, but won 52 lower house seats in the 2018 elections. Source: compiled by authors, placing 271 responses from Brazilian Legislative Surveys, Waves 7 and 8 (see article text for details). Some 20 respondents were dropped due to having too many missing responses in any of the five issue sets.

The two resulting parties would be quite consistent in terms of their issue preferences. Figure A1 shows the distribution of preferences on each of the issue-sets within and between the

two optimal clusters. The two hypothetical parties would ensure quite a lot of separation on the first three issue-sets, and slightly less so on Fiscal matters and International issues.[10]

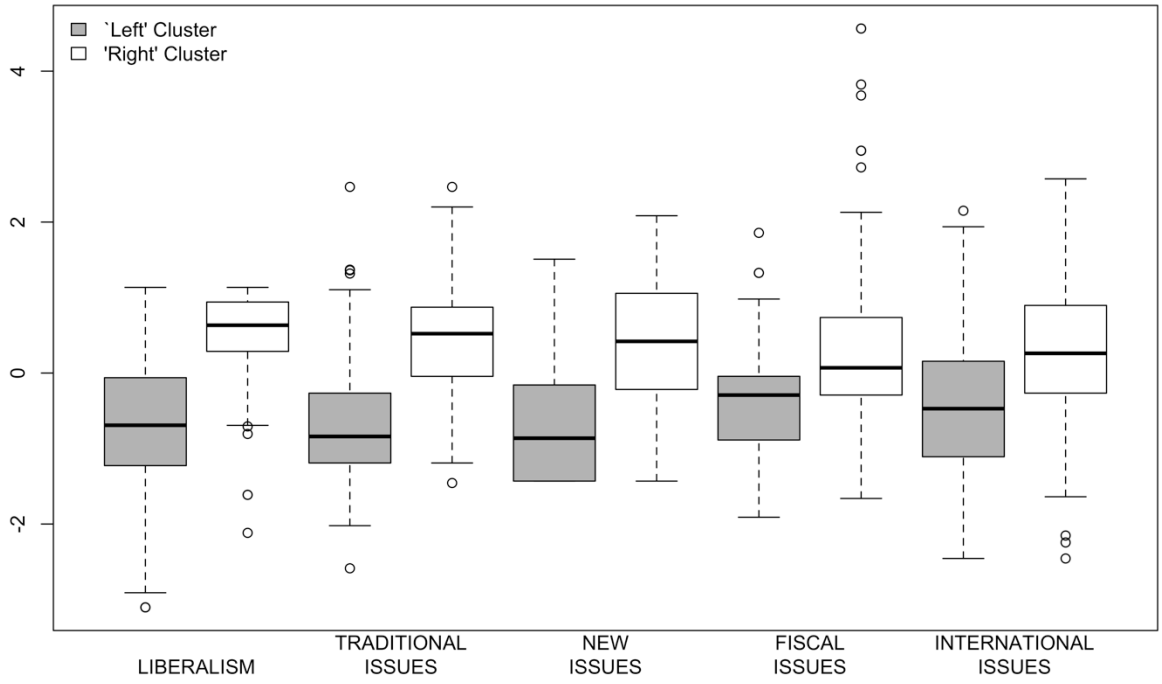

Figure A1: Positions of the Two Optimal Parties on the Five Issue-Sets

Notes: The boxplot shows the distribution of scores of members of the hypothetical two parties implied by optimal cluster analysis on each of the five bundles of substantive issues. See text for details. Source: compiled by authors from Brazilian Legislative Surveys, Waves 7 and 8.

Legislators are also well sorted into the two "optimal parties" based on their overall ideology. This is quite striking given the fact that the estimates of the ideological position of the legislators (discussed in the next section) are based exclusively on legislators self- and other-regarding perceptions. Even though these estimates do not use any of the data that went into the clustering exercise, the two lead to very similar conclusions.

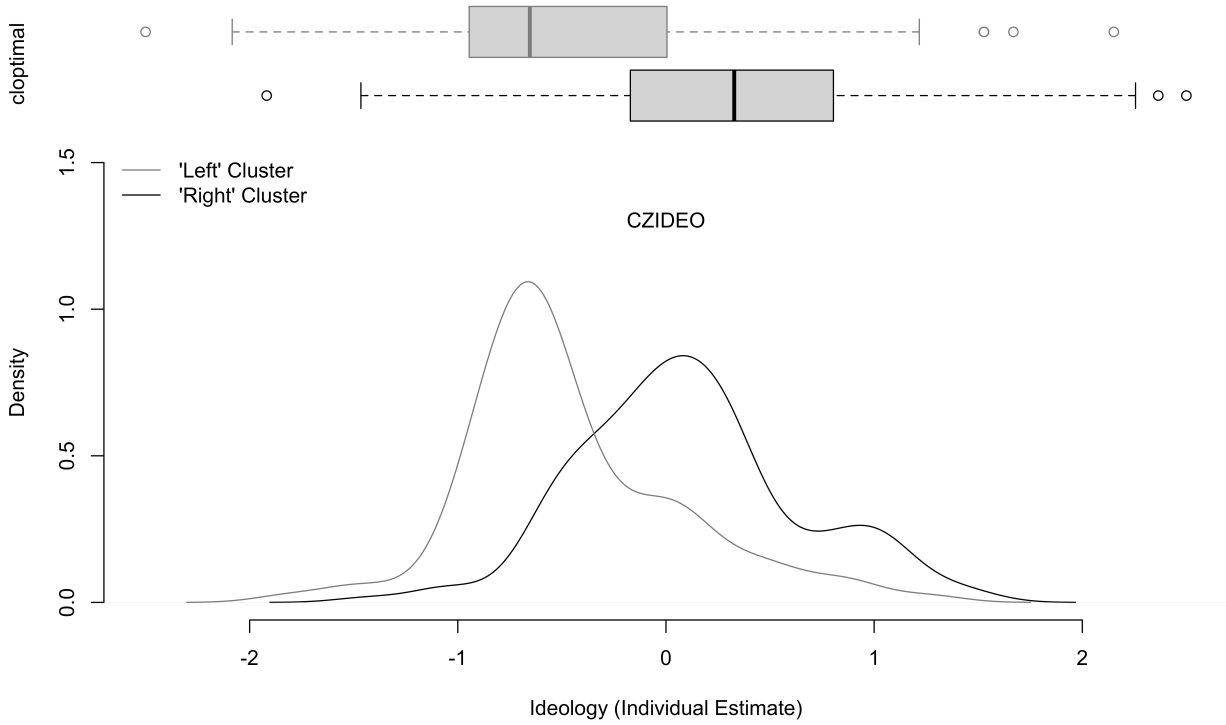

Figure A2: Ideological Positions of Members of the Two Optimal Parties

Notes: The figure shows the distribution of ideological positions of members of the two "optimal parties." These positions are estimated from the individual placement and self-placement questions in the surveys. See text for details. Source: computed by authors from the Brazilian Legislative Surveys, Waves 7 and 8.

Even if our clustering analysis is a somewhat arbitrary exercise, it is clear that the parliamentary issue space does not require the large number of political parties that currently exist. This underscores our rejection of H1 in the article text.

Original Text of the BLS Issue-Set Questions (20 Questions, 5 Issue-Sets)

Here we reproduce the original Portuguese-language survey questions as they appear on the BLS questionnaires.

<u>Traditional Economic Issues Battery (4 Items)</u>

1. Na sua opinião, que tipo de sistema econômico seria mais adequado para o Brasil? (a) Uma economia predominantemente de mercado com a menor participação possível do Estado; (b) Um sistema econômico em que houvesse uma distribuição equitativa entre uma parte de

responsabilidade das empresas estatais e outra das empresas privadas; (c) Uma economia em que as empresas estatais e o Estado constituíssem o setor principal, mas sem que a participação da economia do mercado fosse eliminada: (d) Uma economia em que o capital privado fosse totalmente afastado dos principais setores econômicos, passando as grandes empresas para o controle estatal. [Respondents choose one.]

2. [Reproduced from World Values Survey] *A renda deve ser distribuída de forma mais igualitária…..Diferenças de renda servem como incentivo ao esforço individual.* [Respondents asked to use a 5-point scale to indicate proximity to one of the two polar options.]

3. [Reproduced from WVS] *O governo precisa se responsabilizar mais para garantir o sustento de todos…..As pessoas precisam se responsabilizar mais para garantir seu próprio sustento.* [Respondents asked to use a 5-point scale to indicate proximity to one of the two polar options.]

4. É justo que as universidades públicas reservem vagas para pessoas de famílias de baixa renda. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

Classical Liberalism Battery (4 Items)

5. [Reproduced from WVS] Deveria haver mais iniciativa privada na indústria e no comércio……Deveria haver mais participação do governo na indústria e no comércio. [Respondents asked to use a 5-point scale to indicate proximity to one of the two polar options.]

6. [Reproduced from WVS] A concorrência é uma coisa boa porque estimula as pessoas a trabalhar muito e desenvolver novas ideias…..A concorrência é uma coisa ruim porque desperta o que há de pior nas pessoas. [Respondents asked to use a 5-point scale to indicate proximity to one of the two polar options.]

7. [Reproduced from WVS] No longo prazo, quem trabalha muito sempre vai ter uma vida melhor…..Nem sempre quem trabalha muito consegue uma vida melhor. Depende de sorte e de bons relacionamentos. [Respondents asked to use a 5-point scale to indicate proximity to one of the two polar options.]

8. [Reproduced from WVS] Só se pode ficar rico às custas dos outros…..O crescimento da riqueza pode beneficiar a todos. [Respondents asked to use a 5-point scale to indicate proximity to one of the two polar options.]

Fiscal Issues Battery (5 Items)

O orçamento federal determina os gastos do governo em diferentes áreas. Para cada item abaixo, indique se o(a) Sr.(a) acha que o nível atual de gastos deveria ser diminuído, mantido, ou aumentado?

9. Serviços de saúde pública

10. Ensino fundamental e médio público

11. Ensino superior público

12. Infraestrutura

13. Programas de assistência social

[Respondents were asked to indicate their preference for taxation/spending tradeoffs using the following answer scale.] *(a) Diminuir o nível atual de gastos para possibilitar uma diminuição de impostos; (b) Diminuir o nível atual de gastos, sem alterar impostos; (c) Manter o nível atual de gastos; (d) Aumentar o nível atual de gastos, desde que não seja necessário aumentar impostos; (e) Aumentar o nível atual de gastos, ainda que seja necessário aumentar os impostos.*

<u>New Political Issues Battery (3 Items)</u>

14. É justo que as universidades públicas reservem vagas para pessoas afrodescendentes. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

15. Casais homossexuais devem ter o direito de se casar. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

16. O aborto deve ser proibido em qualquer circunstância. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

<u>International Issues Battery (4 Items)</u>

17. Seria mais vantajoso economicamente aprofundar as relações com países da OECD do que com os países vizinhos. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

18. O estreitamento de laços com a China gerará mais riscos do que oportunidades para o Brasil. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

19. O Brasil deve firmar tratados de proteção ao investimento externo no país. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

20. Ao invés de financiar projetos de empresas brasileiras no exterior o BNDES deve priorizar o financiamento de atividades no Brasil. [Strongly agree, somewhat agree, somewhat disagree, strongly disagree.]

On Estimation of Party Ideological Placements

Our estimates of the positions of Brazilian political parties are produced by rescaling the answers given by legislators to survey questions that require that they position themselves and all main parties in the political system on a "left-right" scale that ranges from 1 (left) to 10 (right). These questions have been part of eight all waves of the Brazilian Legislative Surveys (BLS). The BLS surveys have been carried out once each legislature since the 48th. BLS 1 was fielded in 1990 and BLS 8 in 2017.

The basic model is marginally different from previous editions of these estimates, but its underlying logic has remained the same. Following the classic approach, we assume that each party, in each survey-year, has a "true" ideological position in the left-right scale, which is allowed to vary freely from one survey to the next. Legislators participating in each survey observe the true party's position, but interpret the left-right scale in idiosyncratic ways and report the party positions with legislator-specific error. The model seeks mainly to retrieve the true ideological position of parties, but in the process it also estimates the legislator-specific distortion parameters. We then compute legislators' "true" self-placements by assuming that legislators apply the same distortion parameters to themselves as they do to parties. As a number of legislators have answered more than one wave of the surveys, their scale distortion parameters constitute the implicit anchor via which surveys are linked through time. That is, while legislators' "true" positions to vary from survey to survey, distortion parameters are fixed for each individual.

Formally, let $P_{jit} \in [1,10]$ be the placement of party j ($j = 1, \dots, J$) by legislator i ($i = 1, \dots, I$), in year t ($t = 1, \dots, T$). We then estimate the following model:

$$P_{jit} = \alpha_i + \beta_i \pi_{jt} + \epsilon_{ijt}$$

where $\pi_j t$ is the "true" position of each party in each year and α_i and β_i are legislator-specific "shift" and "stretch" rescaling factors, and ϵ_i is a legislator specific error term. Note that only P_{jit} are data, all other parameters are estimated.

The rescaling of legislator's reported self-placement is performed simultaneously by estimating

$$P_{iit} = \alpha_i + \beta_i \pi_{it} + \epsilon_{it}$$

Where $P_{iit} \in [1,10]$ is the self-placement of each legislator i in each year t, and π_{it} is the "true" position of each legislator in each year.

The data that consist of P_j, which is a vector of 17,932 placements of parties,[11] and P_i, a vector of 1,235 self-placements of legislators made by 950 unique survey respondents.[12]
We first standardized the raw data and then estimated the model by MCMC simulation in JAGS. We provided non informative priors for the error terms but provided semi-informative priors for the α and β parameters and for π_{it} and π_{jt}. More specifically, the priors for α and β are normally distributed around zero and one. This is justified because "neutral" rescaling parameters would be, respectively, zero and one. In order to preserve the original scale, priors for the "true placements" were centered on the mean of the standardized placements, with precision set to what was observed in the raw data.[13] Although this is somewhat unusual in the Bayesian framework, we believe the context of our application justifies the usage of this information as the raw data in use is, in fact, a strong prior for the parameters being estimated.

Only eleven of the 950 legislators yielded negative stretch factors (β_j). This means that most legislators do not completely flip the meaning of "left" and "right" relative to their peers.

On the Fundo Especial de Financiamento de Campanha (FEFC) in 2018

In the article, we mention the Fundo Especial de Financiamento de Campanha (FEFC) was created by Congress in 2017 as a response to a 2015 Supreme Court decision prohibiting campaign contributions by private firms. The FEFC was available for the first time in the 2018 elections, with a total value of 1.7 billion BRL. National parties were largely free to allocate their funds to national or subnational candidates, or executive or legislative candidates, as they wished. The only restrictions were that their internal allocation criteria would have to be transparent and published online by the TSE, and that 30% of the total value would have to go to female candidacies. In Table A5 below, we report the total allocations by party.

Table A5: FEFC Allocations by Party, 2018 General Election

Party	BRL value	USD value	Share
MDB (PMDB)	$230,974,290.08	$63,194,060.21	13.47
PT	$212,244,045.51	$58,069,506.30	12.37
PSDB	$185,868,511.77	$50,853,217.99	10.84
PP	$131,026,927.86	$35,848,680.67	7.64
PSB	$118,783,048.51	$32,498,782.08	6.93
PL (PR)	$113,165,144.99	$30,961,735.98	6.60
PSD	$112,013,278.78	$30,646,587.90	6.53
DEM	$87,503,080.78	$23,940,651.38	5.10
PRB	$66,983,248.93	$18,326,470.30	3.91
PTB	$62,260,585.97	$17,034,360.05	3.63
PDT	$61,475,696.42	$16,819,615.98	3.58
Solidariedade	$40,127,359.42	$10,978,757.71	2.34
Podemos (PTN)	$36,112,917.34	$9,880,415.14	2.11
PSC	$35,913,889.00	$9,825,961.42	2.09
PCdoB	$30,544,605.53	$8,356,937.22	1.78
Cidadania (PPS)	$29,203,202.71	$7,989,932.34	1.70
PV	$24,640,976.04	$6,741,717.11	1.44
PSOL	$21,430,444.90	$5,863,322.82	1.25
PROS	$26,124,350.14	$7,147,565.02	1.52
PHS	$18,064,589.71	$4,942,432.21	1.05

Avante (PTdoB)	$12,438,144.67	$3,403,049.16	0.73
Rede	$10,662,556.58	$2,917,252.14	0.62
Patriota (PEN)	$9,936,929.10	$2,718,722.05	0.58
PSL	$9,203,060.51	$2,517,937.21	0.54
PTC	$6,334,282.12	$1,733,045.72	0.37
PRP	$5,471,690.91	$1,497,042.66	0.32
DC (PSDC)	$4,140,243.38	$1,132,761.53	0.24
PMN	$3,883,339.54	$1,062,473.20	0.23
PRTB	$3,794,842.38	$1,038,260.57	0.22
PSTU	$980,691.10	$268,314.94	0.06
PPL	$980,691.10	$268,314.94	0.06
PCB	$980,691.10	$268,314.94	0.06
PCO	$980,691.10	$268,314.94	0.06
PMB	$980,691.10	$268,314.94	0.06
Totals	$1,715,228,739.08	$469,282,828.75	100.00

Notes: Parties that have recently changed their names have their discarded names in parentheses. One party (Partido Novo) refused to accept FEFC funding and is not shown. USD values computed using the average exchange rate (1 USD = 3.655 BRL) for 2018. Source: TSE.

On Party Switchers and One-Member State Delegations (OMSD)

In the main body of the article we mention that there were more party switchers among legislative OMSDs than among parties with larger delegations to the Chamber of Deputies. In Figure A3, we report figures for each legislature since the 48th, which ended in 1990. We considered all deputies serving at the end of each legislative session and determined whether they had switched parties at any point in since the start of the legislature. The difference is not statistically significant in the 52nd legislature ending in 2006 (p=0.11) and in the 54th legislature ending in 2014 (p=0.27).

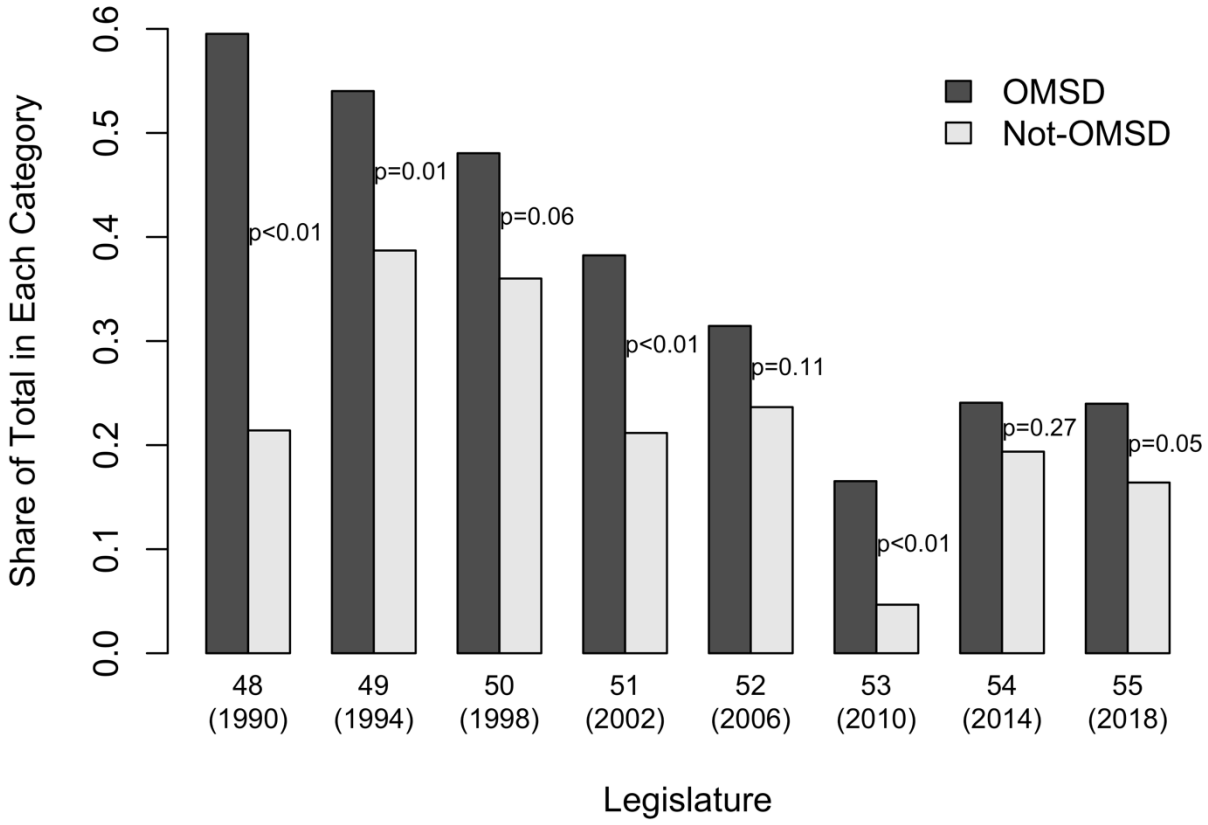

Figure A3: Party Switching Among OMSDs vs. Multimember Delegations, 1990-2018

Source: compiled by authors from public records of the Chamber of Deputies. Exceptionally in this figure, the dates refer to the final year (not the electoral year) of each quadrennial legislative session.

On Intra-List Dominance in Different Party Types

Table 2 in the article reports the average level of vote concentration (using a Herfindahl-Hirschman index) in each type of party contesting the 2018 election. In Figure A4, below, we report the full range of variation in HHIs across all parties in each category. The figure reveals (1) the high similarity between OMSDs and those parties that did not elect any candidate, and (2) how strikingly different these two subtypes are from the larger parties.

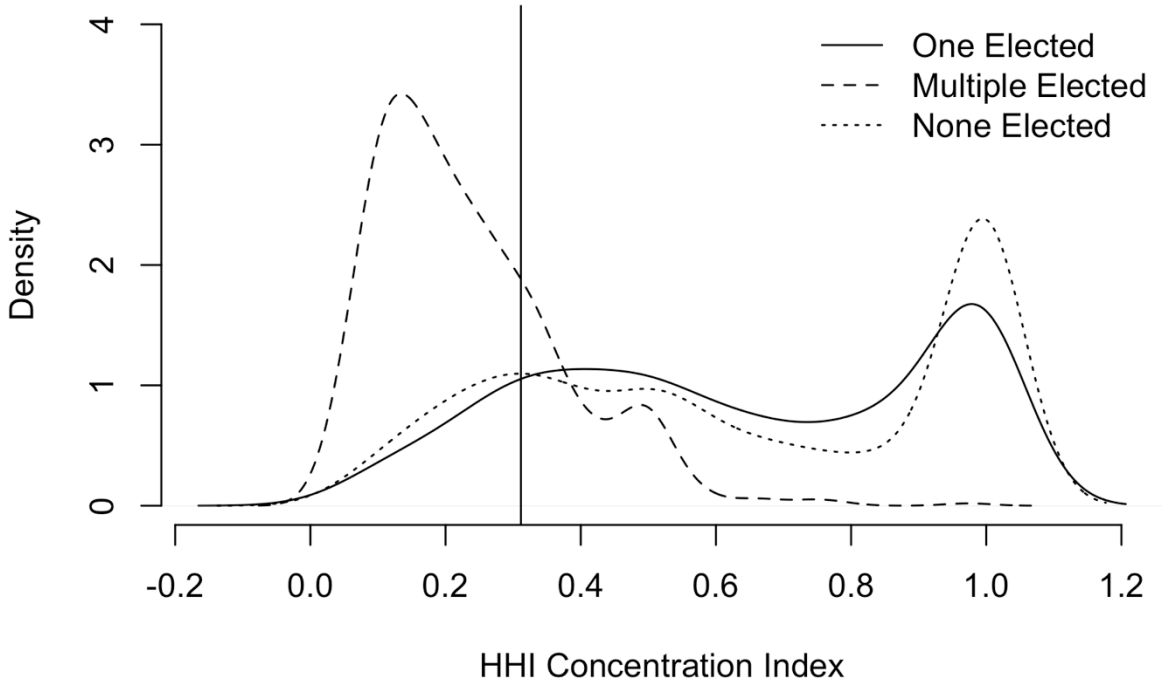

Figure A4: Vote Concentration Patterns by Type of Party

Note: Figure reports the distribution of a Herfindahl-Hirschman index of intra-list concentration of votes by type of party in six elections (1998-2018). The vertical line is the 75th percentile among the "multiple elected" parties, which is mentioned in the main body of the paper. Source: compiled by authors from TSE data.

NOTES

[1] Markku Laakso and Rein Taagepera, "Effective Number of Parties: A Measure with Application to West Europe," *Comparative Political Studies*, 12 (April 1979), 3-27.

[2] Patrick Dunleavy and Françoise Boucek, "Constructing the Number of Parties," *Party Politics*, 9 (May 2003), 291-315.

[3] Molinar took the view that ENP overstated fragmentation, and proposed an index that would emphasize the standing of the largest party. See Juan Molinar, "Counting the Number of Parties: An Alternative Index," *American Political Science Review*, 85 (December 1991), 1357-82.

This index, however, was strongly criticized by Dunleavy and Boucek.

[4] Dunleavy and Boucek, p. 307.

[5] After the 1986 elections, the PMDB briefly held an absolutely majority in the Chamber of Deputies (53% of seats), but this majority vanished within 18 months due to party switching.

[6] One question was coded on a four-point answer scale and all others on a five-point answer scale.

[7] John Horn, "A Rationale and Test for the Number of Factors in Factor Analysis," *Psychometrika* 30 (June 1965), 179-85.

[8] There were a total of 289 respondents in the last two waves of the BLS. However, we excluded legislators for which we did not have at least two items in each of the five issue sets.

[9] The N of 271 in this exercise corresponds to the number of responses with minimal non-response across the 20 variables used to compute the five issue scores. A total of 233 observations had no missing data at all. For those with fewer than 5 missing data points, we employed Amelia. See James Honaker, Gary King, and Matthew Blackwell, "Amelia II: A Program for Missing Data," *Journal of Statistical Software*, 45 (December 2011), 1-47.

[10] The relative lack of differentiation on fiscal issues is fully congruent with the response pattern we observed on a direct question on how to plug the fiscal deficit that was included solely in BLS 8. On this question, we found that almost no respondents believe the deficit should be dealt with solely or primarily by increasing revenues. More than 50% of respondents answered that deficit reduction should be achieved primarily by cutting expenditures. The remainder were divided between those who advocated exclusive reliance on spending cuts and those who would adopt some mix of spending cuts and tax increases.

[11] In BLS 7 and 8 respondents also placed past and current presidents of Brazil. We leave the analysis of presidential placements for future research.

[12] We excluded two respondents from the data set that were utterly non-informative and, therefore, did not allow for the estimation of the respondent's positions.

[13] The use of less precise normally distributed priors does affects only the dispersion and not the ordering of the estimates. We chose the dispersion in order to generate legislator-specific estimates (P_{iit}) in roughly a -1.5 to 1.5 scale.