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Are Firms Gerrymandered?

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Stigler Center

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Abstract

We provide the first evidence that firms, not just voters, are gerrymandered. We compare allocations of firms in enacted redistricting plans to counterfactual distributions constructed using simulation methods. We find that firms are over-allocated to districts held by the mapmakers' party when partisans control the redistricting process. Firms are more proportionately allocated by redistricting commissions. Our results hold when we account for the gerrymandering of seats: holding fixed the number of seats the mapmakers' party wins, firms tend to obtain more firms than expected. Our research reveals that partisan mapmakers target more than just voters.

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"Legislators at the federal, state and local level subject to redistricting are first and foremost concerned about the impact of new district boundaries on their ability to get re-elected. However, many also fight hard to keep or have included in their new boundaries structures which have no voters. Examples are major corporate headquarters, sports arenas, airports, historical landmarks."

-Former member of Congress heavily involved in redistricting

1. INTRODUCTION

Every ten years, state mapmakers redraw the geographic boundaries that determine voting districts for the United States House of Representatives. Economists and political scientists typically study this as an allocation problem in which voters are selected into districts maximizing some criteria. Partisan mapmakers, for example, might optimize their party's power, a practice known as gerrymandering, while court-appointed or nonpartisan bodies might optimize some fairness criteria (Cox & Katz 2002; Coate & Knight 2007; Gul & Pesendorfer 2010; Friedman & Holden 2008; Koltin & Wolitzky 2020; Owen & Grofman 1988).

In this paper, we broaden the study of this allocation problem beyond voters to analyze whether mapmakers also consider firms when drawing district boundaries. Having firms embedded in a district is politically valuable for many reasons:

- (i) they provide campaign financing via political action committees (Stratmann 1996), executives' (Gordon et al. 2007; Fremeth et al. 2013; Fremeth et al. 2016; Richter & Werner 2017), and employees' contributions (Ovtchinnikov & Pantaleoni 2012; Stukatz 2021);

- (ii) they provide a path to power via committee assignments (Jenkins 2021);
- (iii) they can connect to and mobilize voters (Hertel-Fernandez 2018);
- (iv) they provide public goods in their districts (Card et al. 2010; Bertrand et al. 2020; Slattery & Zidar 2020); and,
- (v) they provide legislative subsidies to enable more policymaking (Hall & Deardorff 2006; