




# Party Discipline, Representation, and the Condorcet Jury Theorem.

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# Party Discipline, Representation, and the Condorcet Jury Theorem\*

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## Abstract

How does district size affect the quality of political representation? We examine a mechanism derived from the Condorcet Jury Theorem (CJT), which predicts that larger legislative delegations more accurately reflect constituents' preferences when individual legislators vote independently. However, nominal seat counts often overstate the number of independent decision-makers, because party discipline causes legislators' votes to be correlated. We introduce effective district size as a measure that more accurately captures the number of independent politicians within a constituency. Using 263 Swiss referenda (1992-2024) matched to parliamentary decisions, we provide evidence in line with the CJT: the probability that a majority of a delegation reflects its constituents' preferences increases with (effective) district size. Crucially, the CJT aggregation mechanism accurately predicts delegation-constituency congruence only for effective, not nominal, district size. These results provide empirical evidence that the CJT applies to representative democracies and highlight how party discipline constrains the representative benefits of larger district sizes.

**Keywords:** representation, district magnitude, Condorcet Jury Theorem, voting behavior, party discipline, legislative accountability.

**JEL:** D72, K16, H11.

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# 1 Introduction

In representative democracies worldwide, politicians frequently vote in blocs because of party discipline. We argue theoretically and show empirically that defections from party lines can mechanically improve the overall congruence between parliamentary decisions and constituents' preferences. The reason for this is that such defections strengthen the core mechanism of the Condorcet Jury Theorem (CJT) linked to the Law of Large Numbers.

The CJT offers a compelling theoretical foundation for democratic decision-making (Congleton, 2007).<sup>1</sup> It states that, if each individual selects the *correct* option between two alternatives with a probability greater than 0.5, then adding more decision-makers increases the probability that the collective majority will also select the correct option. In its original form, the CJT is a statement about the attainment of *truth* in collective choice. In democratic applications with majority voting, however, *correct* is naturally interpreted not as an objectively true policy, but as the option consistent with the majority preference within a constituency. The underlying Law of Large Numbers in the CJT thus implies that a larger number of independent legislators should, on average, more accurately reflect constituents' preferences, provided that individual legislators are more likely than not to vote in line with those preferences.

Empirical evidence on whether the mechanism of the Law of Large Numbers underlying the CJT applies to parliamentary decisions is mixed (Golder and Stramski, 2010, Stadelmann et al., 2014). A likely reason for this is that parliamentary decisions are correlated because of party discipline. The *effective* size of a parliament, meaning the number of legislators deciding independently, is therefore smaller than its nominal size, which is the total number of MPs. If party discipline is perfect, the effective size of parliament corresponds to a weighted average of the number of parties from a CJT viewpoint. The same logic holds for the representation of constituents' preferences when more politicians represent an electoral district. In principle, larger district delegations should increase the likelihood that the majority of a district's legislators reflect the preferences of the majority of their constituents.

We contribute to the existing literature by providing empirical evidence that the CJT applies to legislative decisions in representative democracies. Moreover, we show that defection from

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<sup>1</sup>In his *Essai sur l'application de l'analyse à la probabilité des décisions rendues à la pluralité des voix*, Condorcet (1785) did not formulate the theorem using modern mathematics; subsequent work has provided formal versions (e.g., Grofman, 1975). The CJT can be interpreted as an application of the Law of Large Numbers to majority voting, where the aggregation of many independent, slightly competent judgments drives the probability of a correct collective decision towards one.

party lines increases the alignment between legislators' majority decisions and the preferences of the majority of their constituents through the aggregation mechanism of the CJT. We propose *effective district size (EDS)* as a new measure that more accurately captures the number of independent decisions made in a district. We define the effective district size as the sum of two components for a given vote: the number of parties represented in the district and the number of legislators who deviate from the majority position of their party within that district.

Empirically, we leverage the Swiss institutional setting, which combines direct and representative democracy. It enables us to observe both the individual voting behavior of legislators and the revealed preferences of their constituents on the same policy issues. We can directly compare 47,368 legislative decisions with constituents' preferences across 263 referenda from 1992-2024. We examine whether the quality of political representation follows the theoretical predictions of the CJT more closely for effective district size than for nominal district size. We measure the quality of political representation with congruence, defined as the extent to which the decisions made by individual legislators or the majority of legislators in a district align with the preferences of the majority of their constituents.

Consistent with the CJT, our results suggest that the probability that the majority of a district's political delegation reflects the preferences of the majority of its constituents increases with district size. Moreover, we show that delegation-constituency congruence under effective district size follows the predictions of the CJT's aggregation mechanism more closely than those under nominal district size. Our findings suggest that party discipline limits the theoretical potential of the CJT in representative democracies. We conclude that adding an independent politician to a delegation improves political representation more than simply increasing its size with party-aligned politicians.

## 2 Theoretical considerations

We define an individual legislator as congruent with her constituency if she votes in parliament according to the preferences of the majority of her constituents. Similarly, a district's delegation of legislators is considered congruent if the majority of its members vote in line with the preferences of the majority of their constituents.

Theoretically, an individual legislator voting on a legislative proposal aligns with the preferences of the majority of her constituents with probability  $p$  and votes against it with proba-

bility  $1 - p$ . Various factors, including the electoral system, personal characteristics, ideological orientation, or free-riding incentives, may affect  $p$  (Butler and Broockman, 2011, Golder and Stramski, 2010, Portmann et al., 2012, Barber, 2016, Kläy et al., 2025, Mukhopadhaya, 2003). In districts with many seats, legislators can win office by appealing to a small part of the electorate. In contrast, in small districts with fewer legislators, they must appeal more to the majority of the electorate. As a result, legislators from smaller districts typically align with the majority’s preference with a higher probability  $p$ . This implies that the individual probability  $p$  tends to decrease as district size increases (Cox, 1990, Catalinac, 2018).

The negative relationship between district size  $n$  and the individual probability  $p$  of representing the majority of voters does not extend to the probability  $P_n$  that the majority of a district’s legislative delegation aligns with the preferences of the majority of their constituents. In democratic systems, it is reasonable to assume that  $0.5 < p \leq 1$ .<sup>2</sup> Thus, the CJT predicts that as district size increases, that is, as more legislators represent a district, the probability  $P_n$  that the majority of the delegation of  $n$  legislators aligns with the majority preference of the constituency increases.<sup>3</sup> Thus, according to the CJT’s mechanics, district size improves the quality of political representation, as measured by the congruence between the majority preferences of legislators and those of their constituents. Importantly, legislators are neither normatively expected to cater to the majority preferences of their constituencies, nor do they typically face individual reelection incentives to do so. The aggregation perspective proposed here is mechanical, grounded in the same probabilistic logic as the CJT, rather than derived from normative or behavioral theories of representation.

The mechanism of the CJT relies on the assumption that individual decisions are independent. This assumption is unlikely to hold in parliamentary practice due to party discipline. Legislators may share information, engage in strategic communication, or trade votes, all of which introduce correlations between individual decisions. Prior research has shown that a positive correlation between the votes of individual decision-makers weakens the effectiveness of the CJT mechanism (Boland et al., 1989, Kaniowski, 2010, Ladha, 1992). We address this by introducing effective district size as a measure that better captures the degree of independence

<sup>2</sup>The average individual congruence is above 50 percent in both the United States and Switzerland, at remarkably similar values of 66.3% and 66.8% (Stadelmann et al., 2013, Matsusaka, 2025).

<sup>3</sup>Theoretically, the CJT states that the probability that a majority of  $k$  legislators in a district of size  $n$  corresponds to majority preference is  $P_n = \sum_{k=\lfloor (n/2) \rfloor + 1}^n \binom{n}{k} p^k (1 - p)^{n-k}$  (Mueller, 2003, p.129).

among legislators’ decisions. This measure accounts for correlated voting behavior without requiring specific distributional assumptions about how individual votes are aggregated.

### 3 Research design

#### 3.1 Institutional setting to measure congruence

Analyzing district size and whether the CJT applies to political representation requires evaluating whether the policy decisions of legislators align with the preferences of their constituents. The Swiss political system offers an ideal institutional setting for such an analysis. Swiss federal legislators vote on a wide range of policy issues in parliament. Citizens, in turn, can vote on these same issues through three types of direct democratic votes: (1) facultative referenda, which allow voters to challenge any legislation passed by parliament; (2) mandatory referenda, required for all constitutional amendments; and (3) popular initiatives, through which citizens can propose their own constitutional amendments. For simplicity, we refer to all such popular votes as referenda. [Stadelmann et al. \(2013\)](#) provides details on the institutional setting.

Referenda offer citizens a binary choice between the proposed legislation and the status quo. Since legislators and voters decide on the same policy proposals with identical wording, we can directly compare parliamentary and referendum outcomes. For each referendum  $r$  and district  $d$ , we define two measures of congruence. *Individual congruence* ( $Congruence_{dr,i}^{(Ind)}$ ) is an indicator equal to 1 if a legislator  $i$  from district  $d$  voted in parliament in line with the majority of constituents in their district in referendum  $r$ , and 0 otherwise.<sup>4</sup> *Delegation congruence* ( $Congruence_{dr}^{(Del)}$ ) is an indicator equal to 1 if the majority of legislators from district  $d$  voted in line with the majority of their constituents in referendum  $r$ , and 0 otherwise.<sup>5</sup>

We examine the decisions of the members of the National Council, the lower chamber of parliament, for all 263 referenda held between 1992 and 2024. In the National Council, 200 members are elected via an open ballot proportional representation system. The seats are allocated to 26 electoral districts (the cantons) according to their population size. District size varies across cantons and over time, ranging from 1 to 35 seats. In total, we compare 47,368 individual legislative decisions and 6,656 delegation-level decisions with the preferences of the

<sup>4</sup>Formally,  $Congruence_{dr,i}^{(Ind)} = \mathbb{1}[V_{dr,i} = C_{dr}]$ , where  $V_{dr,i}$  is an indicator equal to 1 if legislator  $i$  votes yes, and 0 otherwise.  $C_{dr}$  is an indicator equal to 1 if the majority of district  $d$ ’s constituents vote yes and 0 otherwise.

<sup>5</sup>Formally,  $Congruence_{dr}^{(Del)} = \mathbb{1}[V_{dr}^{maj} = C_{dr}]$ , where  $V_{dr}^{maj}$  is an indicator equal to 1 if the majority decision of the delegation of legislators in district  $d$  on referendum  $r$  is yes, and 0 otherwise. A majority is defined as more than 50 percent of yes votes.

corresponding constituents.<sup>6</sup> While Switzerland has unique direct democratic institutions, its federal legislature and popular votes operate similarly to those of other democracies, making our results generally applicable.

### 3.2 Measuring effective district size

The number of seats in a district does not accurately reflect the number of legislators making independent decisions, since individual legislators do not vote independently due to party discipline. Our measure of effective district size sums up the number of parties present in a district and the number of legislators who deviate from the majority position of their district’s party members for a given referendum. EDS varies at the level of each referendum, reflecting potential changes in party discipline on different policy proposals. Formally:

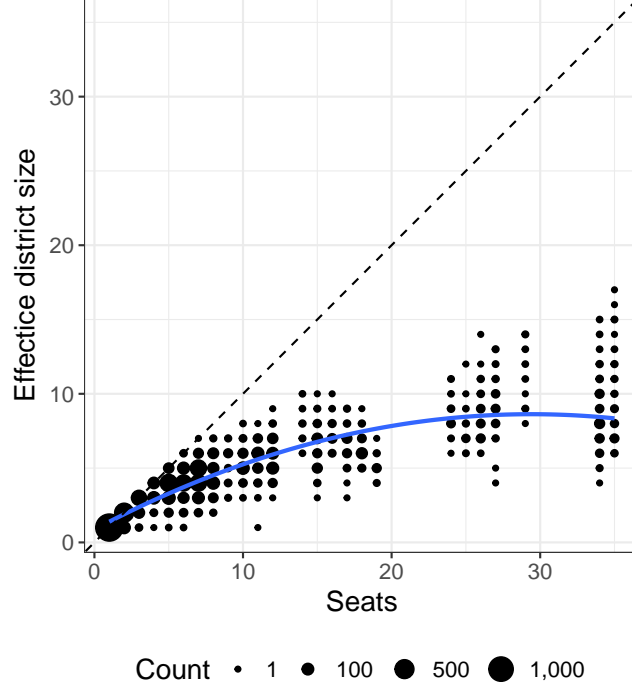
$$EDS_{dr} = \underbrace{|\mathcal{P}_{dr}|}_{\text{Number of parties in district}} + \underbrace{\sum_{i \in \mathcal{L}_{dr}} \mathbb{1}[V_{r,i} \neq V_{dr, \mathcal{P}(i)}^{maj}]}_{\text{Legislators deviating from party majority}},$$

where  $|\mathcal{P}_{dr}|$  is the number of parties present in district  $d$  whose members vote on referendum  $r$ .  $\mathcal{L}_{dr}$  denotes the set of all legislators in district  $d$  who voted on referendum  $r$ .  $V_{r,i}$  is the vote of legislator  $i$  on the policy proposal with subsequent referendum  $r$ .  $\mathcal{P}(i)$  denotes the party affiliation of legislator  $i$ .  $V_{dr, \mathcal{P}(i)}^{maj}$  represents the majority decision (50% or more) of the members of party  $\mathcal{P}(i)$  in district  $d$  on referendum  $r$ . Thus,  $EDS_{dr}$  corresponds to the number of parties in a district plus the number of legislators deviating from the majority of their party.<sup>7</sup> In single-seat districts, the effective district size, the number of represented parties, and the number of politicians (seats) all correspond to one.

Figure 1 displays the correlation between the nominal district size (i.e., the number of seats) and the effective district size, with each point representing a district-referendum observation. For districts with up to approximately five seats, there is a strong positive correlation between the number of seats and the effective district size. Beyond this threshold, the correlation weakens and variability increases. In small districts, we often observe representation from two, three, or even four parties, resulting in a relatively higher effective district size. The number

<sup>6</sup>We observe somewhat fewer than 52,600 ( $263 \times 200$ ) individual decisions and fewer than 6,838 ( $263 \times 26$ ) delegation decisions because of abstentions and absences.

<sup>7</sup>For example, consider a district with five seats held by members of three parties: A, B, and C. Party A has two legislators who vote along the party line. Party B also holds two seats; one member follows the party line while the other deviates. Party C has one member. The effective district size counts each party once and adds any legislators who vote independently of their party’s majority. This results in an effective district size of four. This reflects the fact that fewer independent political positions than available seats have been expressed.



*Notes:* Correlation between the number of seats and effective district size. Each point represents a district-referendum observation, with point size indicating the number of observations. Effective district size varies across referenda and districts, while the number of seats varies across cantons and legislative periods.

Figure 1: Correlation between the number of seats and the *effective district size (EDS)*

of parties is also positively associated with effective district size (see Appendix Figure B1). Appendix Figure B2 shows the distribution of observations by seats, effective district size, and the number of represented parties. Table B1 presents the distinct values of the three district size measures for each canton.

### 3.3 Empirical strategy and hypotheses

To assess whether the CJT aggregation mechanism applies to legislative decisions, we investigate how district size affects the probability that individual legislators, as well as the delegation of a district, represent the preferences of the majority of their constituents. Our outcome variables are individual congruence ( $Congruence^{(Ind)}$ ) and delegation congruence ( $Congruence^{(Del)}$ ), for which we estimate the following models:

$$Congruence_{dr,i}^{(Ind)} = \alpha + \beta^{(Ind)} DistrictSize_{dr} + \epsilon_{dr,i}, \quad (1)$$

$$Congruence_{dr}^{(Del)} = \gamma + \beta^{(Del)} DistrictSize_{dr} + \xi_{dr}, \quad (2)$$

where  $DistrictSize_{dr}$  is measured either by the number of seats, effective district size, or the

number of parties in a district. Following our theoretical considerations, we formulate the following hypotheses:

**H1.** *Individual congruence ( $Congruence^{(Ind)}$ ) decreases in district size such that  $\hat{\beta}^{(Ind)} < 0$ .*

**H2.** *Delegation congruence ( $Congruence^{(Del)}$ ) increases in district size such that  $\hat{\beta}^{(Del)} > 0$ .*

Using Generalized Additive Models (GAM), we explore how accurately the CJT predictions fit our data when using either the nominal or the effective district size. Considering that the effective district size more closely approximates the number of independent decision-makers, we expect the theoretical delegation congruence predicted by the CJT to be closer to the estimated delegation congruence when using the effective district size in Equation 2 rather than the nominal district size.

**H3.** *The estimated relationship between effective district size and delegation congruence corresponds more closely to the theoretical predictions of the CTJ than the estimated relationship between the number of seats and delegation congruence.*

## 4 Results

### 4.1 Empirical evidence for the CJT

Table 1 presents OLS estimates expressed in percentage points, relating individual congruence and delegation congruence to the number of seats (Panel A) and effective district size (Panel B). Consistent with Hypothesis H1, the results in Panel A indicate that congruence between individual legislators and the preferences of their constituents decreases as the number of seats increases. Specification (2) provides no evidence of a statistically significant nonlinear relationship. The initial (linear) negative effect remains robust when controlling for referendum fixed effects<sup>8</sup> in Specification (3). An additional seat in a district reduces individual congruence by approximately 0.068 percentage points.

In contrast, delegation congruence increases with district size, supporting Hypothesis H2. An additional seat is associated with a 0.453 percentage point increase in the probability that a district's delegation of legislators is congruent with its constituents' majority preference. As delegation congruence is predicted to follow the logic of the CJT (see Appendix A), we do not

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<sup>8</sup>Referendum fixed effects address potential issues arising from the heterogeneous nature of referenda. For example, different types of referenda may entail distinct strategic incentives for legislators and voters. Controlling for referendum fixed effects also alleviates concerns that differences in congruence reflect variation in referendum type, timing, or salience of topics.

