Party System Fragmentation and Electoral Accountability

Christian Salas

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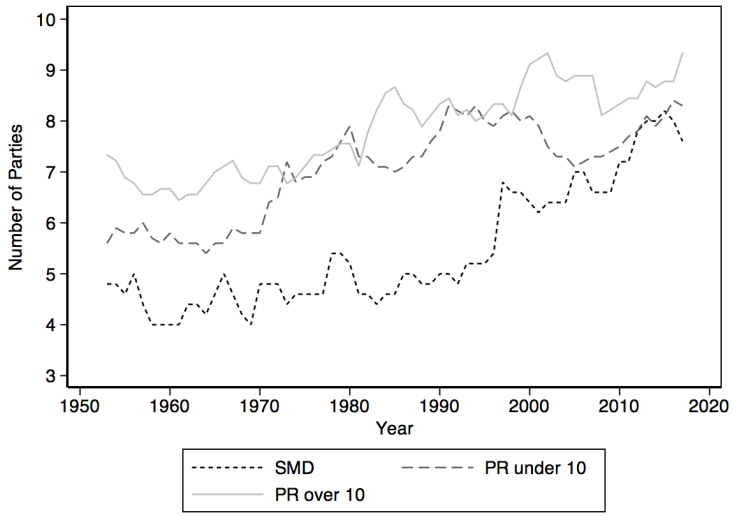
Abstract

More parties in legislature, coined *Party System Fragmentation*, is believed to decrease the ability of voters to hold their representatives accountable. This paper provides a formal model that claims this relationship to be non-monotone. Voters obtain information about their representative's quality from publicly observed policy outcomes, information that is *distorted* within parliament as well as within parties. The more pivotal a party is, the less *distorted* information about that party in parliament, the more legislators a party has, the more *distorted* information about each representative. Fragmentation changes both dimensions in competing directions changing the degree to which a voter can learn about her representative, and thus her capacity to hold her accountable, in a non-monotone manner. Simulating the model in 620 Parliaments of OECD democracies, I provide a measure of the degree to which a representative should be held accountable. Using party-level variation in this degree to produce *differences-in-differences* estimates, I find that doubling unemployment decreases 4 percent the intention to vote for parties about which voters can learn the most according to the model, compared to when nothing can be learned. Among majority parties, where pivotality is held constant, smaller parties are held more accountable.

1 Introduction

The number of parties represented in Parliament has been increasing in developed democracies. Figure 1 shows that the average number of parties elected to Parliament in OECD countries has increased by an outstanding 40% in the past decades, in aggregate as well as across electoral systems. Some scholars have argued that, while it can improve representation by enriching the supply of political alternatives, party system fragmentation decreases electoral accountability by making it more difficult for voters to attribute credit or blame for policy outcomes. Carefully examining these claims is important to understand the effect of recent trends, and can also prove crucial for electoral reform. Carey and Hix (2011) proposed an electoral system with district magnitude in a range of 3 to 8 intended to optimally balance representation and accountability. Partly inspired on this work, in 2015 Chile changed its electoral system from one having 60 districts

Figure 1: Party System Fragmentation in the OECD, 1953-2017.



Note. Plotted the average number of parties in Parliament (or lower house, if two exist) for the period 1953-2017 in 25 OECD democracies (only countries that were democratic for the whole period are included, to avoid compositional effects) grouped by district-magnitude. *SMD* refers to countries that had Single-Member Districts (most of the period): Australia, Canada, France, UK and USA. *PR under 10* and *PR over 10* refer to non-SMD countries with (average in time period) district magnitude below and above 10 respectively: Austria, Belgium, Denmark, Greece, Iceland, Ireland, Japan, Norway, Switzerland and Turkey in the first case; Finland, Germany, Israel, Italy, Luxembourg, Mexico, Netherlands, New Zealand and Sweden in the second.

of magnitude 2 to one having 28 districts of magnitude varying from 3 to 8. This change doubled the number of parties from a stable three-decade average of 8 parties to 16 in 2017, and that of pre-election coalitions from 3 to 6. In order to contribute to our understanding of the consequences of party system fragmentation, in this paper I take a close look at the ways in which fragmentation affect the ability of voters to hold their representatives accountable.

The effect of party system fragmentation on electoral accountability has been studied in the "*clarity of responsibility*" literature, which starting with Powell Jr and Whitten (1993) has sought to understand which political institutions allow voters to most accurately assign credit or blame to representatives for policy outcomes. Four effects of party system fragmentation have been previously discussed. Whitten and Palmer (1999) argue that, since more parties have greater difficulty agreeing on policy, they focus on non-partisan issues like economic growth. Voters, the argument goes, should only hold fragmented incumbents accountable for growth, the more so the more fragmented. Anderson (2000) claims that, by decreasing the size of parties, fragmentation makes parties harder targets to hold responsible. A related argument is that party system fragmentation, by decreasing the size of the biggest party, may decrease the likelihood that a single-party majority government is formed, the most accountable form of government according to Powell Jr (2000). Anderson (2000), Nadeau, Niemi and Yoshinaka (2002) and Bengtsson (2004) argue that party system fragmentation decreases accountability because it increases the number of alternatives, which makes it harder

for voters to learn about the multiple choices or to coordinate around one viable alternative, thus increasing the uncertainty regarding a future government's performance if the current incumbents are replaced.

While appealing at first sight, these explanations are unsatisfactory because they do not carefully consider a voter's rational updating of beliefs. For example, while still holding a majority, a larger seat share may diffuse information about individual representatives. A party that loses the majority may become less accountable, but this does not mean that further fragmentation will necessarily decrease accountability. A coalition that puts less effort on growth and achieves equal results as one that put more should be rewarded more, because higher valence must have been necessary. On the other hand, regardless of the number of other parties, a voter still holds prior beliefs about them all, and thus can evaluate them. Furthermore, if he learns at least about his representative, the fact that it is difficult to collect additional information about others should not prevent him from replacing his representative with a challenger. Finally, if voters can learn about the performance of every party, they could in principle coordinate around a best alternative.

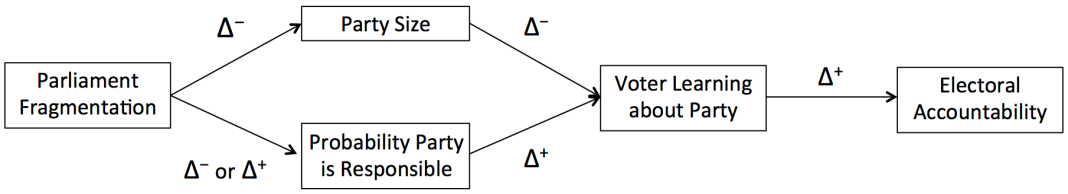
In this paper, I provide an answer that carefully considers the complexity of voter learning. To do so, I first construct a formal model of *voter learning* in multi-member offices. Consider a voter (*he*) attempting to evaluate his representative (*she*) solely based on an observable outcome. He understands that the outcome is the consequence of the Parliament's policy choice, and that Parliament passes policy by voting using majority rule. Voters have no ideology, and solely care about their welfare. Parties are defined as a collective of legislators that share information among themselves, therefore it is commonly understood that in equilibrium a party votes in unison. Given this, the voter knows that his representative's party will be more likely to vote for the policy that benefits him most the higher the valence of his representative and her co-partisans. Thus, the objective of the voter's evaluation is to select the best politician to represent him.

In its simplest form, party system fragmentation changes the number of representatives each party elects to Parliament. This has two effects, summarized in Figure 2. First, each party will have fewer or equal number of representatives. Since each member contributes to their party's deliberation, a voter will have an easier time evaluating his representative if she belongs to a smaller party. Intuitively, if the representative is the sole member of her party, the responsibility for a bad outcome is all hers, whereas if the party has three members there is a chance that his representative argued for the right policy but her two co-partisans pushed in the opposite direction.[1] Party system fragmentation, in this case, enhances voter learning and thus accountability.

However, the voter understands that Parliament may have passed the policy responsible for his current wellbeing without the support of his representative's party. That is, if the voter is doing worst off, he understands that it may not have been his representative's party's fault. This is

[1]Formally, the signal regarding an individual representative's valence produced by a party's decision is noisier the more party members. A full development of this idea can be found in the theory section.

Figure 2: Effect of Party System Fragmentation on Electoral Accountability



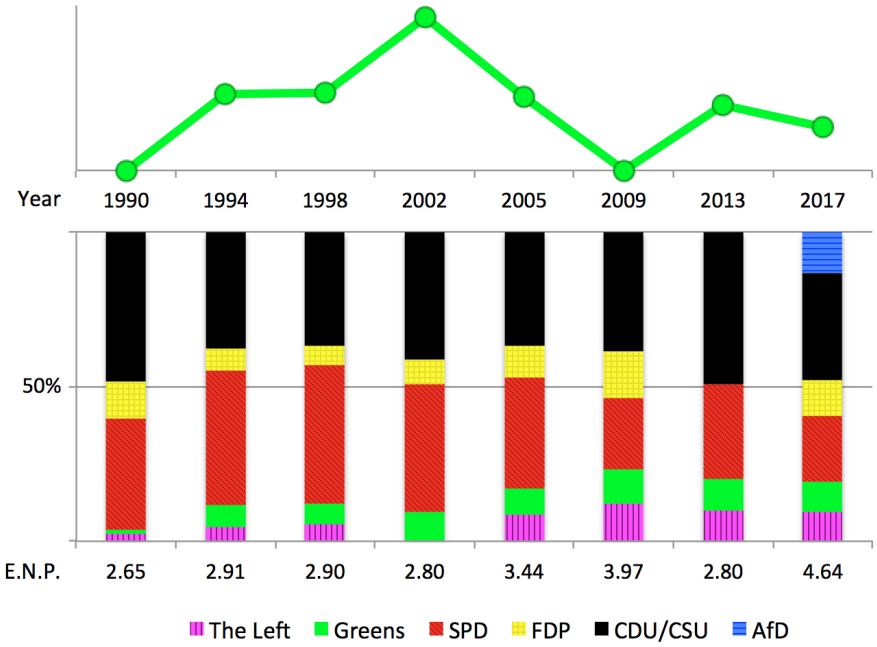
where the second effect plays a role. To assign responsibility, the voter must evaluate the likelihood that his representative's party in fact participated in the *ex-post wrong* (or *right*) decision. Party system fragmentation affects this likelihood by changing the size and quantity of all parties, and changing the propensity that a party is responsible for decision-making. This second effect is better illustrated with an example.

Consider the *Alliance 90/The Greens* Party in Germany since 1990. Figure 3 plots in the bottom panel the seat breakdown by party in Germany's federal Parliament, the *Bundestag*, and in the top panel the prediction that the model, taking into consideration the two channels discussed above, makes regarding how much a voter could have learnt about The Greens in each Parliament, and thus how accountable they should have been for observable outcomes.

When The Greens held only 8 of 662 seats of the Bundestag elected in 1990, the model predicts that voters could hardly learn anything about their valence. This is because, however easy to learn about individual representatives in a small party, The Greens had so few seats that it was highly unlikely that any policy outcome would have been different had The Greens wished it so. In fact, it was the case that coalescing with no other party would have allowed them to reach 50% of the votes, and not even a 3-party coalition among left parties (i.e. them, The Left (then *PDS*) and the SPD) would have gotten them there. Therefore, the model predicts that policy outcomes would have provided very little information, if anything, about the valence of The Greens' representatives.

A more striking example comes from comparing the 2002 and 2009 Parliaments. In 2002, The Greens obtained 9.1% of the seats (55) in the Bundestag, while in 2009 they obtained 10.9% (68). Despite holding a similar share of seats, the model predicts the The Greens were highly accountable in the period 2002-2005 and almost not at all in 2009-2013. This is because in 2002 The Greens were the pivotal party: they had just enough votes to pass law with either the SPD (who held 41.6%) or the CDU/CSU (who held 41.1%). If The Greens sought a formal coalition—which they did—this gave them great power at the coalition negotiation stage, if not—resulting in either a less rigid coalition arrangement or a minority government, giving them freedom to vote with any other party—they held the keys to policy-making. Despite holding slightly more seats in 2009-2013, The Greens had almost no power. They could not reach a majority with either big party. Furthermore, another *small* party, the FDP, had enough votes to reach 50% with the CDU/CSU. Finally, and

Figure 3: Example: Alliance 90/The Greens Party, Germany, 1990-2017



Note. Top panel plots the model's predicted *voter learning* for The Greens party, using $\pi = 0.06$ as prior belief. Bottom panel the seat share of each party in Germany's federal Parliament. E.N.P. indicates the *effective number of parties* of each Parliament.

just as in 1990, The Greens would not have reached 50% even in a 3-party coalition with The Left and the SPD. This is why, despite having a higher seat share than in 2002, The Greens were almost as accountable as they were in 1990.[2]

Finally notice that, just as seat share did not explain The Greens accountability, neither did party system fragmentation in Parliament. Consider the elections of 2002 and 2013, when the resultant Parliament fragmentation was identical: 4 parties or 2.80 *effective number of parties*.[3] Despite The Greens having achieved very similar seat share—9.1% of the seats (55) in 2002 and 10% of the seats (63) in 2013—the model predicts them to be significantly more accountable in 2002 than in 2013. This is because while in 2002 The Greens was the pivotal party for policy-making, in 2013 the biggest party, CDU/CSU, could reach 50% with any of three parties, only one of which was The Greens.

In addition to offering a substantive explanation of the effect that party system fragmentation has on electoral accountability, this paper makes two methodological contributions. On the one

[2]The idea that the *pivotality* of a party or legislator gives her power has been discussed in the literature of coalition government (Laver and Schofield 1998; Laver and Benoit 2015). See the Literature Review section below for more discussion.

[3]Effective number of parties $= \frac{1}{\sum_i (s_i)^2}$, where s_i is the share of seats held by party i. See Laakso and Taagepera (1979).

hand, it builds a *clarity of responsibility* index founded on rational choice theory. It does so by solving the model in 620 OECD Parliaments elected from 1945 to 2015 and simulating the *degree to which a voter should learn about* each of 4141 party-election tuples. This also means that this paper provides a *clarity of responsibility* measure for *all* parties in Parliament—not only governing parties. Furthermore, this paper provides an algorithm that can be used to calculate this index for future elections or any other country. This is important not only to explore the effect of learning in other contexts, but because it will allow scholars to use this framework as the basis to study the effect of more complex political institutions suspected to affect *economic vote*, such as separation of powers, distribution of veto powers, and the varieties of government type, all which this paper has deliberately ignored to present a simple and transparent baseline model of voter learning.

Second, this paper provides a very robust test for the *clarity of responsibility* hypothesis. Most previous tests have relied on cross-sectional or within-country panel variation, which among others requires comparing elected Parliaments that may differ for a number of unobservable factors. The measure of *clarity of responsibility* provided in this paper allows me to exploit within-party variation which, using at least two parties per election, partially solves this endogeneity issue. In addition, I use only observations where two consecutive elections were scheduled ahead of time, that is, not called before the end of the term. This allows me to use the arbitrary timing of scheduled elections, minimizing strategic anticipation of electoral accountability, to estimate differences-in-differences estimates. The simulated *responsibility* variable significantly explains the correlation between unemployment and vote across samples and specifications. Estimates show that a doubling in unemployment decreases in 4 percent—12 percent in non-majority Parliaments—the next election's vote share of parties that voters hold the most responsible compared to when no responsibility can be assigned. Party system fragmentation, as measured by either the number parties or the *effective number of parties*, has an insignificant linear effect on the correlation between unemployment and vote, as expected. Rather, fragmentation appears to increase and decrease accountability when the model predicts it should. For example, majority parties that have a smaller seat share appear to be more accountable: after a doubling in unemployment, majority parties with 10 percent less seat share are punished an additional 8 percent of vote share in the next election.

This paper is organized as follows. In the next section I review some of the past research that has made this paper possible. In section 2 I present the model and put forward testable propositions. In section 3 I describe the data and research design used to test the propositions, and present the results. In section 4 I provide discussion and conclude.

1.1 Literature Review

This paper has benefited from the following branches of the literature in political science and economics: (i) the literature on *clarity of responsibility*, (ii) the formal literature on electoral

accountability, (iii) the study of strategic voting in committees and (iv) the study of distribution of power in multiparty governments.

By the beginning of the nineties, scholars had found evidence that economic voting—the effect the economy has on vote choice—was often inconsistent across countries (Lewis-Beck 1988; Paldam 1991). In a seminal article, Powell Jr and Whitten (1993) argued that cross-national differences in economic voting could be explained by the ease with which voters could identify who had been responsible for the economic outcome, which they called *clarity of responsibility*. They argued that in systems with lack of party cohesiveness, a participatory committee system in the legislature, bicameral opposition, and either minority or coalition government, formally "governing" parties would be less rewarded or penalized for incumbency. Using these political features they classified 19 industrialized democracies in two categories, where responsibility is more and less clear, and found evidence that political institutions indeed matter for economic vote.[4]

Using both official voting records as well as survey data, several subsequent papers have extended this work. Powell Jr and Whitten (1993)'s classification is perfected by Whitten and Palmer (1999) to include variation across countries over time and, extending the sample of elections, provide evidence further supporting the original findings. Powell Jr (2000) argues that the most important determinant of clarity is whether the government is formed by a single-party majority. Anderson (2000) highlights the importance of available alternatives for voters to have the incentive to punish incumbents. Nadeau, Niemi and Yoshinaka (2002) use a cross-national survey that allows them to incorporate individual-level characteristics to complement previous indices. Bengtsson (2004) introduces two new features that may affect clarity, the stability of government and the volatility of voter turnout, and shows that the inclusion of these strengthens the effect of economic voting. Duch and Stevenson (2006) provide survey evidence that voters respond to economic perceptions by switching their support among parties. Hobolt, Tilley and Banducci (2013) separate the clarity index into two, institutional rules and government cohesion, to show that only government cohesion influences the voters' ability to hold representatives accountable.

A political institution that has received special attention is separation of powers. It has been shown that separation of powers increases the potential for accountability (Hellwig and Samuels 2008), yet divided government—when executive and legislature are controlled by different parties—tends to decrease *clarity of responsibility* (Leyden and Borrelli 1995; Samuels and Shugart 2003). However, there is evidence that Presidents are still held accountable in the context of divided government, yet voters' response may be asymmetric depending on whether the government is divided or unified (Norpoth 2001; Nicholson, Segura and Woods 2002; Samuels 2004).

Finally, *clarity of responsibility* has also been shown to improve policy outcomes. Kiewiet (2000) uses the classification of Powell Jr and Whitten (1993) to provide evidence that countries with low

[4]See Royed, Leyden and Borrelli (2000) and Palmer and Whitten (2003) for further discussion on this evidence.

clarity of responsibility are more inclined to over-regulate and engage in inefficient levels of transfers and subsidies. Tavits (2007) and Schwindt-Bayer and Tavits (2016) provide evidence that countries with institutions that prevent the diffusion of responsibility have lower levels of corruption.

A second important input in this paper is the formal literature on electoral accountability. Underlying the ideas of this paper is the fact that competitive elections create a relationship of formal accountability between representatives and their constituents (Przeworski, Stokes and Manin 1999; Ashworth 2012). A vast literature in political science and economics has modeled the incumbent policy-makers' problem as a career concerns one (Holmström 1999; Levy 2004), where incumbents take actions to signal to voters their ability to execute policies or their congruence with voters' preferences (Fearon 1999; Canes-Wrone, Herron and Shotts 2001; Maskin and Tirole 2004; Ashworth 2005; Ashworth, Bueno de Mesquita and Friedenberg 2017).

Closer to this paper, Duch and Stevenson (2005, 2008, 2010) build on the signal extraction model of Alesina and Rosenthal (1995) to formalize two important aspects of electoral accountability. Firstly, when evaluating their representatives, voters will discount the variation in economic output that is not the direct responsibility of incumbents. Secondly, when a coalition of parties governs together, a more evenly distributed power will make it more difficult for voters to assign responsibility. This model, however, is not adapted to study party system fragmentation. Furthermore, the model echoes previous literature by formalizing the power-sharing structure of government as a determinant of *clarity of responsibility*, which in both cases is treated as an exogenous input. What these accounts are missing is that *clarity of responsibility* is about the visibility of representatives, one determinant of which may be the power their parties have in Parliament. This paper advances our understanding in two ways: the power-sharing structure is determined endogenously as an equilibrium outcome and that electoral accountability depends on the voter's capacity to learn about his representative's party, which in addition to policy-making power depends on the within-party garbling of information.

A third branch of the literature that is related to this paper is that of the distribution of power in multiparty governments. I have greatly benefited from the discussion on coalition government and bargaining in parliamentary democracies (Laver and Schofield 1998; Strøm, Müller, Bergman, Müller et al. 2003; Scarrow, Webb and Poguntke 2017). More specifically, when a voter evaluates the likelihood that a party was responsible for the policy outcome affecting him, the voter formally calculates a *value* equal to the probable responsibility a party *may* have had in the Parliament's decision. The idea may seem familiar to that of the Shapley value (Shapley 1953), in which case each player is a party i which can belong to a coalition S and the characteristic function is $v(S) = 1$ if $\sum_{i \in S} |p_i] \geq \frac{1}{2}$ and 0 otherwise. Laver and Benoit (2015) use this insight to calculate the Shapley value in European Parliaments with the purpose of calculating the impact of a party's power on the type of government that is formed and the duration of government. However, for the purpose

of measuring electoral accountability, the crucial difference in my paper is that the object of study is voter learning, not the payoff-sharing arrangement. In particular, parties wish to show off to voters by voting for a policy of unknown merit, and the set of parties that ultimately vote together is determined by this fundamental objective and the quality of the information each party has. On the one hand, the calculation of *responsibility* does not involve a permutation exercise but a counting exercise considering that each party has a different probability of supporting the *ex-post correct*, or *incorrect*, policy. This means that the voter may conjecture many cases in which his party participated in the Parliament's decision—and thus hold it accountable for it—without having had any power, for example when conjecturing that 80% of Parliament voted in favor of a policy, including his party which only held 20% of the seats: the Shapley value, by definition, only considers cases in which the party has power, that is, when the value function changes with the party's inclusion. On the other hand, the probability that a party participated in the body's decision is determined in the equilibrium of the game because parties have the capacity to alter it with their vote strategy. In addition to the above, the Shapley value calculates the *fair* distribution of power in, for example, governing coalitions, which is a notion coming from non-cooperative game theory, that is does not take into account that post-election negotiations are non-cooperative, and bargaining theory may have very different predictions. My paper rests solely on non-cooperative game theory and the *visibility* of each party does not come from power negotiation but by virtue of the quality of each party's information and the endogenous likelihood that each party participates in the winning decision. Finally, as discussed in the introduction and developed below, the potential for *voter learning*—the main object of study in this paper—does not only depend on the degree to which a party can be held responsible for Parliament's decision but also on the degree to which the information about individual representatives is garbled within parties. This is crucial for electoral accountability and to understand the impact party system fragmentation has on it.

Finally, this paper benefits from the study of voting in bodies whose members have uncertainty about a common-value. Most relevant for this paper are two insights, the way different vote disclosure rules affects the legislators' vote strategy (Gradwohl 2018) and strategic voting, that is, that in equilibrium voters condition on being pivotal and thus weight their own information less (Austen-Smith and Banks 1996; Feddersen and Pesendorfer 1998). Following the literature on *clarity of information*, this paper assumes the disclosure rule that only the consequence of the body's choice is made public, not the vote tally. Under majority, this assumption makes sincere voting the only equilibrium, while under super-majority strategic voting is. Since majority is the most common form of voting in most legislative bodies, the model assumes this voting rule which has the added benefit of conveniently isolating the analysis from strategic voting considerations.[5] Interestingly, allowing the observation of vote tallies—anonymous or non-anonymous—generates

[5]The effect of electoral accountability under super-majority rules is studied in a parallel piece.

the additional strategic issue of the anticipation that legislators must make of what the voter will learn when observing other legislators' vote (Gradwohl 2018; Buisseret and Prato 2018). In this paper I abstract from these additional channels, on the one hand to convey the basic insights in the simplest manner while using the disclosure assumption that has been widely assumed in the literature, and because the complexity involved in finding the equilibrium is already high. Future work will explore these and other extensions.

2 Theory

In this section I present a simple model of legislative accountability.

2.1 Model

Five legislators (to each of whom I reserve the pronoun *she*) vote in favor or against the implementation of a policy, which is commonly believed to benefit voters ($\omega = 1$) with probability $p \in (0,1)$ or not ($\omega = 0$) with the complementary probability.[6] Each legislator has a type $\theta \in \{0,1\}$, unknown to all, whose common prior is $\Pr(\theta = 1) = \pi \in (0,1)$.[7] Before voting, each legislator receives a private signal $y \in \{0,1\}$ whose quality depends on the type. If $\theta = 1$, the signal reveals the state, that is $\Pr(y = 1|\omega = 1) = \Pr(y = 0|\omega = 0) = 1$, while it is uninformative, that is, $\Pr(y|\omega) = \frac{1}{2}$, $\forall y, \omega$, when $\theta = 0$. Private signals are independent and identically distributed. To ignore cases of dominant decisions, I limit the prior to the range $p \in \left((1-\pi)\frac{1}{2}, \pi + (1-\pi)\frac{1}{2}\right)$ so that the private signal y is always *decision-relevant*.[8]

Each legislator belongs to a single party. Formally, consider the set of legislators $\{1,2,3,4,5\}$ to be partitioned in $P \in [1,5]$ cells, called *parties* p_i, of size $|p_i|$. For example, a two-party Parliament could be $\{\{1,2,3\},\{4,5\}\}$ or $\{\{1,3,5\},\{2,4\}\}$. Legislators privilege working and sharing information with members of their own party vis-a-vis of others. To capture this, assume that each legislator within a party observes the private signal of each party member in addition to their own. Note that this definition of party implies full party discipline. Since all legislators within a party will hold the same information, they have no reason to vote differently.[9] For this reason, below I may refer to *party vote* to mean the vote that has been decided by the collective of legislators within

[6] $N = 5$ is the minimum number of legislators that allows me to show the accountability issues brought about by fragmentation, yet most of the results hold for an arbitrary N.

[7] It is a common assumption in the political accountability literature that when the dimension of interest to voters is ability, uncertainty about it is symmetric. Formally, this assumption allows one to abstract from any signaling role that the choice of policy may have, and focus solely on symmetric reputation concerns.

[8] If the prior p is sufficiently high or low, it is optimal to disregard y. It is easy to check that this assumption implies that a legislator who observes realization y knows the probability that the signal is correct is greater than $\frac{1}{2}$. Formally, for $y \in \{0,1\}$, $\Pr(\omega = y|y) > \Pr(\omega = 1 - y|y)$. See Prat (2005) for a similar assumption on signals.

[9] In order to have some degree of party indiscipline I would require that a share of legislators were *behavioral*, that is, legislators that ignore new information and always vote in the same way.

a party after observing their private signals. After observing their and their co-partisans' private signal, every legislator simultaneously votes,[10] and the policy is implemented following majority rule.

Voters (to each of whom I reserve the pronoun *he*) solely observe the policy consequence, $\omega \in \{0, 1\}$.[11] For this reason, every voter learns the same about every legislator. Suppose that every voter has a representative,[12] and a voter decides whether to re-elect his representative or replace her with a challenger. The belief that the voter will hold regarding whether the challenger is of high valence, $\Pr(\theta_{challenger} = 1)$, is drawn from a cumulative distribution function $\mathcal{C}$ at the moment of re-election, a distribution with realization χ and whose support includes at least one value less than, and one value greater than, π.[13] The legislator wishes to be re-elected, thus her preference can be represented by the indicator function $\mathbb{1}_{\text{re-elected}}$. The voter wishes to elect the representative of highest quality, thus his preference can be represented by $\mathbb{E}[\theta]$, the expected quality of the representative.[14]

The timing of the game is as follows:

0. Nature determines the welfare consequence of the policy ω, each legislator's type θ and the realization of each legislator's private signal y.

1. Legislators observe their and their co-partisans' private signal, and vote in favor or against the policy. The policy is passed according to majority rule.

2. Each voter observes the policy outcome, updates his beliefs about the quality of the legislators,

[10] That is, I do not allow for legislators to learn from each other's vote.

[11] This assumption is implicitly or explicitly made by the literature on *clarity of responsibility*, thus I keep it in order to continue the dialogue. Notice that the merit of the assumption may depend on the type of issue the policy is addressing. For example, legislators may consider more likely that voters will pay attention to their vote on whether to have background checks for gun purchase, but less attention on how they voted a major economic package. This is true, among others, because the latter usually involves a higher degree of complexity than the former, which is perhaps the reason this assumption is particularly adequate for economic voting. Despite these differences, both policies have very observable outcomes.

[12] In this paper, if the voter voted for a party list, results would follow without change. This is because, as explained in the analysis below, voter learning is at the party level, that is the voter learns symmetrically about each representative within a party, thus the average expected quality of legislators within his party in a party-list system is the same as the expected quality of his representative in, for example, a single-member district or an open list PR system.

[13] For the results of the model, it does not matter whether this challenger belongs to a new party or one that currently has representation in Parliament. Notice that, even though the voter learns about every current legislator, it is most often the case that he cannot replace his representative with a current legislator, and even if the challenger came from a party that currently has Parliament representation the challenger's valence is still the realization χ, regardless of what the voter learnt about the challenger's party members who currently hold a seat.

[14] That is, I assume a reduced form for the electoral accountability problem. I do so solely to simplify exposition. In equilibrium, legislator's will wish to pass the policy that maximizes the voter's welfare, which is easier for a higher quality legislator, thus a voter concerned about future welfare will wish to maximize the quality of his representative (to the extent that an extension of the game involves legislators wanting to choose in the same way in equilibrium; if the game ended in the second period, legislators would be indifferent, but this can easily be solved by adding a direct preference for welfare to legislator's objective).

and decides whether to re-elect or replace his representative.

The equilibrium concept is Subgame Perfect Nash Equilibrium (SPE) extended to moves of nature.

Finally, the main purpose of this paper is to accurately measure *voter learning*—the underlying idea behind *clarity of responsibility* and accountability. I will measure *voter learning* by the extent to which the voter changes its beliefs about the quality of his representative after observing the policy outcome.[15] Therefore, throughout I will measure learning with either $\Pr(\theta|\omega)$ or $\Pr(\theta|\omega) - \pi$, that is, with the belief updated after observing the policy outcome, or the difference between the updated belief and the prior belief. To ease exposition, I will mainly focus on $\Pr(\theta = 1|\omega = 1)$, the updated belief that a legislator is of good valence given a good policy result.[16] A full discussion of the assumptions of the model can be found in the appendix.

2.2 Equilibrium Analysis

2.2.1 Voter learning

Let us start with two remarks regarding voter's learning.

Remark 1. *Each voter learns about his representative's valence in two steps.*
(a) Given the policy outcome, the voter makes an inference regarding how likely it is that his representative's party voted for, rather than against, the policy that resulted in the outcome.
(b) Then, conditional on the inference about his representative's party's vote, the voter forms a belief about which signal his representative observed, which reflects on her valence.

In the appendix I describe this remark in full formality. However, there are three important aspects that need to be highlighted about this learning process.

First, the vote decision of each party is made considering only the case that they are pivotal which, under majority rule, provides no information regarding how the rest voted. Thus, parties have only their private information to make a decision. Therefore, party system fragmentation affects the way a party votes only if it affects its own size. Hence, party system fragmentation affects (b) only through changing the size of the party being evaluated.

Second, since the policy choice is binary—a party can either vote for or against it—, to learn about (a) is to calculate with which probability the party of one's representative was on either side of the vote. This calculation depends on two aspects: on the one hand, how likely the voter thinks that each party got more favorable information for the *ex-post correct* decision, which depends on its size and, on the other, on the possible combinations there are for parties to be on either side of the vote. Party system fragmentation affects both, and thus affects (a).

[15] Recall that learning is symmetric across voters, thus it is really the case that each voter learns about each legislator.

[16] The statistics $\Pr(\theta = 1|\omega = 1)$, $\Pr(\theta = 0|\omega = 1)$, $\Pr(\theta = 1|\omega = 0)$ and $\Pr(\theta = 0|\omega = 0)$ are highly correlated.

Third, a voter will make the same evaluation for parties of the same size. This is because parties of the same size have the same number of members, which affects (a) and (b), and they face the same party structure of the remaining parties, which affects (a). Since this paper's focus is on voter learning, for this reason below parties are indexed by their size, regardless of which party it is. Furthermore, since members of the same party do not differentiate themselves on the eyes of the voter, the voter's evaluation of his representative is the same as his evaluation of any other member of his representative's party. A direct implication of this is that it does not matter whether the voter is evaluating a party or an individual legislator.

Given the above, consider the voter's re-election rule. If legislators follow at least in part their private information in equilibrium, then following a good outcome the voter can only improve their evaluation of legislators and deteriorate their evaluation in the opposite case. Since the voter re-elects if the updated belief that $\theta = 1$ is greater than χ, and since legislators wish to be re-elected, then the equilibrium strategies of voters and legislators' are the ones described in Lemma 1.

Lemma 1. *In equilibrium,*
(i) Voters re-elect their representative if and only if their updated belief about her valence is higher than their belief about the challenger's valence.
(ii) Legislators vote to maximize the probability that the welfare maximizing policy is chosen.

Proof. All proofs are in the appendix.

2.2.2 Effect of party system fragmentation on voter learning

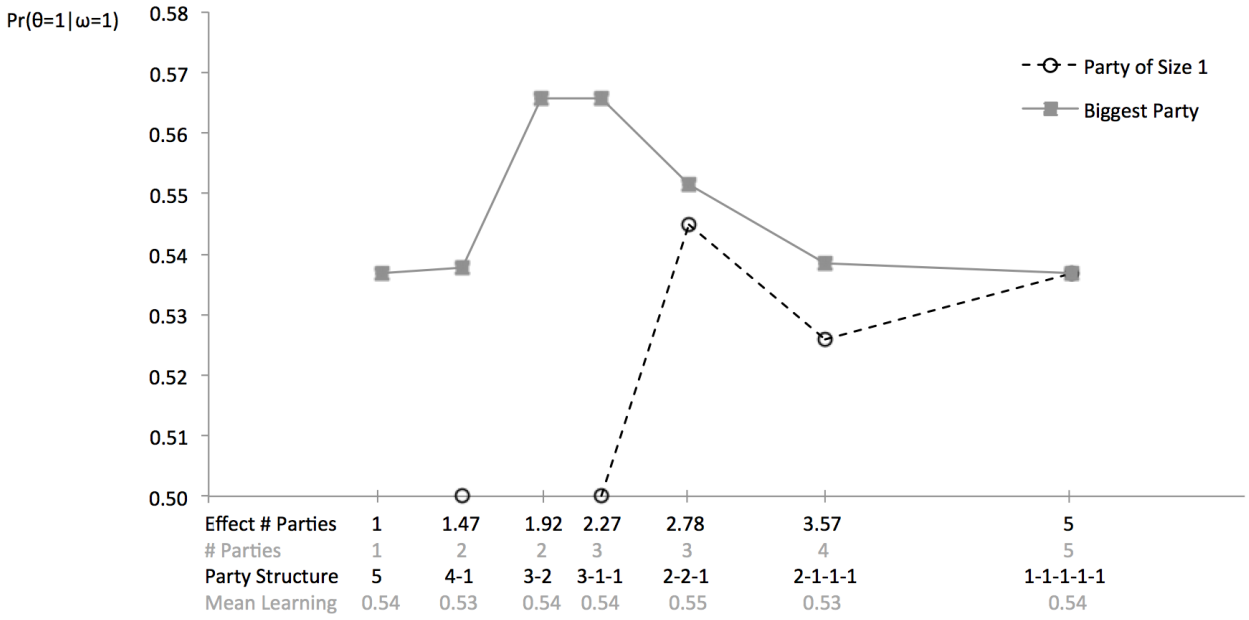
As explained above, voter learning is measured by the updated belief that a legislator within a party of size $|p_i|$ is of high valence having observed a good outcome, that is $\Pr(\theta_{|p_i|} = 1|\omega = 1)$. For illustrative purposes only, it is interesting to point the reader's attention to two cases: the biggest party in Parliament and a single-member party, when it exists. The biggest party is interesting because I can track the change in learning about this party while it holds a majority—i.e. keeping constant effect (a)—as well as when it loses it, and the singleton party is interesting because its size remains constant—and so does effect (b). Figure 4 graphs $\Pr(\theta_{|p_i|} = 1|\omega = 1)$ for these two parties, plotting it against party system fragmentation using a typical measure of fragmentation, *effective number of parties*, where a higher number on the scale indicates greater fragmentation.[17] The exact party structure is indicated alongside.

The model's insights regarding the effect of party system fragmentation on electoral accountability can be summarized in four main conclusions. Below I organize them in four propositions.

Proposition 1. *The effect of party system fragmentation on voter learning is not monotone. Party system fragmentation affects learning about each party differently, and its effect is non-monotonic.*

[17] Effective number of parties $= \frac{1}{\sum_i (|p_i|/5)^2}$. See Laakso and Taagepera (1979).

Figure 4: Effect of Party System Fragmentation on Voter Learning, 5-legislator Parliament



Note. Voter's posterior belief that a legislator is of high type in y-axis, *effective number of parties* in x-axis. Two plots: party of size 1, if it exists, and the biggest party. Number of parties, party structure and *Mean Learning*—the average of posterior beliefs of parties in Parliament, weighted by the number of legislators in each party—in the x-axis. Parameter values: $N = 5$, $\pi = \frac{1}{2}$, $p = \frac{3}{4}$.

As discussed in the introduction, previous theories about party system fragmentation and electoral accountability speculated that as Parliaments fragmented it should be more difficult for voters to assign responsibility because more actors could fight for credit or blame. This idea is based on the notion that the policy-making power each party enjoys—one of the determinants of its accountability—decreases with fragmentation. The model in this paper shows, to the contrary, that policy-making power changes in a non-monotone and party-specific fashion depending on how parties fragment. In addition, policy-making power is not the only determinant of accountability: the more representatives a party has the less accurate can a voter's evaluation be about it.

Figure 4 shows not only the non-monotone fashion in which the policy-making power of the singleton party changes, but also how the biggest party's accountability peaks when it holds the minimum possible majority, and how the average learning of parties in Parliament (below the x-axis) peaks right after the biggest party loses its majority.[18] The exact degree to which a voter can learn about each party depends on the specific party structure in Parliament. To shed more light on the details of this non-monotone relation, the following propositions explore three instances in the fragmentation progression: when the biggest party holds a majority (2), when the biggest party loses the majority (3), and when no party holds a majority (4).

[18]This peak, as well as the non-monotone evolution in average learning, is equivalent if the average is calculated weighting by the size of each party or not.

Proposition 2. *When a party has a majority, only the majority party is held accountable by voters. The smaller the majority party, the more accountable it is.*

Holding the majority of the seats grants a party full control of the policy agenda, and voters know this. However, conditional on holding a majority, the bigger the party is the more garbled the information about each legislator's valence will be. This decreases the accountability of the majority party, because evaluating a bigger party allows voters to make a less accurate measure of each representative's valence and thus of the party's ability to make a good decision in the future.

Therefore, having a party hold a majority of the seats helps with accountability of this party, but it does so more the smaller this majority. However, having a party hold a majority has a negative effect on accountability as well, for nothing can be learnt about every other party: the Parliament's output provides no information about non-majority parties in Parliament because their vote cannot change the body's decision. This changes when the biggest party loses its majority, as discussed next.

Proposition 3. *Electoral accountability of every party, other than the biggest party, is higher when the biggest party does not have a majority of the seats.*

When the biggest party holds a majority of the seats, the voter knows that the vote of other parties is inconsequential for the Parliament's decision. Therefore, a bad policy outcome provides no information about the valence of these parties' representatives. When the biggest party loses the majority, however, this is no longer true: however small a party is, its vote may now be consequential. Hence, a bad outcome becomes informative about the valence of a small party's representative because, having observed a bad outcome, the voter knows that it is more likely that this party voted for the wrong, rather than for the right, policy. Party system fragmentation, in this case, increases electoral accountability.

This is of utmost relevance, on the one hand because many voters vote to small parties, and on the other because one or more parties about which voters could not learn anything about may be considered alternatives to the current ruling party. In our 5 legislator model, when the biggest party loses the majority, the voter's posterior beliefs about the singleton party spikes. Electoral accountability of the biggest party may increase or decrease, because on the one hand it becomes less likely to be responsible for the policy outcome, but on the other its size is reduced, allowing voters to make a more accurate assessment of its members' valence.

Finally, consider fragmentation in Parliaments where no party has a majority.

Proposition 4. *When no party has a majority, party system fragmentation may increase or decrease the electoral accountability of a legislator, depending on which of two effects on voter learning dominates: the change in the likelihood that her party voted for the policy that is responsible for the observed outcome, and the change in her party's size.*

Proposition 4 summarizes what has been learnt so far about fragmentation, and its applicable to any Parliament, but I use a non-majority Parliament to illustrate the mechanics involved. The effect of party size on garbling information and thus decreasing accountability has been already discussed at length. The effect of party system fragmentation on the likelihood of participating in the Parliament's decision is more convoluted. To illustrate the latter, hold the first effect constant by focusing on the singleton party.

Once no party has a majority, fragmentation of other parties has two competing effects on accountability. On the one hand, fragmentation increases the number of possible cases in which this party may have voted in line with what the Parliament ultimately decided, thus making it easier for a voter to evaluate this party observing only the Parliament's decision. On the other hand, each of these cases becomes less likely, which affects voter learning in the opposite direction. Which effect dominates depends on the party structure. For the singleton party, the second effect dominates going from 2-2-1 to 2-1-1-1 but the first effect does going from 2-1-1-1 to full fragmentation, as shown in Figure 4.

The reason behind this is better illustrated looking at the case where the singleton party is pivotal for the body's decision.[19] Notice two facts. First, since $\pi > 0$, legislators are more likely than not to get the correct signal; second, in order for a legislator to be pivotal, the rest need to tie their vote. Therefore, a tie is rather difficult because it requires half wrong signal realizations, which are ex-ante less likely than correct ones.[20] However, notice that a tie is easier among more consolidated parties than among more fragmented ones, because in the former only about half of legislators need to get the incorrect signal but in the latter many more need to get it.[21]

In the model, the singleton party is pivotal when the vote tally among the other legislators is 2 votes against and 2 for the policy. In both the 2-2 and 2-1-1 arrangements, the number of cases in which the rest of Parliament ties is 2 (the party of 2 legislators votes one way, and the other legislators—grouped or individually—vote in the opposite way), but in the 2-1-1 arrangement both former members of the big party need to get the wrong signal, as opposed to both or only one before (the prior belief breaks the tie within parties). Thus, the probability the singleton party is pivotal decreases, and so thus learning about it. When the second big party splits, two new former members of a big party need to get the wrong signal but this time the number of possible ties

[19] There are many cases in which the singleton party is part of the Parliament's decision: when all parties vote in the same way, when only one party votes against, etc. The singleton party being pivotal, that is when the other parties tie, is only one of these cases. However, the pivotal case is the most affected by fragmentation, and it illustrates very well what happens in the rest of the cases that change with fragmentation.

[20] In the case of the singleton party and an odd-numbered Parliament, the singleton party will be pivotal only if the rest tie. However, in other cases, party A is pivotal simply if the difference in the vote tally among the rest of the parties is less than the number of legislators that party A has.

[21] For example, consider a 7-member Parliament. If there are two parties of 3 legislators each in addition to the singleton party, the singleton can be pivotal if only 2 legislators get the wrong signal (in the same party). If there are only singleton parties, however, a singleton party is pivotal only if 3 legislators get the wrong signal.

triples, which in aggregate increases the probability the singleton party is pivotal and thus voter learning about it.

To end this section, return your attention to the example of *The Greens* Party in Germany. Figure 3 showed that despite The Greens having similar seat share and despite Parliament having the same *effective number of parties* in 2002 and 2013, The Greens were more accountable in 2002 than they were in 2013. In fact, the 2002 Parliament was very similar to the 2-2-1 case in the model, in that there were two big parties both of which could reach a majority coalescing with The Greens, which the model predicts makes a policy outcome in the period 2002-2005 highly informative about The Greens legislators. On the other hand, the 2013 Parliament resembles the 2-1-1-1 case in that the CDU/CSU could reach a majority with any of three other parties, only one of which was The Greens, which leads the model to predict them to be less accountable.

3 Empirical Evidence

In this section I perform two empirical exercises. First, I test whether party system fragmentation has a negative, monotone effect on accountability (proposition 1). Second, I test whether *voter learning*—which considers the non-linear effects of changing the party structure—is a determinant of electoral accountability (propositions 2, 3 and 4). In this section, I will describe the data and research design that I will utilize, and then I will present the results.

3.1 Data

The data from Salas, Rosenbluth and Shapiro (2018*a*) will be used. This consists of the electoral rules and results of every legislative election (lower house, if bicameral) held democratically in the 35 current OECD countries from 1945 to 2017, for a total of 625 elections.

Electoral rules include closed/open list, district magnitude, whether the election was called ahead of the next scheduled election, as well as political system (e.g. parliamentary, presidential) for every year.[22] Electoral results includes vote share and seat share obtained by each party as well as turnout for every election held democratically. Finally, this data includes the unemployment rate obtained from the OECD database, which covers a varying number of years for each country, and provides a standard measure comparable across countries.[23] Appendix table 6 displays basic descriptive statistics.

Salas, Rosenbluth and Shapiro (2018*a*) provide the data at the party level but without labelling

[22] In the case of countries using mixed-member electoral systems, such as Germany and Mexico, we code the PR one. In general, Salas, Rosenbluth and Shapiro (2018*a*) follow standard coding rules such as Carey and Hix (2011)'s. We use several sources, including previous publications containing such information (e.g. Carey and Hix (2011) and Cruz, Keefer and Scartascini (2016)), official records (in print and online), and unofficial online sites.

[23] https://data.oecd.org/.

which party is which. In order to test accountability, I need to follow a party across elections. In order to maximize the number of elections observed for a given party, as well as to avoid issues of merging, splitting, disappearing or new parties, or confusion product of name changes, this paper utilizes only traditional parties, parties that have existed roughly since the end of World War II. This corresponds to 61 traditional parties competing in 26 countries.

Finally, I wish to test whether voters reward or punish parties for policy outputs more when they are capable of learning more about them. I choose to use unemployment as the observable policy outcome for several reasons. First, it's comparable across countries and time. Second, it's a first degree concern to voters. Third, it is highly observable, through their own experience or that of relatives and community. Fourth, it's the measure that is most often used in the literature on *clarity of responsibility*. Fifth, policy makers can affect unemployment in the short- and medium-term, as opposed to productivity (the main determinant of higher wages and economic growth), which takes several years to be impacted, or inflation, which in developed democracies is in most cases under the watch of an autonomous agency. Sixth, while very salient issues in the seventies and eighties, the average and standard deviation of GDP growth and inflation has decreased highly in developed economies since the mid-eighties, unlike the unemployment rate, making the latter a better source of information for voters and a better source of variation for estimation.[24] Potential problems of using the unemployment rate is that some countries have unemployment insurance, which would temper the variation, or have strong safety nets, which makes unemployment a less salient issue for voters. For empirical purposes, I calculate the change in the unemployment rate from one election to the next, to attempt to measure the voter's perception of improvement in their livelihoods.

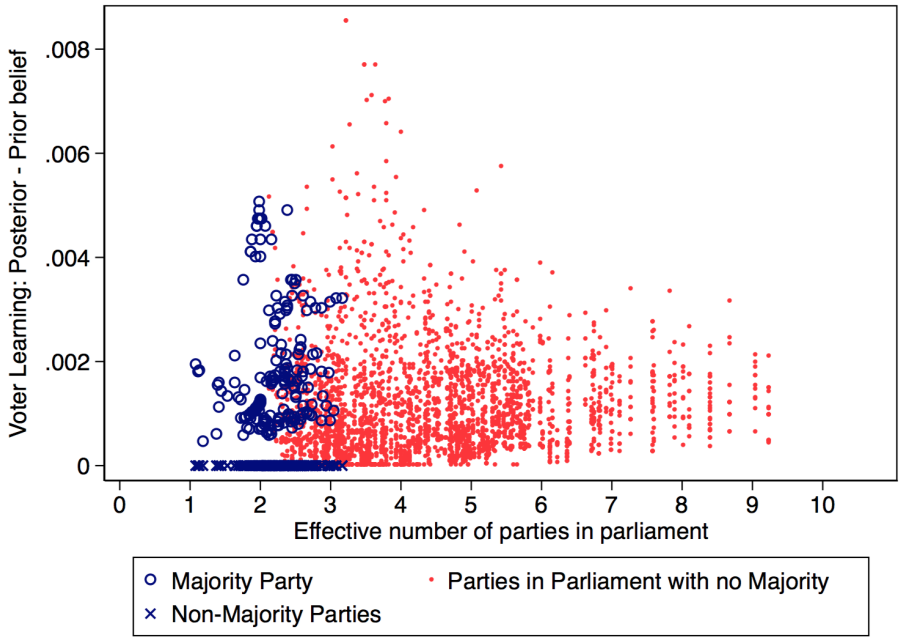
3.2 Theory to Data

The model in the previous section proposes a measure of how much voters can learn about each party consisting of the updated belief that a legislator is of good valence given the observed policy outcome. To use this measure, the model is solved and simulated for each elected Parliament, and the updated beliefs are recorded for each party. The model is solved numerically, with starting value the prior $\pi = 0.06$.[25] For computation purposes, I exclude elections with more than 15 parties,

[24] See Figure 6 in the appendix for an illustration.

[25] The posterior beliefs are calculated by solving the system of equations (3) in the appendix. Convergence is fast, changing the sixth decimal in the third iteration. The prior $\pi = 0.06$ was chosen simply because it was the highest prior that did not make the "probability that a party of size $|p|$ got their vote decision (ex-post) correct" grew too fast with $|p|$ and thus converged at a low $|p|$, since it is desirable for this statistic to vary with $|p|$ (which in the data goes from 1 to almost 500). While convergence requires few iterations, each iteration takes a long time. For this reason, to the date of this draft the empirical results have only been produced using this prior. There are no theoretical reasons to believe that results should be different with different priors, however for transparency future drafts will include variations in the prior.

Figure 5: Simulated Voter Learning in OECD Parliaments, 1953-2017.



Note. Plotted is the voters' simulated posterior belief that a legislator is of high valence after observing a good outcome, subtracting the prior. Prior $\pi = 0.06$ is used. The dark blue plot corresponds to Parliaments where a party achieved a majority of the seats, while red dots corresponds to those Parliaments where no party did. Within the dark blue plot, circles represent majority parties, crosses non-majority parties. 4141 observations are plotted, corresponding to 4141 party-elections.

leaving a total of 620 elections with 4141 party-years.[26] Figure 5 plots the result of the simulation for the 4141 cases. Specifically, I plot the change in beliefs, that is, the updated belief minus the prior belief for each party, a value ranging between 0 and 0.0087.

For estimation purposes, I re-scale this variable to occupy the $[0, 1]$ range so as to interpret the effect of *learning* as the difference between maximum learning possible in the sample and no learning. This rescaling is simply a linear transformation of the original variable and is done over the entire sample, so the variation is kept intact. The resulting variable is called $Learning_{pt}$, indexed by party p and year t. Learning after a success and after a failure have different signs and slightly different magnitudes, but are highly correlated ($\rho \approx -0.91$), so for the analysis below I will use learning after a success.

In order to test the theory, I will use *change in the vote share* of each party as dependent variable to measure the extent to which voters respond to economic outcomes. The exact translation from the model to this variable is the following. At the time of re-election, the voter's belief about the challenger is drawn from a distribution. A legislator is re-elected if this realization is lower than the

[26] This leaves out Chile's election of 1953 (18 parties) and 2017 (16 parties), Italy's of 1992 (16 parties), Switzerland's of 1991 (17 parties) and Poland's of 1991 (29 parties).

posterior belief the voter formed about her. This posterior belief is equal for all party members, but the challenger each member competes against may differ. Thus, the higher the updated belief about the party's legislators the more of them will receive votes for re-election. After a good policy outcome, the updated belief is highest if voters can learn more, and after a bad policy outcome, the updated belief is highest when voters can learn the least. Therefore, the more a voter can learn about the legislators in a party, I expect that the more votes this party will get after a good outcome and the less votes after a bad one.

3.3 Research Design

In order to test propositions 1 through 4, I estimate two equations using OLS. First,

$$\Delta vs_{pt} = \beta_0\ \Delta U_{ct} + \beta_1\ \Delta U_{ct} \times A_{ct} + \beta_2\ A_{ct} + \alpha_p + \lambda_t + W_{pct}\Pi + \epsilon_{pt} \tag{1}$$

where p indexes parties, c countries and t years, and ΔU_{ct} is the change in unemployment rate from year t to year $t+1$ in country c.[27] The dependent variable is Δvs_{pt}, the change in vote share obtained by party p between elections t and $t+1$.

I will use Δvs_{pt} as dependent variable while controlling for vote share in t (as part of the vector W_{pct} described below) in order for the results to be as comparable to the main ones in the literature (Powell Jr and Whitten 1993; Whitten and Palmer 1999). An alternative specification may have vote share in $t+1$ as dependent variable, without controlling for its lag in order to avoid the risk of producing inconsistent estimates,[28] since fixed effects effectively uses variables in deviations from the mean. In appendix Table 8, I show and discuss the main results using both versions of the dependent variable, and with or without the control for vote share in t, with very similar results.

The variable A_{ct} in equation (1) will be either of two. First, a measure of party system fragmentation in the elected parliament of country c and year t: either number of parties or effective number of parties, of the parliament as a whole or of the government coalition. Second, an indicator variable equal to 1 if there exists a party in the parliament elected in country c and year t that holds a majority of the seats. Therefore, equation (1) exploits within-country variation. The coefficient β_1 will measure whether and how A_{ct} matters for the degree to which voters hold their representatives accountable.

[27] I use change in unemployment, rather than levels, for two reasons. First, given the fixed effects α_p, λ_t, this allows me to compare a performance (e.g. a decrease in unemployment) not in isolation but as compared to previous (or the average) performance. For example, the mean yearly change in US unemployment since Carter is -0.1 percentage points, with best in Reagan2 and Clinton1 (-0.5) and Obama2 (-0.8), and, relative to that, Trump is doing "well" at -0.7 in his first year. As it is usual with changes in these types of variables, within-country means are very close to zero, making the variable and its deviation from the mean near identical, which eases interpretation. Second, to make it conceptually more comparable to previous measures of economic activity which use either changes or measures as deviations from global measures (called *comparative measures*).

[28] See Nickell (1981) and Angrist and Pischke (2009).

Regarding the second variable, while I expect smaller parties to become accountable as the majority party loses its majority, I may not be able to measure this because some parties may be getting the support that those who were held more accountable for negative results got in the previous election. In order to attempt to get around this, I test this proposition only among parties inside the government coalition, perhaps those who voters would, if indifferent, turn last to reward with spare votes. Thus, I estimate equation (1) in two samples. In both samples, I include all parties in the government coalition of Parliaments where no party has a majority. In Parliaments where a party holds a majority of the seats, I include in the first sample the majority party and in the second sample the non-majority coalition partners. In the first case, I expect that the majority party is held more accountable than the average governing party in non-majority Parliaments. In the second case, I expect the non-majority coalition partners of majority Parliaments to be held less accountable than the average coalition partner in non-majority Parliaments.[29]

The second equation that I estimate is

$$\Delta vs_{pt} = \beta_0 \ \Delta U_{ct} + \beta_1 \ \Delta U_{ct} \times B_{pt} + \beta_2 \ B_{pt} + \alpha_p + \lambda_t + W_{pct} \ \Pi + \epsilon_{pt} \tag{2}$$

where B_{pt} is either an indicator variable equal to 1 if party p obtained a majority of the seats in election t, party p's seat share in election t, or the theoretical prediction of the degree to which a voter should learn about a representatives in party p in election t, $Learning_{pt}$. Therefore, equation (2) exploits within-party variation. The coefficient β_1 will measure whether and how B_{pt} matters for the degree to which voters hold their representatives accountable.

The sample used to estimate equations (1) and (2) includes a minimum of 2, a maximum of 17, and a median of 5 parties competing in each election. Time-series data at the party level allows me to use party-fixed effects α_p to control for time-invariant characteristics that make parties intrinsically different.[30] For example, suppose there exists two parties and two elections, and I predict that voters can learn about one party in neither election, while they can learn about the other only in the second election. If we observe that the correlation between vote and unemployment is zero in the first election and negative and similar for both parties in the second, this design will not hold *voter learning* responsible for the increase in vote share. In this sense, this design is a version of *differences-in-differences*, but where *voter learning* potentially changes in every election, for every party. Concordantly, each specification also includes year fixed effects λ_t to control for

[29] Even comparing within country, this strategy compares the average *majority* Parliaments versus the *average* non-majority ones, which may defer for a number of additional, unobservable reasons which may affect parties' accountability. One solution would be to estimate a regression-discontinuity design, using as running variable the seat share of the largest party, effectively estimating coefficients locally at parliaments where the largest party got $50\% - \epsilon$ and $50\% + \epsilon$. Unfortunately, the sample doesn't have enough data to make such a design credible.

[30] Notice that, since parties do not compete in more than one country, party-level fixed effects are nested within country-level fixed effects. That is, party fixed effects capture more unobserved variation than country fixed effects would.

global shocks that affect all countries, and thus elections, similarly. All standard errors are clustered at the party level to correct for non-independence of observations over time within a party.

The main identification assumption of this design is a version of the *parallel trends* assumption: that the correlation between vote share and unemployment would, on average, have parallel trends across parties in the absence of any changes in party structure, thus making each party a good *control* for the other. There are two main threats to this assumption. First, both our independent and dependent variables are results of elections, the timing of which are potentially endogenous to the explanatory variables of interest or third variables omitted in the estimations. For example, in the midst of a growing interest in the status of the economy, elections may be called by those expected to increase their influence in Parliament. For this reason, all specifications include only observations where both elections in t and $t+1$ were scheduled ahead of time (i.e. were not *called*). This forces the party structure to be determined, and the vote share to be measured, at arbitrary dates.[31] This restriction, together with the others above, reduces the sample to 313 observations: 56 traditional parties competing in as many as 51 elections from 1955 to 2014, in 24 countries. Second, party structure is potentially correlated with other party-specific time-varying factors that could affect the extent to which unemployment leads to lower vote intention. To address this, all estimations control for the vote share obtained by each party in t, which may capture trends on the size of each party's base as well as on other party-specific factors. In addition to this variable, the vector of covariates W_{pct} contains controls traditionally used in similar studies, including indicator variables for systems with single-member districts, for closed list systems, and for parliamentary systems, and the number, and effective number, of parties in Parliament resulting from election t.

Finally, notice that my objective is to measure a voter's response to good or bad news. I chose to measure this response with the vote share obtained by each party. The main drawback of this strategy is that votes usually leave parties to go to another one. So, in the case of a rise in unemployment, I expect voters to update downwards their evaluation of some parties more than others, which may transfer vote share from the former to the latter. This could lead equation (2) to bias β_0 towards zero, or even estimate a positive coefficient.[32] It is important to keep in mind that the sample includes only traditional parties, not every party that competed in the election, which decreases the risk that this becomes a problem. So, for example, in Parliaments where a party holds a majority my sample includes an average of 2.05 parties, whereas in Parliaments where no party reached a majority my sample includes an average of 2.5 parties. This is natural because countries using a multi-member district system such as Chile and Germany are also the ones that have had more parties competing in a stable fashion over a long period of time, as opposed to the

[31] Note that *not calling* an election is potentially a strategic choice as well, although not every time like the reverse.

[32] A possible solution is explored in appendix Table 13: adding an additional term that measures the maximum amount of learning in each election, interacted with change in unemployment, which will capture the degree to which votes can be transferred from one party to the other. Further discussion in the empirical section of the appendix.

Table 1: Effect of party system fragmentation on electoral accountability

	All Parties		Gov Parties		Non-Gov Parties	
	(1)	(2)	(3)	(4)	(5)	(6)
ΔUnemploy	-0.01	0.00	0.02	-0.06	-0.00	-0.01
	(0.01)	(0.03)	(0.02)	(0.08)	(0.02)	(0.04)
ΔUnemploy × Number of Parties	-0.00					
	(0.00)					
ΔUnemploy × Effective Number of Parties		-0.01				
		(0.02)				
ΔUnemploy × Gov N of Parties			-0.03			
			(0.02)			
ΔUnemploy × Gov Eff N of Parties				0.03		
				(0.07)		
ΔUnemploy × Non-Gov N of Parties					0.01	
					(0.01)	
ΔUnemploy × Non-Gov Eff N of Parties						0.01
						(0.03)
R^2	0.566	0.567	0.765	0.763	0.792	0.794
Observations	313	313	160	160	153	153
Mean of Dep Var	0.324	0.324	0.338	0.338	0.309	0.309
ΔU + ΔU×NofP (p-value)	0.291		0.144		0.616	
ΔU + ΔU×ENofP (p-value)		0.919		0.111		0.606

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

UK or the US, with only two. Thus, to the extent that votes spared for the party(ies) that voters held most accountable after a bad policy outcome are distributed among other parties near evenly, more parties should collect more of those votes and thus, within my sample, I should expect the problem to be more salient in non-majority Parliaments.

3.4 Results

Proposition 1 claims that the effect of party system fragmentation on electoral accountability is not expected to be monotone. As reviewed in the introduction, past literature conjectures that more fragmentation in parliament decreases accountability, either because it allows representatives to push blame, or because it is harder for voters to coordinate around an alternative. Depending on the form of government, the former may refer to fragmentation in parliament as a whole or that of the government parties, and the latter may refer to fragmentation in parliament as a whole of that of parties not in government.

To test this, in table 1 I estimate equation (1) interacting unemployment with party system

Table 2: Electoral accountability of majority parties

	All Parliaments	Majority Parliaments	Majority Parties
	(1)	(2)	(3)
ΔUnemploy	-0.00	0.01	-0.43**
	(0.01)	(0.02)	(0.18)
ΔUnemploy × Majority	-0.02**	-0.02**	
	(0.01)	(0.01)	
ΔUnemploy × Seat Share			0.80**
			(0.30)
R^2	0.575	0.685	0.973
Observations	313	146	69
Mean of Dep Var	0.324	0.405	0.448
ΔU + ΔU×Maj (p-value)	0.038	0.823	
ΔU + ΔU×SS (p-value)			0.201

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. The interaction test for seats share uses the mean seat share of a majority party, roughly 0.57. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

fragmentation, as measured by the number and effective number of parties, in all parliament, among government parties, and among non-government parties. Evidence shows no support for either hypothesis put forward in the literature: party system fragmentation does not seem to affect the relationship between unemployment and vote share.[33] [34]

Proposition 2 claims that when a party has a majority, only the majority party is held accountable by voters, while the smaller the majority party is, the more accountable it should be. In order to test this, in table 2 I estimate equation (2) using as interaction variable an indicator variable equal to 1 if the party holds a majority of seats in columns (1) and (2), and seats share in column (3). Column (1) uses the full sample while column (2) the subset of Parliaments where a party holds the majority of seats, with similar results. Majority parties lose 2% more vote share as a result of doubling unemployment as compared to non-majority parties.

To address the second point, column (3) of table 2 estimates equation (2) in the sample of majority parties. Results show that as seat share increases there is positive and significant effect of unemployment on vote share, meaning that bigger majorities are punished less, just as conjectured

[33]The reader should keep in mind that the sample does not include all parties in parliament, only traditional parties. However, if the sample did include every party, interpretation would be difficult if vote share is simply distributed among the existing parties.

[34]In order to account for a possible non-linear, yet monotone, relationship between fragmentation and accountability, in appendix Tables 9 and 10 I show that fragmentation has neither a linear nor a quadratic effect on the relationship between unemployment and vote share.

Table 3: Electoral accountability in the presence/absence of a majority party

	Majority Partner versus Coalition (1)	Minority Partner versus Coalition (2)
ΔUnemploy	-0.04	-0.05*
	(0.04)	(0.03)
ΔUnemploy × Majority Parliament	0.02	-0.50
	(0.04)	(0.93)
R^2	0.761	0.900
Observations	158	91
Mean of Dep Var	0.341	0.254
ΔU + ΔU×MP (p-value)	0.037	0.550

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

by the theory.

As explained in the previous section, I test Proposition 3 estimating equation (1), using as interaction an indicator variable equal to 1 for all parties participating in a majority parliament, in two sub-samples: column (1) of table 3 estimates the effect of being in a majority Parliament comparing the majority coalition partner in majority Parliaments and all coalition partners in non-majority Parliaments, and column (2) estimates the effect of being in a majority Parliament comparing the minority coalition partner in majority Parliaments and all coalition partners in non-majority Parliaments.

Column (1) shows that in the first sample coalition partners in non-majority Parliaments get a negative, but not significant shock in their vote share product of increasing unemployment rate, while this shock is statistically significant for majority parties as evidenced by the 0.037 p-value at the bottom of the table. However, the difference between them, the coefficient of $\Delta U_{ct} \times MP_{ct}$, does not appear to be statistically significant.

Column (2) shows that coalition partners in non-majority Parliaments get a negative and statistically significant shock in their vote share product of increasing unemployment rate, equivalent to 5% lost vote share after doubling unemployment rate, while minority coalition partners in majority Parliaments get a negative but not statistically significant shock, as evidenced by the 0.29 p-value at the bottom of the table. However, again the difference between them, the coefficient of $\Delta U_{ct} \times MP_{ct}$, does not appear to be statistically significant.

To end our analysis, I turn to test the explanatory power that the simulated voter learning

Table 4: Effect of voter learning on electoral accountability

	Full Sample	Majority Parliaments	Non-Majority Parliaments
	(1)	(2)	(3)
ΔUnemploy	0.00	0.01	0.04*
	(0.01)	(0.02)	(0.02)
ΔUnemploy × Learning	-0.04**	-0.02**	-0.17***
	(0.02)	(0.01)	(0.06)
R^2	0.585	0.690	0.676
Observations	313	146	167
Mean of Dep Var	0.324	0.405	0.252
ΔU + ΔU×L (p-value)	0.041	0.723	0.016

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

variable has on electoral accountability. This is important on the one hand because the *Learning* variable incorporates the potential effects that different party structures may have, and on the other because *voter learning* is the very root of the *clarity of responsibility* industry, that is, that voters' capacity to learn about their representatives should matter for economic vote.

Table 4 estimates equation (2) using as interaction $Learning_{pt}$ for three samples: all Parliaments, only those that contain a majority party, and only those that do not. Three conclusions can be drawn. First, with the exception of column (3), changes in unemployment cause no change in vote share in the subsequent election among parties that the model predicts voters should have not learned anything about. Second, doubling the fraction of unemployed causes a loss of 4% vote share, 2% in majority Parliaments and 12% in non-majority ones, among parties who the model predicts voters should have learned the most about. Third, the difference in the correlation between unemployment and vote share is statistically significant to the 95% confidence.[35]

In non-majority Parliaments only, parties for whom the model predicts no learning gain 4 percentage points in vote share as a result of doubling unemployment. As explained above, if voters take away vote share from parties they hold responsible after negative policy outcomes they give some of that to parties they do not. I did not necessarily expect this, because not all parties are in the sample. I conjectured that, if anything, one could expect this in non-majority Parliaments where the sample includes more parties than in the majority Parliaments one. The fact that I did not observe a positive β_0 coefficient in columns (1) and (2) points in the direction that was

[35]In appendix table 11 I include both the measure of *Learning* and those of fragmentation together, and the coefficients and statistical significance of both are practically unchanged from when used separately.

Table 5: Electoral accountability of non-majority parties

	(1)	(2)	(3)
ΔUnemploy	0.07	0.01	0.06
	(0.04)	(0.01)	(0.04)
Δ Unemploy × Seat Share	-0.19		-0.15
	(0.13)		(0.12)
Δ Unemploy × Learning		-0.11**	-0.09**
		(0.05)	(0.04)
R^2	0.632	0.637	0.647
Observations	244	244	244
Mean of Dep Var	0.288	0.288	0.288
ΔU + ΔU×ss (p-value)	0.158		0.656
ΔU + ΔU×L (p-value)		0.038	0.263

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

conjectured.[36]

Finally, in order to test proposition (4), in table 5 I estimate equation (2), using seat share and $Learning_{pt}$ as interactions, in the sub-sample of parties that do not hold a majority. Notice this includes both parties in majority Parliaments as well as parties in non-majority ones. The literature claims that a higher seat share should increase accountability, while the model predicts seat share should not matter in the former case while it has contradicting effects in the latter: a higher seat share may mean more relevance in policy-making, but depending on the Parliament's party structure small parties may be just as powerful; in addition, bigger seat share means voters should have a harder time disentangling individual contributions. On the other hand, the *Learning* variable summarizes the model's prediction regarding how much voters should learn about each party.

Column (1) of table 5 tests how much seat share explains the correlation between unemployment and the change in a party's intention. The sign of the interacted coefficient is negative, pointing to the fact that the more seat share the more accountable a party should be. However, it is not statistically significant (p-value of 0.140). On the other hand, column (2) shows that parties of whom the model predicts voters should learn more about are significantly more punished (-0.11 change in vote share) that parties predicted to be more obscure to voters. Finally, when included together in column (3), the magnitude and significance of the interacted *Learning* variable remains

[36]Notice that comparing the statistical significance of β_0 coefficients of two different estimations is not a test that this effect is more present in one sample than the other, and I do not make this claim because it is not central to the discussion.

practically the same while that of seat share suffers slightly on both fronts.

4 Discussion and Conclusion

This paper has shown that party system fragmentation can increase or decrease the electoral accountability of a party depending on its effect on the party's size and likelihood of being responsible for the policy outcome. It has done so by formally modeling the accountability problem of a legislature, which produced a micro-founded *clarity of responsibility* index that is used as within-party variation to test the model's implications.

The formal model and empirics allows me to shed light on two insights. First, *clarity of responsibility* is much harder to calculate than previously thought. To the extent that parties play a central role in representative democracy, unveiling the intricate ways in which different party arrangements shape the mapping between legislators' valence and policy-making quality is key to understand electoral accountability. Second, *clarity* regarding which party was responsible is not enough. While the *visibility of each party*, as well institutions such as government form, bicameralism or separation of powers are important to determine party responsibility, the fundamental policy-making instrument, and thus the main focus of the voters' attention, remains the individual legislator. Thus, electoral accountability depends crucially on the degree to which voters can learn about individual representatives, which is harder both when it is more difficult to link the party to the observable outcomes, but also when individual legislators' contributions are more diffused in larger parties.

The starting motivation of this paper is the rise in party system fragmentation in Parliament, and I am aware that much about this phenomenon was left unanswered in this paper. First, the effects of fragmentation, specially on policy, may not be decoupled from what caused fragmentation in the first place. In Salas, Rosenbluth and Shapiro (2018*a*) we study the causes of fragmentation among left parties, arguing that a major responsible has been the fall in industrial jobs. Second, the effect of party system fragmentation on policy and welfare may crucially depend on *party discipline*, an aspect that has been ignored in this paper. In Salas, Rosenbluth and Shapiro (2018*b*), we are currently targeting this question, finding that while both party system fragmentation and party indiscipline may increase the number of effective decision-makers in parliament—with possible consequences for the provision of public goods, for example—the effect of one may be diminished by the other. Third, as useful as the basic framework provided in this paper is, many important institutions suspected to impact accountability have been neglected, and their interaction with the forces unveiled in this paper may not be trivial. In future work, this framework can be used as baseline to incorporate these institutions.

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A Discussion of the Model's Assumptions

The model presented in this paper is a highly stylized model of Parliaments which leaves out important aspects of legislative policy-making. It does so, as models do, in order to highlight how features of party system fragmentation −change in size and pivotality of parties− affect accountability. However, omitted aspects may give important nuances to the results presented below. This section discusses some of these aspects.

First, notice that parties are defined simply as a group of legislators who can share their information. Consequently, a party's quality is the aggregation of its legislators', and parties have no traits of their own −e.g. ideology, brand, binding rules. These traits may be relevant to the extent that they constraint their member's voting decision or that they affect voter welfare directly.

Related to the above, this is a model of accountability of individual legislators, but learning occurs at the party level. The former is true regardless of whether voters vote for individual legislators or party lists, because voters need to make an inference regarding the quality of each party member in order to make one about the party. Learning occurs at the party level, on the other hand, because legislators observe every other member's private signals thus have no reason not to share a vote strategy, and is this feature that which makes the party −its size, seat share and likelihood of being in a winning coalition− the central piece in the accountability puzzle.

Furthermore, the fact that legislators observe every other member's private signals results in full party discipline, an unrealistic implication that is however not central to this paper's message. To the extent that assumptions that relax full discipline −such as heterogeneity of objectives among party members (e.g. ideological)− induce some legislators to disregards their information, this would shut down learning about them but would increase learning about every other party member because it decreases the number of legislators that need to be accounted for by voters.

Second, voters are limited in their voting strategy in that they are only allowed to asses and choose legislators based on valence. A more sophisticated voter could in principle consider choosing not only high valence individuals but also a less or more fragmented Parliament directly if this resulted in higher welfare.[37] However, such a concern is not opposed to that of valence, because whichever party structure the voter thought best for her welfare, he would still need to fill those (party) seats with individuals, filling which would ultimately be based on valence (that is, having a single party sharing a lot of information would not be optimal if the individual signals being aggregated are poor).

Third, if voters learn nothing they would be indifferent regarding whether to re-elect a representative, which depending on how this indifferent is broken could induce legislators to disregard their signal and secure re-election. There are many ways to fix this issue, for example breaking the voter's indifference towards changing the incumbent, or assuming that legislators care about society's welfare in top of being re-elected. Below I will focus on informative equilibria.[38]

Fourth, related to the last point, the model does not specify which party(ies) are *de jure* in power, may this be occupying the presidency, cabinet positions or parliamentary leadership positions. This *baseline* model is necessary to be able to study more complex power arrangements, yet I argue that the baseline is still a great approximation of the observed distribution of power in Parliament. First, if a party holds a majority of the seats, it will usually form a single-party majority. In this case, the model echoes previous literature in that this party should be held more responsible that the average non-majority party (Powell Jr 2000). In the logic of the model this is true because, in majority Parliaments, regardless of what any other party does the majority party's vote calls the shots, and voters solve half of the learning problem they have, leaving only the inference regarding individual legislators within the party, which is more accurate the fewer the representatives it has. When no party has a majority, however, every party elected to Parliament is and

[37] Notice this model also prevents legislators to switch parties, which together with a very sophisticated voter could make switching or creating new parties optimal.

[38] Formally, depending on how the voter's indifference is broken, there is always an equilibrium in which all legislators disregard their signals, in which case voters learn nothing from the policy outcome and are indifferent as to whether re-elect their legislator. There can also be an equilibrium where legislators contradict their private information, voting for what from their point of view if most likely the wrong policy, which for all analysis purposes is a re-labelling of the case where legislators follow their signal, but with lower expected welfare consequences.

should be considered *de facto* in power, may this be because of direct power through committee work, veto powers and roll call voting in case the agenda setters call upon them to reach the necessary votes, or indirect power exercised in anticipation of the use of direct power. Crucially, to the extent that the direct and indirect power that each party has relative to other parties comes from their potential voting strength, the model captures exactly the *de facto* power and thus the extent to which voter's should hold them responsible. Second, there is a range of evidence that shows that voters don't only punish government parties, but also other parties holding seats in Parliament, generally according to their seat share and widely advertised veto powers (Duch and Stevenson 2013; Duch, Przepiorka and Stevenson 2015).

A different approach to the last issue is that, just as parties have full discipline, the implicit assumption in the set up is that government coalitions have no discipline, that is, parties vote according to their own information and do not share information nor negotiate with other parties. This is an extreme case, the opposite of which would be that coalition parties share all their information, in which case the current set up would treat the coalition as a merged party, thus both limiting cases are considered here. It would be interesting to extend the model to consider partial information sharing or negotiation (which would potentially reveal some information in equilibrium), and see how this affects accountability of member of the governing coalition vis-a-vis those outside.

B Proofs

Unless otherwise defined, denote:

- $\alpha = \pi + (1-\pi)\frac{1}{2}$, that is, the prior probability that a legislator gets the *ex-post correct* signal.
- $\mathcal{P}$ the partition of the set of legislators.

B.1 Remark 1: Formalization of how the voter learns

This section formally discussed Remark 1 in the text, and also provides the procedure that is used in the empirical section to simulate the model.

The following remark characterizes the posterior beliefs formed by the voter in an N-legislators Parliament, that is, formalizes and generalizes remark 1 in the text and provides some useful results.

Remark 2. *Suppose there exists parties of size $s_1, ..., s_k, ..., s_K$. After observing the policy choice of a Parliament of N legislators fragmented in parties according to $\mathcal{P}$ and a good outcome $\omega = 1$, the voter forms beliefs $\vec{\pi} = (\pi_{s_1}, ..., \pi_{s_K})$, where $\pi_{s_k} = \Pr(\theta_{s_k} = 1 | \omega = 1)$ is her belief that a legislator in a party of size s_k is of high type, defined as*

$$\pi_{s_k} = \Pr\left[\theta_{s_k} = 1 | C_{s_k}, \omega = 1\right] \Pr\left[C_{s_k} | \omega = 1\right] + \Pr\left[\theta_{s_k} = 1 | \neg C_{s_k}, \omega = 1\right] \Pr\left[\neg C_{s_k} | \omega = 1\right] \tag{3}$$

where C_{s_k} is the event "party of size s_k voted for the policy that was ex-post successful".

Equation (3) is simply the weighted average of the updated belief that a legislator is of high valence knowing his party voted in the correct fashion and knowing it didn't, where the weights are the probability the party voted in each way. In order to find $\vec{\pi}$, a system of K equations defined by (3) needs to be solved,

where $\Pr[C_{s_k}|\omega=1]$ and $\Pr[\neg C_{s_k}|\omega=1]$ are themselves a function of $\vec{\pi}$. The beliefs $\Pr[\theta_{s_k}=1|C_{s_k},\omega=1]$ and $\Pr[\theta_{s_k}=1|\neg C_{s_k},\omega=1]$ are specific to each party size and, since they condition on the event C_{s_k}, do not depend on $\vec{\pi}$.

Consider first the object $\Pr[\theta_{s_k}=1|C_{s_k},\omega=1]$. Conditional on conjecturing that the party voted for the *ex-post correct* policy, C_{s_k}, the voter's uncertainty about the valence of one of its members depends on four factors. First, bad types may still get lucky and get a good signal, contributing to their party's good decision. Second, learning is lowest the lower the initial uncertainty, that is, the closer π is to 0 or 1. Third, even if the evaluated legislator is of bad type and gets the incorrect signal, this may be camouflaged by other party members with good signal realizations or by the party's strategic use of its private information in equilibrium.

The following proposition evaluates how learning is affected by these factors.

Lemma 2. *In equilibrium under majority,* $\Pr[\theta_{s_k}=1|C_{s_k},\omega=1]$

(a) decreases with the size of the party

(b) decreases with the probability a bad type gets the correct signal.

(c) increases with π. $\Pr[\theta_{s_k}=1|C_{s_k},\omega=1]-\pi$ *increases with* π *until* $\pi=\sqrt{2}-1$*, then decreases.*

(d) does not change with party system fragmentation.

Proof. (a) First notice that when a party of even-number of legislators gets equal number of signals on each side, that party (under majority rule) follows the prior, because the private signals provide no new information and the event *being pivotal* does not either. Since I assumed that the prior $p\in(1-\alpha,\alpha)$, in case of a tie of signals a party would vote for the *ex-post correct* policy with probability $[\frac{1}{2},\alpha)$. Below I will prove that accountability decreases if in case of tie a group of legislators got the policy right with probability less than α^*, if going from even to odd number of legislators, and always if going from odd to even. Clearly, $\forall\alpha^*$ in an equilibrium involving $\omega=1$, I have that $\alpha^*>\alpha$.

I am now going to prove that with majority rule and tie-breaking rule with success probability R, adding 1 legislator always decreases $\Pr[\theta_{s_k}=1|C_{s_k},\omega=1]$ because:

- from odd to even number of legislators, decreases $\Pr[\theta_{s_k}=1|C_{s_k},\omega=1]$
- from even to odd, decreases $\Pr[\theta_{s_k}=1|C_{s_k},\omega=1]$ iff $R<\pi^*+(1-\pi^*)\frac{1}{2}$

I have that

$$\Pr[\theta=1|\omega=1]=\Pr[\theta=1|\omega=1,y=1]\Pr[y=1|\omega=1]+\Pr[\theta=1|\omega=1,y=0]\Pr[y=0|\omega=1]$$

Recall $\Pr[\theta=1|\omega=1,y=0]=0$ and $\Pr[\theta=1|\omega=1,y=1]=\frac{\pi}{\pi+\frac{1}{2}(1-\pi)}$. On the other hand,

$$\Pr[y=1|\omega=1]=\frac{\Pr[\omega=1,y=1]}{\Pr[\omega=1]}$$

For N even, let $\alpha=\pi'+\frac{1}{2}(1-\pi')$ where $\pi'=\Pr[\theta=1|\omega=1,N]$. Thus

$$\Pr[y=1|\omega=1,N]=\frac{\binom{N}{0}\alpha^N+\binom{N-1}{1}\alpha^{N-1}(1-\alpha)+\cdots+\binom{N-1}{\frac{N}{2}-1}\alpha^{\frac{N}{2}+1}(1-\alpha)^{\frac{N}{2}-1}+\binom{N-1}{\frac{N}{2}}\alpha^{\frac{N}{2}}(1-\alpha)^{\frac{N}{2}}R}{\binom{N}{0}\alpha^N+\binom{N}{1}\alpha^{N-1}(1-\alpha)+\cdots+\binom{N}{\frac{N}{2}-1}\alpha^{\frac{N}{2}+1}(1-\alpha)^{\frac{N}{2}-1}+\binom{N}{\frac{N}{2}}\alpha^{\frac{N}{2}}(1-\alpha)^{\frac{N}{2}}R}$$

Notice that $\binom{N-1}{\frac{N}{2}} = \frac{1}{2}\binom{N}{\frac{N}{2}}$, and that the derivative of this expression with respect to R is smallest at $\alpha \to 0$, in which case the expression is $\to \frac{1+\epsilon\frac{1}{2}R}{1+\epsilon R}$, thus $\Pr[y=1|\omega=1,N]$ is decreasing in R, and so is $\Pr[\theta=1|\omega=1,N]$.

For $N+1$ odd, let $\hat{\alpha} = \hat{\pi} + \frac{1}{2}(1-\hat{\pi})$ where $\hat{\pi} = \Pr[\theta=1|\omega=1,N+1]$. Thus

$$\Pr[y=1|\omega=1,N+1] = \frac{\binom{N+1}{0}\hat{\alpha}^{N+1} + \binom{N}{1}\hat{\alpha}^{N}(1-\hat{\alpha}) + \cdots + \binom{N}{\frac{N}{2}-1}\hat{\alpha}^{\frac{N}{2}+2}(1-\hat{\alpha})^{\frac{N}{2}-1} + \binom{N}{\frac{N}{2}}\hat{\alpha}^{\frac{N}{2}+1}(1-\hat{\alpha})^{\frac{N}{2}}}{\binom{N+1}{0}\hat{\alpha}^{N+1} + \binom{N+1}{1}\hat{\alpha}^{N}(1-\hat{\alpha}) + \cdots + \binom{N+1}{\frac{N}{2}-1}\hat{\alpha}^{\frac{N}{2}+2}(1-\hat{\alpha})^{\frac{N}{2}-1} + \binom{N+1}{\frac{N}{2}}\hat{\alpha}^{\frac{N}{2}+1}(1-\hat{\alpha})^{\frac{N}{2}}}$$

which simplifies to

$$\Pr[y=1|\omega=1,N+1] = \frac{\binom{N+1}{0}\hat{\alpha}^{\frac{N}{2}} + \binom{N}{1}\hat{\alpha}^{\frac{N}{2}-1}(1-\hat{\alpha}) + \cdots + \binom{N}{\frac{N}{2}-1}\hat{\alpha}(1-\hat{\alpha})^{\frac{N}{2}-1} + \binom{N}{\frac{N}{2}}(1-\hat{\alpha})^{\frac{N}{2}}}{\binom{N+1}{0}\hat{\alpha}^{\frac{N}{2}} + \binom{N+1}{1}\hat{\alpha}^{\frac{N}{2}-1}(1-\hat{\alpha}) + \cdots + \binom{N+1}{\frac{N}{2}-1}\hat{\alpha}(1-\hat{\alpha})^{\frac{N}{2}-1} + \binom{N+1}{\frac{N}{2}}(1-\hat{\alpha})^{\frac{N}{2}}} \tag{4}$$

Suppose $R=\alpha$. Simplifying I have

$$\Pr[y=1|\omega=1,N] = \frac{\binom{N}{0}\alpha^{\frac{N}{2}-1} + \binom{N-1}{1}\alpha^{\frac{N}{2}-2}(1-\alpha) + \cdots + \binom{N-1}{\frac{N}{2}-1}(1-\alpha)^{\frac{N}{2}-1} + \binom{N-1}{\frac{N}{2}}(1-\alpha)^{\frac{N}{2}}}{\binom{N}{0}\alpha^{\frac{N}{2}-1} + \binom{N}{1}\alpha^{\frac{N}{2}-2}(1-\alpha) + \cdots + \binom{N}{\frac{N}{2}-1}(1-\alpha)^{\frac{N}{2}-1} + \binom{N}{\frac{N}{2}}(1-\alpha)^{\frac{N}{2}}} \tag{5}$$

I will prove that (5)=(4), by proving both numerators and denominators are equal. Start with the denominator of (4). Recall that by definition of a binomial coefficient $\binom{n}{k} = \binom{n-1}{k} + \binom{n-1}{k-1}$. Thus the first two terms of the denominator of (4) are equal to

$$\binom{N+1}{0}\hat{\alpha}^{\frac{N}{2}} + \binom{N}{0}\hat{\alpha}^{\frac{N}{2}-1}(1-\hat{\alpha}) + \binom{N}{1}\hat{\alpha}^{\frac{N}{2}-1}(1-\hat{\alpha}) = \hat{\alpha}^{\frac{N}{2}-1} + \binom{N}{1}\hat{\alpha}^{\frac{N}{2}-1}(1-\hat{\alpha})$$

The third term in the denominator is $\binom{N+1}{2}\hat{\alpha}^{\frac{N}{2}-2}(1-\hat{\alpha})^2$ which is $\binom{N}{1}\hat{\alpha}^{\frac{N}{2}-2}(1-\hat{\alpha})^2 + \binom{N}{2}\hat{\alpha}^{\frac{N}{2}-2}(1-\hat{\alpha})^2$. The first term of these added to the above is

$$\hat{\alpha}^{\frac{N}{2}-1} + \binom{N}{1}\hat{\alpha}^{\frac{N}{2}-1}(1-\hat{\alpha}) + \binom{N}{1}\hat{\alpha}^{\frac{N}{2}-2}(1-\hat{\alpha})^2 + \binom{N}{2}\hat{\alpha}^{\frac{N}{2}-2}(1-\hat{\alpha})^2 = \hat{\alpha}^{\frac{N}{2}-1} + \binom{N}{1}\hat{\alpha}^{\frac{N}{2}-2}(1-\hat{\alpha}) + \binom{N}{2}\hat{\alpha}^{\frac{N}{2}-2}(1-\hat{\alpha})^2$$

With these operations, I have generated the first two terms in the denominator of (5). Continuing this operation, the general term is.

Which must mean that $\hat{\alpha} = \alpha$. Since $\Pr[\theta=1|\omega=1,N]$ is decreasing in R and $\Pr[\theta=1|\omega=1,N+1]$ constant, for $R > \alpha$ $\Pr[\theta=1|\omega=1,N] < \Pr[\theta=1|\omega=1,N+1]$.
Now if N odd, I have

$$\Pr[y=1|\omega=1,N] = \frac{\binom{N}{0}\hat{\alpha}^{\frac{N-1}{2}} + \binom{N-1}{1}\hat{\alpha}^{\frac{N-1}{2}-1}(1-\hat{\alpha}) + \cdots + \binom{N-1}{\frac{N-1}{2}-1}\hat{\alpha}(1-\hat{\alpha})^{\frac{N-1}{2}-1} + \binom{N-1}{\frac{N-1}{2}}(1-\hat{\alpha})^{\frac{N-1}{2}}}{\binom{N}{0}\hat{\alpha}^{\frac{N-1}{2}} + \binom{N}{1}\hat{\alpha}^{\frac{N-1}{2}-1}(1-\hat{\alpha}) + \cdots + \binom{N}{\frac{N-1}{2}-1}\hat{\alpha}(1-\hat{\alpha})^{\frac{N-1}{2}-1} + \binom{N}{\frac{N-1}{2}}(1-\hat{\alpha})^{\frac{N-1}{2}}} \tag{6}$$

For $N+1$ even,

$$\Pr[y=1|\omega=1,N{+}1]=\frac{\binom{N+1}{0}\alpha^{\frac{N+1}{2}}+\binom{N}{1}\alpha^{\frac{N+1}{2}-1}(1-\alpha)+\cdots+\binom{N}{\frac{N+1}{2}-1}\alpha(1-\alpha)^{\frac{N+1}{2}-1}+\binom{N}{\frac{N+1}{2}}(1-\alpha)^{\frac{N+1}{2}}R}{\binom{N+1}{0}\alpha^{\frac{N+1}{2}}+\binom{N+1}{1}\alpha^{\frac{N+1}{2}-1}(1-\alpha)+\cdots+\binom{N+1}{\frac{N+1}{2}-1}\alpha(1-\alpha)^{\frac{N+1}{2}-1}+\binom{N+1}{\frac{N+1}{2}}(1-\alpha)^{\frac{N+1}{2}}R} \tag{7}$$

First, notice that the only difference between $\Pr[\omega=1]$ in (6) and (7) is when the vote is close. Since the signal realizations of each legislator are independent, these numbers will be equal when

$$\binom{N}{\frac{N-1}{2}}\alpha^{\frac{N+1}{2}}(1-\alpha)^{\frac{N-1}{2}}=\binom{N}{\frac{N-1}{2}}\alpha^{\frac{N+1}{2}}(1-\alpha)^{\frac{N-1}{2}}\left[\alpha+(1-\alpha)R\right]+\binom{N}{\frac{N+1}{2}}\alpha^{\frac{N-1}{2}}(1-\alpha)^{\frac{N+1}{2}}\alpha R$$

which occurs when $R=\frac{1}{2}$. By the same logic, the numerators are equal if

$$\binom{N-1}{\frac{N-1}{2}}\alpha^{\frac{N+1}{2}}(1-\alpha)^{\frac{N-1}{2}}=\binom{N-1}{\frac{N-1}{2}}\alpha^{\frac{N+1}{2}}(1-\alpha)^{\frac{N-1}{2}}\left[\alpha+(1-\alpha)R\right]+\binom{N-1}{\frac{N+1}{2}}\alpha^{\frac{N-1}{2}}(1-\alpha)^{\frac{N+1}{2}}\alpha R$$

which occurs when $R=\frac{N+1}{2N}\left(>\frac{1}{2}\right)$.

Since the numerator of (7) increases in R, at $R=\frac{1}{2}$ the (6)>(7). I know (7) is decreasing in R for the same reasons established above for the N-even case. The proof is done because the lowest value R can take is $\frac{1}{2}$. □

Proof. (b) In the set-up I assume that the probability a bad type gets the correct signal is $\frac{1}{2}$. This is only for expositional purposes, because no results change if I assume this is probability is q. Prior π only affects voters knowledge of each legislator's conditional on knowing she got $y=1$. So,

$$\Pr[\theta=1|\omega=1,y=1]=\frac{\Pr[y=1|\omega=1,\theta=1]\Pr[\theta=1]}{\Pr[y=1|\omega=1,\theta=1]\Pr[\theta=1]+\Pr[y=1|\omega=1,\theta=0]\Pr[\theta=0]}=\frac{\pi}{\pi+q(1-\pi)}$$

Let A be the equilibrium belief that the legislator being evaluated received the correct signal given that her party voted for the correct policy (A does not depend on π). Since $\Pr[\theta=1|\omega=1,y=0]=0$, then $\Pr\left[\theta_{s_k}=1|C_{s_k},\omega=1\right]=A\frac{\pi}{\pi+q(1-\pi)}$, which is decreasing in q (and increasing in π, for (c)). □

Proof. (c) From above, with $q=\frac{1}{2}$, I have $\Pr\left[\theta_{s_k}=1|C_{s_k},\omega=1\right]-\pi=A\frac{\pi}{\pi+\frac{1}{2}(1-\pi)}-\pi$, the derivative of which is positive until $\pi=\sqrt{2A}-1$, 0 at that point, then negative. □

Proof. (d) First, conditional on the event C_{s_k} voters learn nothing from different party system fragmentation. Second, under majority party's "follow their private info" for any party system fragmentation. Thus, party system fragmentation has no effect on learning inside parties. □

Statement 2(d) is due to the fact that, under majority, parties do not learn anything from the mere fact of being pivotal, thus "follow their private information". Under unanimity, on the other hand, parties use a mixed strategy after a combination of signals, and the choice mixture changes with the variables analyzed in $(a)-(d)$ because so does the learning within parties. For this reason, analyzing learning under unanimity in general terms is more convoluted.

B.2 Proof of Lemma 1

Proof. Notice two things. First, under majority rule, the event "*I am pivotal*" provides no information on its own. Second, notice that

$$\Pr(\omega = 1|y = 1) = \frac{\Pr(y = 1|\omega = 1)\Pr(\omega = 1)}{\Pr(y = 1)} = \frac{\left(\pi + (1-\pi)\frac{1}{2}\right)p}{\Pr(y = 1)}$$

$$\Pr(\omega = 0|y = 1) = \frac{\Pr(y = 1|\omega = 0)\Pr(\omega = 0)}{\Pr(y = 1)} = \frac{\left((1-\pi)\frac{1}{2}\right)(1-p)}{\Pr(y = 1)}$$

Thus, $\Pr(\omega = 1|y = 1) > \Pr(\omega = 0|y = 1)$, because it is assumed that $p \in \left((1-\pi)\frac{1}{2}, \pi + (1-\pi)\frac{1}{2}\right)$. By the parallel argument, $\Pr(\omega = 0|y = 0) > \Pr(\omega = 1|y = 0)$. Since private signals are independent, inside a party I have that $\Pr(\omega = 1|\sum \mathbb{1}_{y=1} > \sum \mathbb{1}_{y=0}) > \Pr(\omega = 0|\sum \mathbb{1}_{y=1} > \sum \mathbb{1}_{y=0})$, and analogously $\Pr(\omega = 0|\sum \mathbb{1}_{y=0} > \sum \mathbb{1}_{y=1}) > \Pr(\omega = 1|\sum \mathbb{1}_{y=0} > \sum \mathbb{1}_{y=1})$. Thus, if a group of legislators in a party wishes to maximize the probability that the welfare maximizing policy is chosen, they vote for the policy that gets the most signal realizations in favor.

By backward induction, consider the voter. The voter wishes to maximize the expected ability of its representative. Thus, if his belief that the challenger legislator is of high valence is the prior χ and $\Pr(\theta_{s_k} = 1|\omega)$ is the posterior belief that his current legislator is good given the observation of ω, then her re-election rule is simple: the voter re-elects if and only if he observes $\Pr(\theta_{s_k} = 1|\omega) > \chi$.

Suppose now that a voter re-elects his representative if and only if from his perspective $\Pr(\theta_{s_k} = 1|\omega) > \chi$. Parties don't observe the realization χ. The only tool at a party's disposal is its vote. With it, unless it has a majority, cannot decide the Parliament's decision. However, without observing any other party's signals, a party knows that it is weakly more likely that the decision made in Parliament coincides with the one recommended by the majority of the party's private signals if it votes for this decision. Notice three facts: (1) each legislator wishes to get re-elected, (2) the voter's re-election rule is $\Pr(\theta_{s_k} = 1|\omega) > \chi$, and (3) if the voter anticipates that parties follow their signals, from his perspective $\Pr(\theta_{s_k} = 1|\omega = 0) \leq \pi \leq \Pr(\theta_{s_k} = 1|\omega = 1)$. Fact (3) is true in the $N = 5$ model, but it is also true in general as proved in a parallel paper. Since $\mathcal{C}$ is a cumulative distribution function, then $\mathcal{C}\left(\Pr(\theta_{s_k} = 1|\omega = 0)\right) \leq \mathcal{C}\left(\Pr(\theta_{s_k} = 1|\omega = 1)\right)$. Therefore, the party is better off if it *follows their private information* and thus votes for the policy that gets the most signal realizations in favor.

Two notes. First, that the equilibrium strategy of legislators under the disclosure rule that only the policy outcome is observed is to vote to maximize the probability that the welfare maximizing policy is chosen is not a new result. See Gradwohl (2018) for details equilibrium strategies under different disclosure rules. Second, since legislators ignore the realization χ, this is one of two equilibria, the other being that legislators contradict their signal and in equilibrium the voter knows this, thus the re-election rule holds but this time $\Pr(\theta_{s_k} = 1|\omega = 1) \leq \pi \leq \Pr(\theta_{s_k} = 1|\omega = 0)$; ultimately, this is a simple re-labeling of the original equilibrium with the caveat of an ex-ante voter-welfare inferior policy result. There is also the equilibrium in which the voter expects legislators to ignore their signal and thus they in fact have no incentive to do otherwise; this is an ex-ante inferior equilibrium for both voter- and legislator-welfare. In the text, I focus on the welfare superior, and most intuitive, equilibrium. □

B.3 Solution to $N = 5$ model

This example is solved iterating, using as initial parameter the prior π. Throughout $\alpha = \pi' + (1-\pi')\frac{1}{2}$ and $\pi' = \Pr[\theta_{s_k} = 1|\omega = 1]$. The equations are the following.

When $\mathcal{P} = \{5\}$ or $\mathcal{P} = \{1,1,1,1,1\}$ the solutions coincide, and are equal for any legislator:

$$\Pr[\theta = 1|\omega = 1] = \frac{\alpha^2 + 4\alpha(1-\alpha) + 6(1-\alpha)^2}{\alpha^2 + 5\alpha(1-\alpha) + 10(1-\alpha)^2} \cdot \frac{\pi}{\pi + (1-\pi)\frac{1}{2}}$$

Notice that when $\mathcal{P} = \{5\}$, $\Pr[C_5|\omega = 1] = 1$ and $\Pr[\theta_5 = 1|\omega = 1] = \Pr[\theta_5 = 1|\omega = 1, C_5]$; when $\mathcal{P} = \{1,1,1,1,1\}$, the first fraction is $\Pr[C_1|\omega = 1]$ and the second fraction is $\Pr[\theta_1 = 1|\omega = 1, C_1]$.