Table 1: District size and individual and delegation congruence

	Individual Congruence			Delegation Congruence		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Panel A: District seats</b>						
Constant	66.940*** (0.384)	67.258*** (0.669)		70.666*** (0.760)	68.969*** (1.089)	
District seats	-0.069*** (0.020)	-0.121 (0.092)	-0.068*** (0.019)	0.453*** (0.062)	0.904*** (0.205)	0.458*** (0.053)
District seats <sup>2</sup>		0.001 (0.002)			-0.015** (0.006)	
Referendum FE			✓			✓
N	47,368	47,368	47,368	6,656	6,656	6,656
R <sup>2</sup>	0.0003	0.0003	0.122	0.007	0.008	0.277
<b>Panel B: Effective district size</b>						
Constant	68.500*** (0.566)	69.931*** (1.024)		68.121*** (1.064)	65.593*** (1.563)	
EDS	-0.446*** (0.088)	-0.947*** (0.315)	-0.377*** (0.086)	1.567*** (0.223)	3.009*** (0.664)	1.799*** (0.193)
EDS <sup>2</sup>		0.037* (0.023)			-0.149** (0.063)	
Referendum FE			✓			✓
N	47,368	47,368	47,368	6,656	6,656	6,656
R <sup>2</sup>	0.0005	0.0006	0.122	0.007	0.008	0.279

*Notes:* The table presents OLS estimates relating the probability of an individual legislator (Specifications (1) to (3)) and the majority of a district's legislators (Specifications (4) to (6)) voting as the majority of the electorate to the number of district seats in Panel A and the effective district size in Panel B. Coefficients expressed in percentage points. Robust standard errors in parentheses. \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ .

expect a strictly linear relationship. Specification (5) confirms this expectation: the relationship is positive but concave. Our results also do not change when employing referendum fixed effects.

Panel B shows qualitatively similar patterns for the effective district size. As effective district size increases, individual congruence decreases while delegation congruence increases. This is fully consistent with the CJT mechanism and with Hypotheses H1 and H2. Notably, the decline in individual congruence is more pronounced with effective district size than with district seats. The corresponding positive association with delegation congruence is also quantitatively stronger for the effective district size. Employing referendum fixed effects in specification (6) in Panel B shows that as effective district size increases by one unit, delegation congruence increases by approximately 1.8 percentage points.

The evidence presented so far is in line with our theoretical framework and the pattern predicted by our CJT-inspired aggregation mechanism: The likelihood that the delegation's decision aligns with the majority preference of its constituents increases with the number of independently deciding legislators in the district. Hence, congruence at the delegation level

correlates positively with effective district size,  $\hat{\beta}^{(Del)} > 0$ , and does so more strongly than with the number of seats.

The results remain robust when including canton fixed effects<sup>9</sup>, weighting observations by the inverse number of parties represented in a canton, estimating logit models, or using the number of represented parties as the explanatory variable (see Tables B2, B3, B4, and B5 in the appendix).

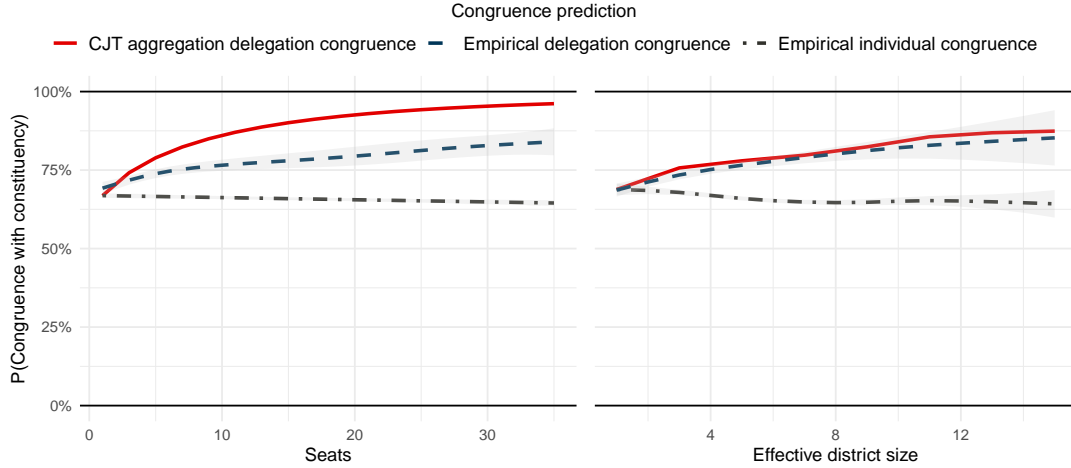
## 4.2 Assessing the accuracy of CJT predictions

We estimate a generalized additive model (GAM) with a binomial family and a logit link function to explore nonlinearities in the relationship between district size and congruence. The results in Figure 2 provide additional support for Hypotheses H1 and H2. The dashdotted grey line shows that empirically predicted individual congruence decreases as either the number of seats or the effective district size increases. In contrast, the dashed blue line shows that empirically predicted delegation congruence increases with both the number of seats and effective district size in line with the CJT.

To assess Hypothesis H3, we compare the delegation congruence we would expect if political representation followed the CJT’s aggregation mechanism with our empirical estimations. Mathematical details are provided in Appendix A. We use the predicted individual congruence ( $\hat{p}_n$ ) from the generalized additive model to compute the theoretical probability ( $P_n$ ), as implied by the Condorcet Jury Theorem (CJT), that a majority of legislators in a district of (effective) size  $n$  agrees with the constituency majority. We plot the results in Figure 2 as the solid red line for the number of seats (left) and the effective district size (right).

The left panel of Figure 2 shows that when using the number of seats as the explanatory variable, the CJT largely mispredicts the empirically predicted delegation congruence. The dashed blue line and the solid red line do not overlap. The root mean squared error (RMSE) between the CJT and empirical predictions for delegation congruence in our data is 10.97 percentage points. In contrast, when we use effective district size, the theoretical predictions of the CJT align closely with our empirical findings (RMSE 1.89 percentage points). The right panel of Figure 2 shows that the solid red line closely follows the dashed blue line.

<sup>9</sup>The variation in the number of seats within the cantons is limited because of similar population trends across cantons. Although the effective district size varies with each referendum, the variation within the cantons is also limited (see Table B1). Thus, while the results with district fixed effects are statistically robust, identification relies on a relatively small number of cantonal observations.



*Notes:* The figure plots predicted congruence between legislators and their constituencies as a function of the number of district seats (left panel) and effective district size (right panel). The solid red line shows theoretical delegation congruence based on the Condorcet Jury Theorem (CJT) aggregation mechanism. The dashed blue line shows predicted delegation congruence from generalized additive models. The dashdotted grey line shows predicted individual congruence from generalized additive models. Shaded areas represent 90% confidence intervals for the empirical estimates. Table B6 in the appendix presents formal results.

Figure 2: Comparing congruence predictions: CJT aggregation mechanism vs. empirical models

These results support Hypothesis H3: The CJT accurately characterizes the empirically predicted delegation congruence when accounting for the number of independent decision-makers, which is captured more closely by the effective district size than by the number of seats.<sup>10</sup> We illustrate this with a concrete example: For 9 *seats*, the empirically predicted delegation congruence is 8.78 percentage points below the delegation congruence predicted by the CJT aggregation mechanism (76.19%–84.97%). For an *effective district size* of 9, however, the empirically predicted delegation congruence is only 1.20 percentage points below the delegation congruence predicted by the CJT aggregation mechanism (81.19%–82.40%).<sup>11</sup> The close correspondence between the theoretical predictions of the CJT aggregation mechanism and our empirical results based on effective district size is particularly noteworthy, as effective district size likely understates the true number of independent individual decisions.

<sup>10</sup>Results remain qualitatively robust when using the number of parties in a district as the explanatory variable (see Figure B3, and Table B6 in the appendix). The RMSE between the CJT prediction and the observed data for the number of parties is 0.82 percentage points.

<sup>11</sup>The CJT aggregation mechanism yields different delegation congruence predictions for the two district size measures because each measure implies a different level of individual congruence (see Table 1).

### 4.3 Discussion: CJT, correctness, and congruence

The evidence presented in this paper shows that congruence between a district’s legislative delegation and the preferences of the majority of its constituents increases with (effective) district size, consistent with a mechanism inspired by CJT.

In its classical form, the CJT is an epistemic result about reaching the correct state of the world and does not directly apply to political choices (Black, 1958).<sup>12</sup> Our outcome of interest is the congruence between a constituency’s majority preference (as revealed in a referendum) and its legislators’ majority position. *Correctness* and *congruence* are conceptually distinct. Typically, there is no independent way to determine what a *correct* policy choice would be. Neither our CJT-inspired aggregation perspective nor our empirical results suggests that legislative decisions yield an objectively correct policy. Rather, we draw on the underlying logic of the CJT. When multiple, at least partially independent signals are combined, and each is more likely than not to point toward a target state, the probability that the collective decision matches that target increases with the number of signals. In our setting, the target is the constituency’s majority preference on a binary proposition revealed in a referendum. The decisions of (independent) legislators serve as signals. Although the goals differ (correctness versus congruence), the probabilistic mechanism of improvement through aggregation remains the same.

Neither delegations nor individual legislators need to aim to represent the majority of their constituents. Legislators can vote according to party programs, ideology, or other strategies. However, as long as each legislator has a probability greater than 0.5<sup>13</sup> to vote in line with the majority of their constituents, increasing the number of legislators per district increases the likelihood that the delegation’s collective decision aligns with the majority of their constituents. This provides a probabilistic foundation for the overall representativeness of the delegation’s decision, irrespective of the idiosyncratic aims and behaviors of individual legislators.

It is important to note that the CJT’s independence condition is statistical, not behavioral. Deviating from one’s party is neither necessary nor sufficient for independence. Rather, it is one observable channel through which correlation among signals is reduced. Accordingly, we use effective district size as a descriptive proxy for the number of quasi-independent signals

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<sup>12</sup>In its original formulation, the Jury Theorem assesses the probability that a majority in a jury is correct.

<sup>13</sup>Among all legislators with at least ten roll-call votes, 11.26% had a probability below 0.5 of voting with the constituency majority.

within a delegation, acknowledging that party discipline and shared information induce correlation. Using effective district size, the empirical results regarding congruence closely follow the theoretical expectations of the CJT under independence.

Finally, our findings do not imply that larger nominal district sizes automatically improve representation. Rather, they suggest that congruence between legislative delegations and their constituents' preferences increases when the effective district size grows—potentially because there are more parties, party blocs are more fragmented, and legislators occasionally dissent from their party. The Swiss case is particularly well-suited to test this logic, as roll-call votes and referendum outcomes on identical propositions provide an unusually sharp benchmark for congruence. Still, our claims are bound to systems where (i) electoral districts are multimember, (ii) some independence exists within delegations, and (iii) the target is the majority preference of a well-defined constituency.

## 5 Conclusion

We examine whether the Condorcet Jury Theorem (CJT) applies to parliamentary decision-making in representative democracies. We provide empirical evidence for the core predictions of the CJT by exploiting Switzerland's institutional setting, which allows for a precise comparison between legislators' decisions and their constituents' revealed preferences on identical policy issues. We find that the congruence between a district's legislative delegation and the preferences of the majority of its constituents increases with (effective) district size, consistent with the mechanism of the theorem.

Our analysis reveals important limitations that constrain the practical relevance of the CJT in representative democracies. The effective district size, which reflects the number of legislators making independent decisions, is often substantially smaller than the number of seats because of party discipline. This reduces the representational gains that the CJT predicts for larger districts. At the same time, our findings reveal a positive effect of defection from party lines: When legislators defect from party lines, they contribute to enhancing the congruence of the majority of the delegation with their constituents' preferences.