When $\mathcal{P} = \{4,1\}$, only the party of size 4 will be held accountable, thus

$$\begin{aligned}
\Pr[\theta_1 = 1|\omega = 1, \mathcal{P} = \{4,1\}] &= \pi \\
\Pr[\theta_4 = 1|\omega = 1, \mathcal{P} = \{4,1\}] &= \frac{\alpha^2 + 3\alpha(1-\alpha) + 3(1-\alpha)^2 \cdot \max\{p, 1-p\}}{\alpha^2 + 4\alpha(1-\alpha) + 6(1-\alpha)^2 \cdot \max\{p, 1-p\}} \cdot \frac{\pi}{\pi + (1-\pi)\frac{1}{2}}
\end{aligned}$$

When $\mathcal{P} = \{3,2\}$, only the party of size 3 will be held accountable, thus

$$\begin{aligned}
\Pr[\theta_2 = 1|\omega = 1, \mathcal{P} = \{3,2\}] &= \pi \\
\Pr[\theta_3 = 1|\omega = 1, \mathcal{P} = \{3,2\}] &= \frac{\alpha + 2(1-\alpha)}{\alpha + 3(1-\alpha)} \cdot \frac{\pi}{\pi + (1-\pi)\frac{1}{2}}
\end{aligned}$$

When $\mathcal{P} = \{3,1,1\}$, only the party of size 3 will be held accountable, thus

$$\begin{aligned}
\Pr[\theta_1 = 1|\omega = 1, \mathcal{P} = \{3,1,1\}] &= \pi \\
\Pr[\theta_3 = 1|\omega = 1, \mathcal{P} = \{3,1,1\}] &= \frac{\alpha + 2(1-\alpha)}{\alpha + 3(1-\alpha)} \cdot \frac{\pi}{\pi + (1-\pi)\frac{1}{2}}
\end{aligned}$$

When $\mathcal{P} = \{2,2,1\}$, let $\alpha_1 = \pi_1' + (1-\pi_1')\frac{1}{2}$ with $\pi_1' = \Pr[\theta_1 = 1|\omega = 1, \mathcal{P} = \{2,2,1\}]$, $\alpha' = \pi_2' + (1-\pi_2')\frac{1}{2}$ with $\pi_2' = \Pr[\theta_2 = 1|\omega = 1, \mathcal{P} = \{2,2,1\}]$, and $\alpha_2 = (\alpha')^2 + 2\alpha'(1-\alpha')\max\{p, 1-p\}$. Then

$$\begin{aligned}
\Pr[\theta_1 = 1|\omega = 1, \mathcal{P} = \{2,2,1\}] &= \frac{\alpha_2^2\alpha_1 + 2\alpha_1\alpha_2(1-\alpha_2)}{\alpha_2^2\alpha_1 + 2\alpha_1\alpha_2(1-\alpha_2) + \alpha_2^2(1-\alpha_1)} \cdot \frac{\pi}{\pi + (1-\pi)\frac{1}{2}} \\
\Pr[\theta_2 = 1|\omega = 1, \mathcal{P} = \{2,2,1\}] &= \frac{\left[\alpha_2^2\alpha_1 + \alpha_1\alpha_2(1-\alpha_2) + \alpha_2^2(1-\alpha_1)\right] A + \left[\alpha_1(1-\alpha_2)\alpha_2\right] B}{\alpha_2^2\alpha_1 + 2\alpha_1\alpha_2(1-\alpha_2) + \alpha_2^2(1-\alpha_1)}
\end{aligned}$$

where $A = \frac{\alpha' + (1-\alpha')\max\{p,1-p\}}{\alpha' + 2(1-\alpha')\max\{p,1-p\}}$ and $B = \frac{\alpha'(1-\alpha')(1-\max\{p,1-p\})}{(1-\alpha')^2 + 2\alpha'(1-\alpha')(1-\max\{p,1-p\})}$.

When $\mathcal{P} = \{2,1,1,1\}$, let $\alpha_1 = \pi_1' + (1-\pi_1')\frac{1}{2}$ with $\pi_1' = \Pr[\theta_1 = 1|\omega = 1, \mathcal{P} = \{2,2,1\}]$, $\alpha' = \pi_2' + (1-\pi_2')\frac{1}{2}$ with $\pi_2' = \Pr[\theta_2 = 1|\omega = 1, \mathcal{P} = \{2,2,1\}]$, and $\alpha_2 = (\alpha')^2 + 2\alpha'(1-\alpha')\max\{p, 1-p\}$. Then

$$\begin{aligned}
\Pr[\theta_1 = 1|\omega = 1, \mathcal{P} = \{2,1,1,1\}] &= \frac{\alpha_2\alpha_1^3 + 2\alpha_1^2\alpha_2(1-\alpha_1) + \alpha_1\alpha_2(1-\alpha_1)^2 + (1-\alpha_2)\alpha_1^3}{\alpha_2\alpha_1^3 + 3\alpha_1^2\alpha_2(1-\alpha_1) + 3\alpha_1\alpha_2(1-\alpha_1)^2 + (1-\alpha_2)\alpha_1^3} \cdot \frac{\pi}{\pi + (1-\pi)\frac{1}{2}} \\
\Pr[\theta_2 = 1|\omega = 1, \mathcal{P} = \{2,1,1,1\}] &= \frac{\left[\alpha_2\alpha_1^3 + 3\alpha_1^2\alpha_2(1-\alpha_1) + 3\alpha_1\alpha_2(1-\alpha_1)^2\right] A + \left[(1-\alpha_2)\alpha_1^3\right] B}{\alpha_2\alpha_1^3 + 3\alpha_1^2\alpha_2(1-\alpha_1) + 3\alpha_1\alpha_2(1-\alpha_1)^2 + (1-\alpha_2)\alpha_1^3}
\end{aligned}$$

where $A = \frac{\alpha'+(1-\alpha')\max\{p,1-p\}}{\alpha'+2(1-\alpha')\max\{p,1-p\}}$ and $B = \frac{\alpha'(1-\alpha')(1-\max\{p,1-p\})}{(1-\alpha')^2+2\alpha'(1-\alpha')(1-\max\{p,1-p\})}$.

Simulations done with $\pi = \frac{1}{2}$ and $p = \frac{3}{4}$.

B.4 Proof of Propositions 1-4

Proof. (1) This is a summary of Proposition 2, 3 and 4. While a party holds the majority of seats in Parliament, fragmentation does not affect non-majority parties, it can only reduce the number of seats held by the majority party which, by Proposition 2, increases its accountability. If fragmentation implies that the majority is loss, electoral accountability of parties other than the biggest party increases, yet the accountability of the biggest party may decrease. □

Proof. (2) $\Pr[C_{s_k}|\omega = 1] = 1$ for the majority party and $\Pr[\theta_{s_k} = 1|C_{s_k}, \omega = 1]$ is decreasing in size by Lemma 2(a) above. For every other party, the Parliaments' output provides no information about the valence of members of parties that do not have a majority, thus $\Pr(\theta_{s_k} = 1|\omega = 1) = \Pr(\theta_{s_k} = 1)$. □

Proof. (3) The moment no party has a majority, $\Pr[C_{s_k}|\omega = 1] \neq \Pr[C_{s_k}]$, thus $\Pr(\theta_{s_k} = 1|\omega = 1) \neq \Pr(\theta_{s_k} = 1)$. □

Proof. (4) In general terms, this is simply a re-statement of remark 2. In particular for $N = 5$, the basic intuition is on the text. □

C Empirical Appendix

This empirical appendix contains the following material:

- Table 6: Basic descriptive statistics of the sample of 313 party-election observations that is used for estimation.
- Table 7: Table 4 showing the full set of controls.
- Table 8: Equation (2) estimated changing the definition of the dependent variable and choosing whether to control for vote share in t. The specification used in text is in the top left corner: dependent variable is change in vote share and I do control for vote share in t. Results are very similar across the board. Changes are used in the text because theorists find more intuitive to think about changes; however, since I include fixed effects, this is really changes as deviations from the mean, which has a slightly more convoluted interpretation. The specification in the top right, using vote share in $t+1$ as dependent variable and controlling for its lag potentially suffers from potentially inconsistent OLS estimates because of the Nickell (1981) problem. From an empirical perspective, the estimation in the bottom right, dependent variable vote share in $t+1$ without controlling for the lag, is the most appropriate, and results are as, perhaps more, supportive of the theory as those in the baseline specification.
- Tables 9 and 10: Effect of Party System Fragmentation, measured by the number of parties or the *effective number of parties* in Parliament, on the electoral accountability of (a) all parties, and (b) government parties. Table 9 tests the effect of party system fragmentation in Parliament and table 10

the effect of party system fragmentation among government parties (only in sub-sample (b)). Results show that fragmentation has neither a monotone nor a quadratic effect in electoral accountability.

- Table 11: Effect of party system fragmentation and Learning, together, on Electoral Accountability.
- Table 12: Effect of Voter Learning on Electoral Accountability, separating the sample in Parliamentary and Presidential, in Single-member district and Multi-member district. Most elections in the sample are under a Parliamentary system and have a Multi-member district system. For this reason, the estimation of some sub-samples of the Presidential systems or the Single-member systems drop one of more of the coefficients of interest, in which case either the coefficients don't exists or the interpretation of the ones that are left is different from what the design intends to measure. In those cases, the results are omitted.
- Table 13: Effect of Voter Learning on Electoral Accountability when controlling for the maximum possible learning that can be achieved in a given Parliament. The nature of electoral data implies that if a party loses vote share because voters hold it responsible for a bad outcome, another party necessarily gains vote share.[39] This could affect the estimates of accountability, biasing them towards zero. One way to account for this is by controlling for the opportunities for learning in any given Parliament, captured by the maximum learning possible for a party in that Parliament. Intuitively, the more voters can learn about some party, the more they will hold it responsible and punish it for a bad outcome; therefore, the more vote share other parties will gain. Table 13 presents the estimates of equations (2), controlling for the maximum learning possible for some party in any given Parliament. The results are consistent with expectations. An increase in unemployment is associated with higher vote shares Parliaments where more learning is possible (as captured by ΔUnemploy $\times$ Max Learning). Importantly, learning about specific parties, captured by ΔUnemploy $\times$ Learning, has a negative sign, which means that when unemployment increases, voters punish parties about whom the can learn more. These results are consistent with, and reinforce, those presented in Tables 1 and 5 in the main text.
- Table 14: Effect of Voter Learning on Electoral Accountability, testing whether the response to the change in unemployment is asymmetric, that is, voters learn and reward/punish more a positive result than a negative one. Results show that most of the effect comes from increases in unemployment. This result does not provide definitive evidence in favor or against different theses because it confounds two steps in the process: learning may be better after a bad outcome, or voters may punish more harshly bad outcomes than they reward good ones.
- Table 15: Effect of Voter Learning on Electoral Accountability, using all elections for which there is data, both those scheduled ahead of time and those called before the next scheduled election. This table is presented solely for transparency purposes, since a-priori I think that called elections should be excluded. Results are very similar, the only difference being that the coefficient $\Delta U \times Learning$ in the majority sample, which is not significant with a p-value of 0.129 (0.046 in original sample).

[39] Recall that the parties gaining may be the ones not included in the sample, making this problem smaller than it could be.

- Table 16: Effect of Voter Learning on Electoral Accountability, when using other economic variables. In particular, the past literature has used unemployment, GDP growth and inflation. In the text I make the case that only unemployment is a good measure. I gave six reasons: (i) its comparable across countries and time; (ii) its a first degree concern to voters; (iii) as opposed to GDP growth and inflation, the average of, and variation on, unemployment rate has remained steady over the years used in the sample; (iv) it is highly observable, through their own experience or that of relatives and community; (v) its the measure that is most often used in the literature on clarity of responsibility; (vi) policy makers can affect unemployment in the short- and medium- term, as opposed to productivity (the main determinant of higher wages and economic growth), which takes several years to be impacted, or inflation, which in developed democracies is usually under the mandate of an autonomous agency. Regarding point (iii), please direct your attention to Figure 6 and the discussion below. Despite being the best measure, unemployment rate has its pitfalls: some countries have unemployment insurance, which would temper the variation, or have strong safety nets, which makes unemployment a less salient issue for voters. For the purposes of transparency and completeness, table 16 estimates equation (2) for the full sample, the sample of majority Parliaments and that of non-majority Parliaments, using four different economic variables: (a) change in GDP per capita, (b) change in average wage, (c) change in the consumer price index, and (d) change in the consumer price index of food products.
- Figure 6: Plot of the average and standard deviation of the three economic variable regularly used in the *clarity of responsibility* literature: (a) GDP growth, (b) Inflation rate, and (c) Unemployment rate. The first two have info for 26 OECD countries since the beginning of the 1970s, but unemployment only has available for 7 countries since then. So, I plot unemployment rate for the 7 countries since 1970 to date, and then for all countries available at each year, risking capturing variation in the composition of countries. The point of this figure is to show that GDP growth and Inflation rate have been decaying since 1970, both in average and, in the case of inflation, variation. This is not an issue for unemployment, which is very stable. This issue is potentially problematic because, in order to test *clarity of responsibility*, on the one hand voters need to care deeply about the economic phenomena they observe to judge their representatives, and on the other I require variation in the economic variable in order to capture variation in punishment. To the extent that both gross national production and consumer prices have stagnated in developed economies, specially since 1990, makes these two variables not ideal candidates to measure economic vote.
- Figure 7: Simulated Voter Learning in OECD Parliaments, 1953-2017, plotted against four different variables: effective number of parties, number of parties, party size (number of legislators) and party seat share.

Table 6: Descriptive Statistics

	N	Mean	SD
Parties			
(56 parties)			
Number of elections	56	5.59	6.28
Fraction Left	56	0.48	
(313 party-elections)			
Seat Share	313	0.36	0.16
Vote Share	313	0.33	0.14
Learning (in $[0, 1]$)	313	0.16	0.15
Fraction Majority	313	0.22	
Elections			
Number of Parties	139	5.42	3.01
Effective Number of Parties	139	2.98	1.26
Fraction Majority	139	0.51	
Fraction SMD	139	0.47	
Fraction Parliamentary	139	0.72	
Fraction Closed List	139	0.51	
Countries			
Number of Parties	24	2.33	0.87
Number of Years	24	5.79	6.76
Fraction European	24	0.67	

Table 7: Effect of Learning on Accountability: Table 4 showing full set of controls

	Full Sample	Majority Parliaments	Non-Majority Parliaments
	(1)	(2)	(3)
ΔUnemploy	0.00	0.01	0.04*
	(0.01)	(0.02)	(0.02)
ΔUnemploy × Learning	-0.04**	-0.02**	-0.17***
	(0.02)	(0.01)	(0.06)
Party: Degree of Learning from Model, in [0,1]	-0.05	-0.07	-0.00
	(0.03)	(0.04)	(0.09)
Party: Vote Share in t	-0.75***	-0.80***	-0.71***
	(0.08)	(0.15)	(0.17)
Parliament: Number of Parties	-0.00	-0.01	-0.00
	(0.00)	(0.02)	(0.01)
Parliament: Effective Number of Parties	-0.02	-0.08	-0.01
	(0.02)	(0.07)	(0.02)
Election t: Single-Member District	-0.04	-0.05	0.15
	(0.04)	(0.17)	(0.16)
Election t: Parliamentary System	0.26***	0.09	0.28***
	(0.03)	(0.16)	(0.09)
Election t: Closed List	-0.09**	-0.01	-0.10
	(0.04)	(0.12)	(0.16)
Constant	0.18*	0.49*	0.25
	(0.10)	(0.27)	(0.23)
R^2	0.585	0.690	0.676
Observations	313	146	167
Mean of Dep Var	0.324	0.405	0.252
ΔU + ΔU×L (p-value)	0.041	0.723	0.016

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 8: Effect of Voter Learning on Electoral Accountability, Different dependent variable and lagged control

	Change in Vote Share, t to t+1			Vote Share in t+1		
	(1)	(2)	(3)	(4)	(5)	(6)
ΔUnemploy	0.00	0.01	0.04*	0.00	0.01	0.04*
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
ΔUnemploy × Learning	-0.04**	-0.02**	-0.17***	-0.04**	-0.02**	-0.17***
	(0.02)	(0.01)	(0.06)	(0.02)	(0.01)	(0.06)
Vote Share in t	-0.75***	-0.80***	-0.71***	0.25***	0.20	0.29
	(0.08)	(0.15)	(0.17)	(0.08)	(0.15)	(0.17)
ΔU + ΔU×L (p-value)	0.041	0.723	0.016	0.041	0.723	0.016
	(7)	(8)	(9)	(10)	(11)	(12)
ΔUnemploy	-0.00	0.01	0.03	0.00	0.01	0.04**
	(0.01)	(0.01)	(0.04)	(0.01)	(0.02)	(0.02)
ΔUnemploy × Learning	-0.03	-0.02**	-0.15*	-0.05**	-0.02*	-0.18***
	(0.02)	(0.01)	(0.08)	(0.02)	(0.01)	(0.05)
ΔU + ΔU×L (p-value)	0.101	0.620	0.083	0.026	0.749	0.007

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is indicated in heading. Top panel only controls for vote share in t. The specification in the text is the top left corner. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 9: Effect of Party System Fragmentation in Parliament on Electoral Accountability

	(1)	(2)	(3)	(4)
ΔUnemploy	-0.01	-0.00	0.00	-0.05
	(0.01)	(0.03)	(0.03)	(0.11)
ΔUnemploy × Number of Parties	-0.00	-0.00		
	(0.00)	(0.02)		
ΔUnemploy × Number of Parties^2		0.00		
		(0.00)		
ΔUnemploy × Effective Number of Parties			-0.01	0.04
			(0.02)	(0.08)
ΔUnemploy × Effective Number of Parties^2				-0.01
				(0.01)
R^2	0.566	0.569	0.567	0.573
Observations	313	313	313	313
Mean of Dep Var	0.324	0.324	0.324	0.324
ΔU + ΔU×NofP (p-value)	0.291	0.704		
ΔU + ΔU×ENofP (p-value)			0.919	0.621

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Coefficients are identified using within-country variation on election results, not within-party variation as in the text. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 10: Effect of Party System Fragmentation in and out of Government on Electoral Accountability

	Government Parties				Non-Government Parties			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ΔUnemploy	0.02	-0.09	-0.06	0.26	-0.00	-0.01	-0.01	-0.05
	(0.02)	(0.10)	(0.08)	(0.28)	(0.02)	(0.03)	(0.04)	(0.08)
ΔUnemploy × Gov N of Parties	-0.03	0.10						
	(0.02)	(0.12)						
ΔUnemploy × Gov N of Parties^2		-0.03						
		(0.03)						
ΔUnemploy × Gov Effective N of Parties			0.03	-0.45				
			(0.07)	(0.45)				
ΔUnemploy × Gov Effective N of Parties^2				0.16				
				(0.17)				
ΔUnemploy × Non-Gov N of Parties					0.01	0.01		
					(0.01)	(0.02)		
ΔUnemploy × Non-Gov N of Parties^2						-0.00		
						(0.00)		
ΔUnemploy × Non-Gov Effective N of Parties							0.01	0.07
							(0.03)	(0.11)
ΔUnemploy × Non-Gov Effective N of Parties^2								-0.02
								(0.02)
R^2	0.765	0.779	0.763	0.775	0.792	0.802	0.794	0.803
Observations	160	160	160	160	153	153	153	153
Mean of Dep Var	0.338	0.338	0.338	0.338	0.309	0.309	0.309	0.309
ΔU + ΔU×GNofP (p-value)	0.144	0.665						
ΔU + ΔU×GENofP (p-value)			0.111	0.274				
ΔU + ΔU×N-GNofP (p-value)					0.616	0.630		
ΔU + ΔU×N-GENofP (p-value)							0.606	0.399

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Coefficients are identified using within-country variation on election results, not within-party variation as in the text. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 11: Effect of party system fragmentation and learning on electoral accountability

	(1)	(2)	(3)	(4)
ΔUnemploy	-0.01	0.00	0.00	0.01
	(0.01)	(0.03)	(0.01)	(0.03)
ΔUnemploy × Number of Parties	-0.00		-0.00	
	(0.00)		(0.00)	
ΔUnemploy × Effective Number of Parties		-0.01		-0.01
		(0.02)		(0.02)
ΔUnemploy × Learning			-0.04**	-0.04**
			(0.02)	(0.02)
R^2	0.566	0.567	0.585	0.586
Observations	313	313	313	313
Mean of Dep Var	0.324	0.324	0.324	0.324
ΔU + ΔU×NofP (p-value)	0.291		0.653	
ΔU + ΔU×ENofP (p-value)		0.919		0.609
ΔU + ΔU×L (p-value)			0.077	0.443

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 12: Effect of Voter Learning on Electoral Accountability, Comparative Perspective

Estimation	Coefficient	Full Sample	Majority Parliaments	Non-Majority Parliaments
		(1)	(2)	(3)
Full sample	ΔUnemploy	0.00	0.01	0.04*
		(0.01)	(0.02)	(0.02)
	ΔUnemploy × Learning	-0.04**	-0.02**	-0.17***
		(0.02)	(0.01)	(0.06)
	ΔU + ΔU×L (p-value)	0.041	0.723	0.016
	Observations	313	146	167
Parliamentary systems	ΔUnemploy	0.00	0.04**	0.04*
		(0.01)	(0.02)	(0.02)
	ΔUnemploy × Learning	-0.04*	-0.01**	-0.17**
		(0.02)	(0.00)	(0.07)
	ΔU + ΔU×L (p-value)	0.044	0.104	0.042
	Observations	215	83	132
Presidential systems	ΔUnemploy	-0.14		
		(0.25)		
	ΔUnemploy × Learning	-0.02		
		(0.17)		
	ΔU + ΔU×L (p-value)	0.741		
	Observations	98	63	35
Multi-member districts	ΔUnemploy	0.02	-0.01	0.06***
		(0.03)	(0.04)	(0.02)
	ΔUnemploy × Learning	-0.18***	-0.27***	-0.20***
		(0.06)	(0.08)	(0.05)
	ΔU + ΔU×L (p-value)	0.004	0.011	0.007
	Observations	174	37	137
Single-member districts	ΔUnemploy	0.02	0.02	
		(0.02)	(0.02)	
	ΔUnemploy × Learning	-0.02***	-0.02***	
		(0.01)	(0.01)	
	ΔU + ΔU×L (p-value)	0.841	0.912	
	Observations	139	109	30

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 13: Effect of Voter Learning on Electoral Accountability, controlling for possible learning

	Full Sample	Majority Parliaments	Non-Majority Parliaments
	(1)	(2)	(3)
ΔUnemploy	-0.03	-0.14**	-0.05
	(0.04)	(0.06)	(0.05)
ΔUnemploy × Learning	-0.05*	-0.02**	-0.30***
	(0.03)	(0.01)	(0.08)
ΔUnemploy × Max Learning	0.08	0.27**	0.28**
	(0.08)	(0.13)	(0.12)
ΔU + ΔU×L (p-value)	0.079	0.019	0.002
Observations	313	146	167

Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 14: Effect of Voter Learning on Electoral Accountability, asymmetric response to unemployment outcome

	Full Sample	Majority Parliaments	Non-Majority Parliaments
	(1)	(2)	(3)
ΔUnemploy	0.00	0.01	0.04
	(0.01)	(0.02)	(0.03)
ΔUnemploy × Learning	-0.04*	-0.01	-0.19**
	(0.02)	(0.01)	(0.08)
ΔUnemploy × Learning × $\mathbb{1}_{\Delta U<0}$	-0.06	-0.08	0.19
	(0.15)	(0.19)	(0.44)
R^2	0.585	0.690	0.678
Observations	313	146	167
Mean of Dep Var	0.324	0.405	0.252
ΔU + ΔU×L (p-value)	0.071	0.927	0.085
ΔU + ΔU×L×$\mathbb{1}_{\Delta U<0}$ (p-value)	0.460	0.657	0.912

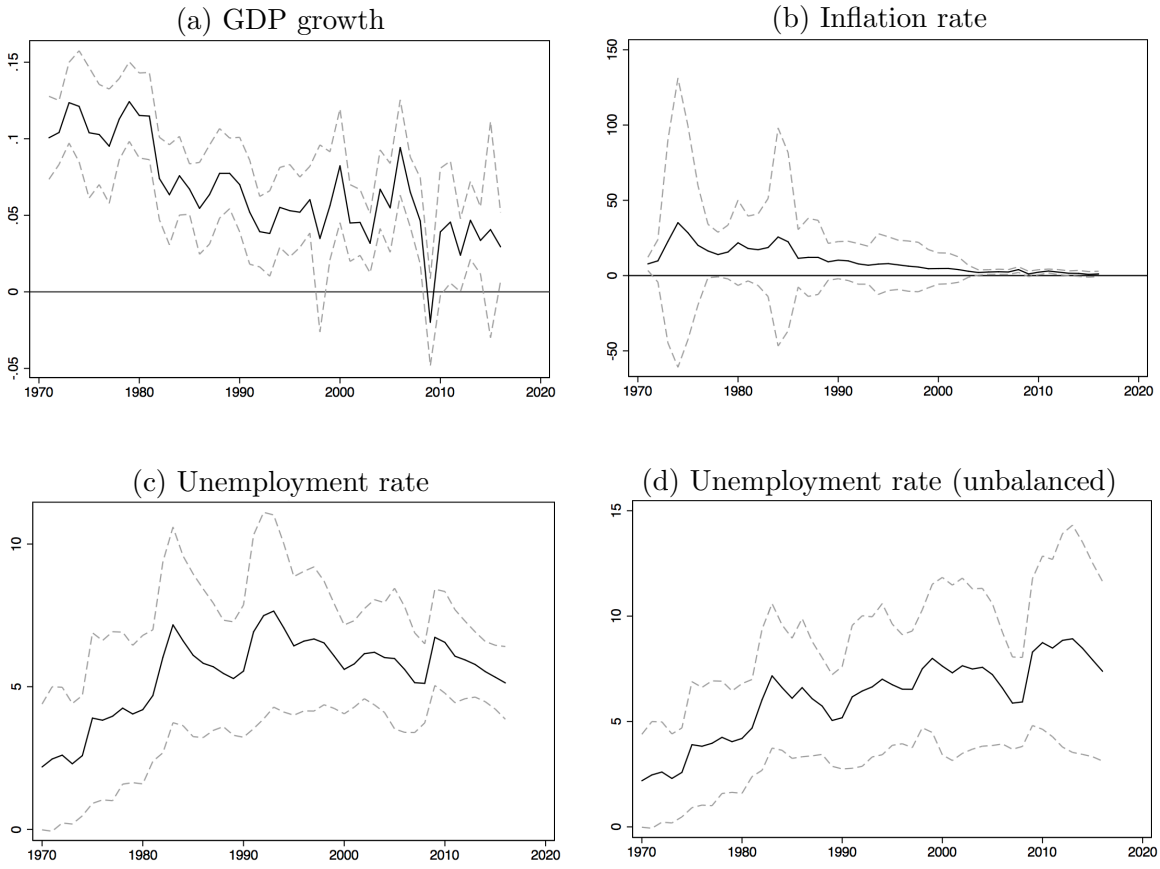
Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. The variable $\Delta Unemploy \times Learning \times \mathbb{1}_{\Delta U<0}$ is equal to $\Delta Unemploy \times Learning$ replaced with 0 whenever $\Delta Unemploy \geq 0$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Table 15: Effect of Voter Learning on Electoral Accountability, Full sample of elections

	Full Sample	Majority Parliaments	Non-Majority Parliaments
	(1)	(2)	(3)
ΔUnemploy	0.01	0.00	0.03**
	(0.01)	(0.01)	(0.01)
ΔUnemploy × Learning	-0.04**	-0.02	-0.12***
	(0.02)	(0.01)	(0.04)
R^2	0.479	0.606	0.556
Observations	451	188	263
Mean of Dep Var	0.316	0.387	0.264
ΔU + ΔU×L (p-value)	0.073	0.179	0.021

Note. Each observation is a party-election, all observations where data is available are used. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Figure 6: Economic variables used in the literature of *clarity of responsibility*



Note. Panels (a) and (b) plot the average for the 26 OECD countries for which there is data from 1971 and 1970 respectively. Panel (c) plots the average of the 7 OECD countries for which there is data from 1970. Panel (d) plots the average of the countries that have data available at each year, so, as opposed to (a), (b) and (c), the composition of the countries changes over time.

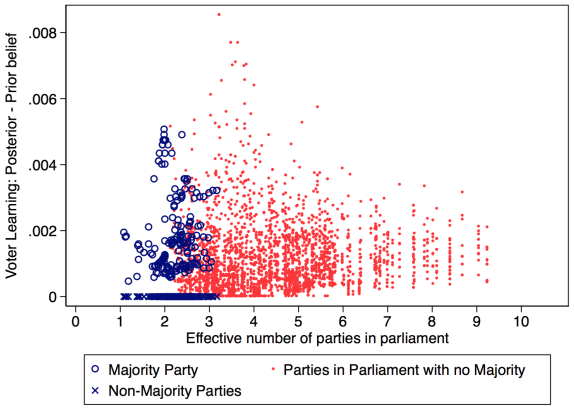
Table 16: Effect of Voter Learning on Electoral Accountability, Different Economic Variables

Economic Variable	Coefficient	Full Sample	Majority Parliaments	Non-Majority Parliaments
		(1)	(2)	(3)
Change in GDP per capita	ΔEcon	-0.02	0.19***	-0.04**
		(0.02)	(0.06)	(0.02)
	ΔEcon × Learning	0.07	0.06	0.12**
		(0.05)	(0.25)	(0.05)
	ΔEcon + ΔEcon×L (p-value)	0.180	0.248	0.081
	Observations	489	154	335
Change in Average Wage	ΔEcon	0.18	0.62**	-0.23
		(0.17)	(0.25)	(0.16)
	ΔEcon × Learning	0.04	0.32	0.66***
		(0.31)	(0.44)	(0.24)
	ΔEcon + ΔEcon×L (p-value)	0.241	0.128	0.001
	Observations	261	71	190
Change in Consumer Price Index (Total)	ΔEcon	0.00	-0.00	0.00
		(0.00)	(0.00)	(0.00)
	ΔEcon × Learning	-0.00	-0.01**	-0.00
		(0.00)	(0.01)	(0.00)
	ΔEcon + ΔEcon×L (p-value)	0.482	0.012	0.808
	Observations	622	208	414
Change in Consumer Price Index (Food)	ΔEcon	0.00	0.00	0.00
		(0.00)	(0.00)	(0.00)
	ΔEcon × Learning	-0.00	-0.01	-0.00
		(0.00)	(0.01)	(0.00)
	ΔEcon + ΔEcon×L (p-value)	0.949	0.327	0.861
	Observations	550	192	358

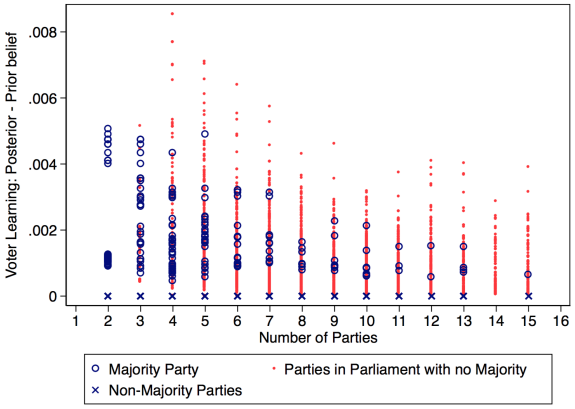
Note. Each observation is a party-election, of which only those observed in two consecutive scheduled elections are included. Dependent variable is change in vote share from t to $t+1$. All columns include party and year fixed-effects, as well as the set of covariates in W_{pct}. Robust standard errors, clustered by party, in parenthesis. Statistical significance: *0.10 **0.05 ***0.01.

Figure 7: Simulated Voter Learning in OECD Parliaments, 1953-2017, plotted against

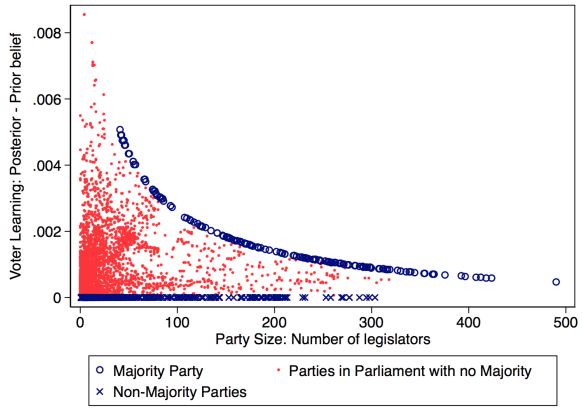
(a) Effective Number of Parties



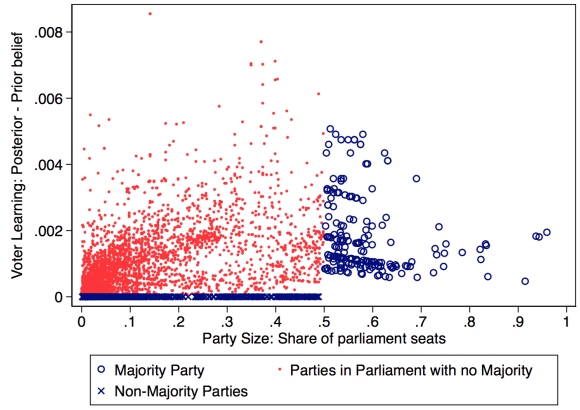
(b) Number of Parties



(c) Number of seats held by each party



(d) Share of seats held by each party



Note. Plotted is the voters' simulated posterior belief that a legislator is of high valence after observing a good outcome, subtracting the prior. Prior $\pi = 0.06$ is used. The dark navy plot corresponds to Parliaments where a party achieved a majority of the seats, red dots those were no party did. Among dark navy, circles are parties that hold a majority of the seats, exes those that do not. 4141 observations are plotted, corresponding to 4141 party-elections.