Quantitatively, we observe diminishing returns in delegation congruence once the effective district size exceeds approximately eight, as the incentives of individual legislators to be congruent with the preferences of their constituents decrease as district size increases. A potential

interpretation of this finding to be explored in future research aligns with the notion of a sweet spot in district size (Carey and Hix, 2011, 2013), suggesting that there is a threshold beyond which additional representatives yield limited improvements to the quality of representation.

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# Online appendix for

## Party Discipline, Representation, and the Condorcet Jury Theorem

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### Appendix A: CJT benchmark comparison

To evaluate how closely the congruence between a majority of a district’s legislative delegation and the preferences of its constituency aligns with theoretical expectations, we use the Condorcet Jury Theorem (CJT) as a benchmark. According to the CJT, if each legislator independently votes in line with the majority preference of their constituents with probability  $p$  (individual congruence), then the probability that a majority of legislators in the district, denoted as  $P_n$  (see fn. 2), reflects those preferences (delegation congruence) increases with the size of the decision-making group, provided  $p > 0.5$ .

To derive a theoretical benchmark for delegation congruence, we first estimate individual congruence  $\hat{p}(n)$  as a function of district size  $n$ , based on the generalized additive model. As district size increases, predicted individual congruence  $\hat{p}(n)$  declines. We then insert these estimates into the CJT formula to compute the theoretical probability  $P_n(\hat{p}(n))$  that a majority of the delegation of size  $n$  votes in alignment with the constituency.

This yields the following expression, which defines the solid red lines labeled as the theoretical CJT benchmark in Figure 2:

$$P_n(\hat{p}(n)) = \sum_{k=\lfloor n/2 \rfloor + 1}^n \binom{n}{k} \hat{p}(n)^k (1 - \hat{p}(n))^{n-k} \quad (3)$$

where  $n$  is the number of seats or effective district size and  $k$  is the number of legislators required for a simple majority.  $P_n(\hat{p}(n))$  thus gives the probability that a majority of legislators vote in accordance with their constituency’s preference, under the assumption of independent voting behavior and by taking into account that the individual congruence decreases with district size. Thus, the solid red line in Figure 2 represents the CJT-based theoretical benchmark for delegation congruence.

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## Appendix B: Further tables and figures

Table B1: Distinct district size measure values per canton

Canton	District seat values	Sum	EDS values	Sum	# of parties values	Sum
AG	14, 15, 16	3	3, 4, 5, 6, 7, 8, 9, 10	8	3, 4, 5, 6, 7, 8	6
AI	1	1	1	1	1	1
AR	1, 2	2	1, 2	2	1, 2	2
BE	24, 25, 26, 27, 29	5	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14	11	4, 5, 6, 7, 8, 9, 10, 11	8
BL	7	1	2, 3, 4, 5, 6	5	2, 3, 4, 5, 6	5
BS	5, 6	2	1, 2, 3, 4, 5, 6	6	1, 2, 3, 4, 5	5
FR	6, 7	2	2, 3, 4, 5, 6	5	2, 3, 4, 5	4
GE	11, 12	2	1, 3, 4, 5, 6, 7, 8	7	1, 3, 4, 5, 6, 7	6
GL	1	1	1	1	1	1
GR	5	1	2, 3, 4, 5	4	2, 3, 4, 5	4
JU	2	1	1, 2	2	1, 2	2
LU	9, 10	2	3, 4, 5, 6, 7, 8	6	3, 4, 5, 6	4
NE	4, 5	2	1, 2, 3, 4, 5	5	1, 2, 3, 4, 5	5
NW	1	1	1	1	1	1
OW	1	1	1	1	1	1
SG	12	1	3, 4, 5, 6, 7, 8, 9	7	3, 4, 5, 6	4
SH	2	1	1, 2	2	1, 2	2
SO	6, 7	2	2, 3, 4, 5, 6, 7	6	2, 3, 4, 5	4
SZ	3, 4	2	1, 2, 3, 4	4	1, 2, 3, 4	4
TG	6	1	2, 3, 4, 5, 6	5	2, 3, 4, 5	4
TI	8	1	2, 3, 4, 5, 6, 7	6	2, 3, 4, 5, 6	5
UR	1	1	1	1	1	1
VD	17, 18, 19	3	3, 4, 5, 6, 7, 8, 9	7	3, 4, 5, 6, 7	5
VS	7, 8	2	2, 3, 4, 5, 6, 7	6	2, 3, 4, 5, 6	5
ZG	2, 3	2	1, 2, 3	3	1, 2, 3	3
ZH	34, 35	2	4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17	14	4, 5, 6, 7, 8, 9, 10, 11, 12, 13	10
Total		45		126		102

*Notes:* The table presents the distinct values of three district size measures per canton over the whole period of analysis. The column *Sum* indicates the number of changes in the district size measure per canton.

Table B2: District size and individual and delegation congruence -  
District fixed effects

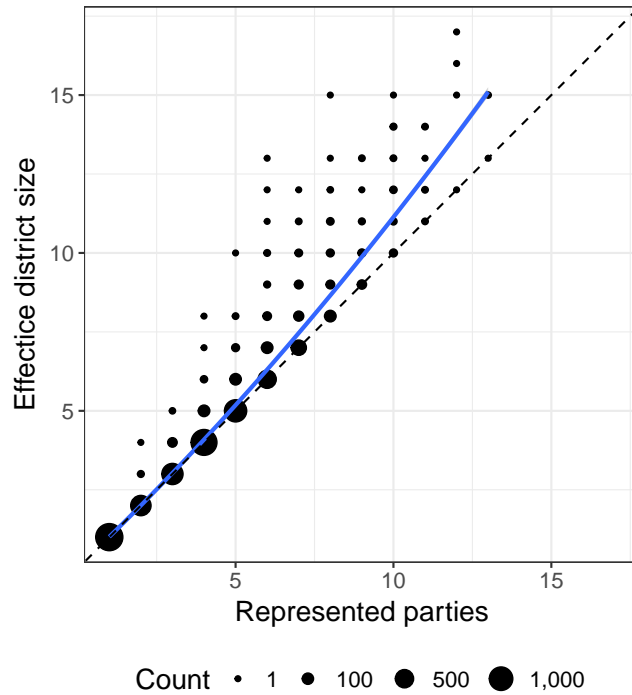
	Individual Congruence	Delegation Congruence
	(1)	(2)
<b>Panel A: District seats</b>		
District seats	0.640* (0.346)	0.701 (1.07)
Referendum FE	✓	✓
Canton FE	✓	✓
N	47,368	6,656
R <sup>2</sup>	0.12347	0.28707
<b>Panel B: Effective district size</b>		
District seats	-0.346* (0.187)	1.196** (0.559)
Referendum FE	✓	✓
Canton FE	✓	✓
N	47,368	6,656
R <sup>2</sup>	0.12347	0.28753
<b>Panel C: Number of parties</b>		
District seats	-0.256 (0.234)	1.45** (0.660)
Referendum FE	✓	✓
Canton FE	✓	✓
N	47,368	6,656
R <sup>2</sup>	0.12342	0.28754

*Notes:* The table presents OLS estimates relating the probability of an individual legislator (1) and the majority of a district's legislators (2) voting as the majority of the electorate to the number of district seats (Panel A), the effective district size (Panel B), and the number of parties per canton (Panel C). Estimation coefficients in percentage point scale. Robust standard errors in parentheses. \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ .

Table B3: District size and individual and delegation congruence - Weighted results

	Individual Congruence			Delegation Congruence		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	68.76*** (0.7371)	69.26*** (1.249)		66.66*** (1.269)	64.90*** (1.742)	
EDS	-0.5112*** (0.1171)	-0.7484* (0.3964)	-0.3443*** (0.1073)	1.884*** (0.2806)	3.353*** (0.7767)	2.113*** (0.2311)
EDS <sup>2</sup>		0.0218 (0.0286)			-0.1880** (0.0736)	
Referendum FE			✓			✓
N	47,368	47,368	47,368	6,656	6,656	6,656
R <sup>2</sup>	0.00076	0.00078	0.13849	0.00656	0.00711	0.31112

Notes: The table presents OLS estimates relating the probability of an individual legislator (Specifications (1) to (3)) and the majority of a district's legislators (Specifications (4) to (6)) voting as the majority of the electorate to the effective district size. The observations are weighted by the inverse of the number of parties represented in a canton in a given vote. Estimation coefficients in percentage point scale. Robust standard errors in parentheses. \*\*\*  $p < 0.01$ ; \*\*  $p < 0.05$ ; \*  $p < 0.1$ .



Notes: Correlation between the number of parties represented in a district and effective district size. Each point represents a district-referendum observation, with point size indicating the number of observations. Both the number of parties represented in a district and effective district size may vary across referenda and districts.

Figure B1: Correlation between represented parties and the effective district size

Table B4: District size and individual and delegation congruence - Logit results

	Individual Congruence			Delegation Congruence		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>Panel A: District seats</b>						
Constant	0.705*** (0.017)	0.720*** (0.030)		0.861*** (0.040)	0.790*** (0.054)	
District seats	-0.003*** (0.0009)	-0.005 (0.004)	-0.003*** (0.001)	0.026*** (0.004)	0.046*** (0.011)	0.036*** (0.005)
District seats <sup>2</sup>		6.2 × 10 <sup>-5</sup> (0.0001)			-0.0007* (0.0004)	
Referendum FE			✓			✓
N	47,368	47,368	45,980	6,656	6,656	5,676
R <sup>2</sup>	0.0002	0.0002	0.091	0.006	0.007	0.192
<b>Panel B: Effective district size</b>						
Constant	0.774*** (0.025)	0.841*** (0.047)		0.733*** (0.055)	0.626*** (0.076)	
EDS	-0.020*** (0.004)	-0.043*** (0.014)	-0.019*** (0.004)	0.086*** (0.013)	0.151*** (0.035)	0.130*** (0.015)
EDS <sup>2</sup>		0.002* (0.001)			-0.007** (0.004)	
Referendum FE			✓			✓
N	47,368	47,368	45,980	6,656	6,656	5,676
R <sup>2</sup>	0.0004	0.0005	0.091	0.007	0.007	0.217
<b>Panel C: Represented parties</b>						
Constant	0.748*** (0.028)	0.851*** (0.054)		0.677*** (0.056)	0.636*** (0.085)	
No. of parties	-0.016*** (0.005)	-0.058*** (0.019)	-0.021*** (0.005)	0.105*** (0.014)	0.133*** (0.045)	0.148*** (0.016)
No. of parties <sup>2</sup>		0.004** (0.002)			-0.004 (0.005)	
Referendum FE			✓			✓
N	47,368	47,368	45,980	6,656	6,656	5,676
R <sup>2</sup>	0.0002	0.0003	0.091	0.008	0.008	0.195

*Notes:* The table presents logit estimates relating the probability of an individual legislator (Specifications (1) to (3)) and the majority of a district's legislators (Specifications (4) to (6)) voting as the majority of the electorate to the number of district seats in Panel A, the effective district size in Panel B, and the number of represented parties in the district in Panel C. Robust standard errors in parentheses. \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ .

Table B5: Number of represented parties and individual and delegation congruence

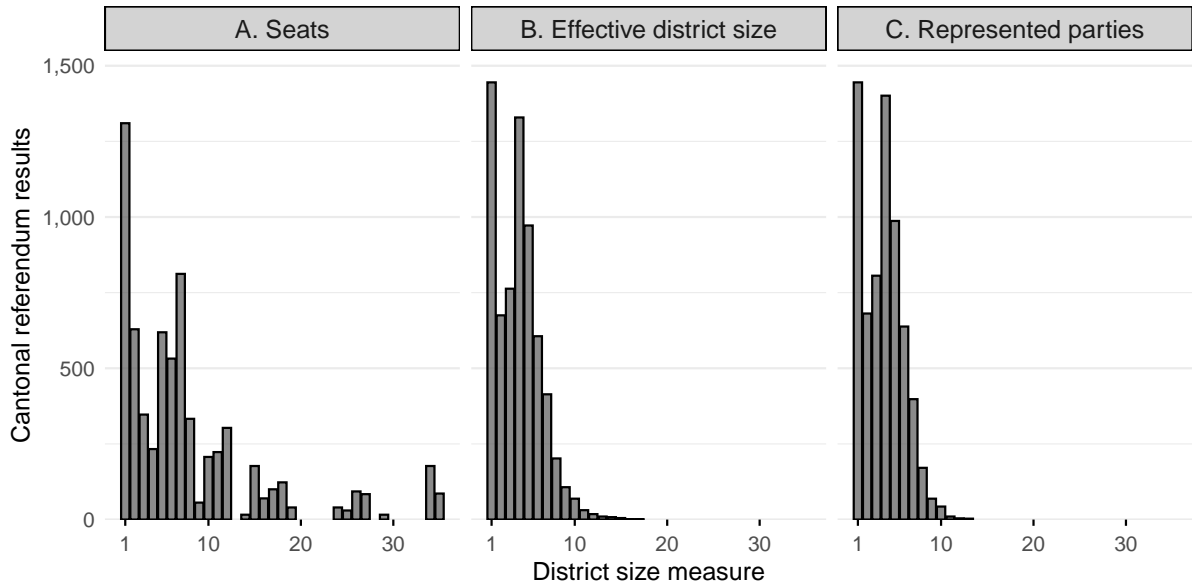
	Individual Congruence			Delegation Congruence		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	67.894*** (0.6268)	70.163*** (1.183)		66.973*** (1.113)	65.542*** (1.704)	
No. of parties	-0.367*** (0.106)	-1.273*** (0.416)	-0.413*** (0.101)	1.934*** (0.245)	2.848*** (0.818)	1.999*** (0.212)
No. of parties <sup>2</sup>		0.079** (0.035)			-0.107 (0.088)	
Referendum FE			✓			✓
N	47,356	47,356	47,356	6,656	6,656	6,656
R <sup>2</sup>	0.0003	0.0004	0.122	0.009	0.009	0.280

Notes: The table presents OLS estimates relating the probability of an individual legislator (Specifications (1) to (3)) and the majority of a district's legislators (Specifications (4) to (6)) voting as the majority of the electorate to the number of parties represented. Coefficients in percentage point scale. Robust standard errors in parentheses. \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ .

Table B6: District size and individual and delegation congruence - Formal GAM results

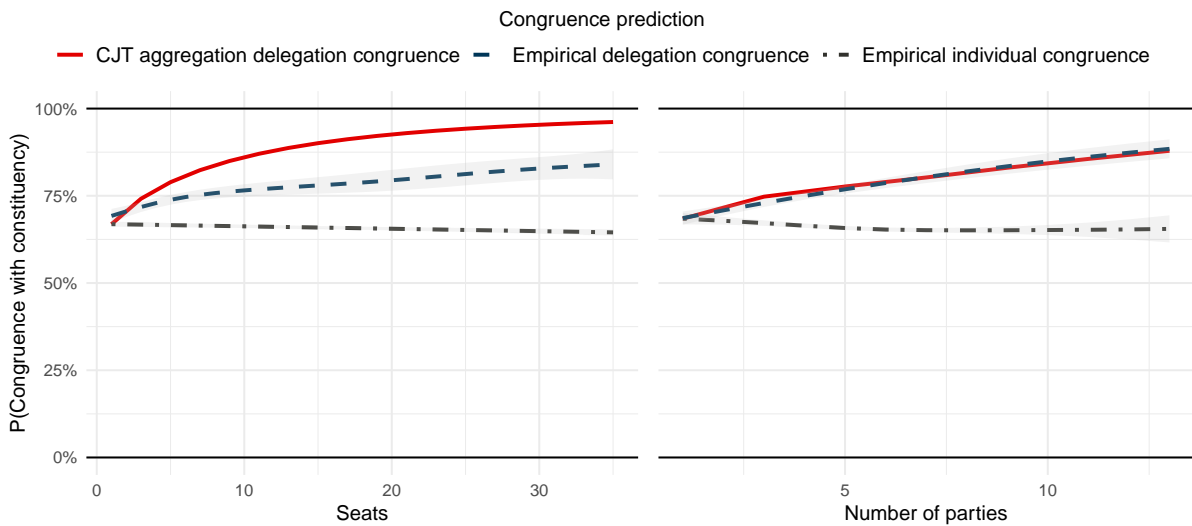
	Individual Congruence			Delegation Congruence		
	(1)	(2)	(3)	(4)	(5)	(6)
<b>A. Parametric coefficients</b>						
Intercept	0.657*** (0.010)	0.658*** (0.010)	0.657*** (0.010)	0.807*** (0.027)	0.809*** (0.027)	0.810*** (0.027)
<b>B. Smooth terms</b>						
EDF: s(seats)	1.022*** (1.045)			7.015*** (7.887)		
EDF: s(EDS)		3.614*** (4.503)			7.685*** (8.346)	
EDF: s(parties)			2.468** (3.146)			7.329*** (8.032)
N	47,368	47,309	47,368	6,656	6,654	6,656

Notes: Family: binomial; Link function: logit; \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ .



Notes: Number of observed district-referendum pairs on the y-axis by the number of seats (A), the effective district size (B), and the number of represented parties (C) per canton on the x-axis.

Figure B2: Observed district-referendum pairs per district size measure



Notes: The figure plots predicted congruence between legislators and their constituencies as a function of the number of district seats (left panel) and the number of represented parties (right panel). The solid red line shows theoretical delegation congruence based on the Condorcet Jury Theorem (CJT) aggregation mechanism. The dashed blue line shows predicted delegation congruence from generalized additive models. The dashdotted grey line shows predicted individual congruence from generalized additive models. Shaded areas represent 90% confidence intervals for the empirical estimates.

Figure B3: Comparing congruence predictions: CJT aggregation mechanism vs. empirical models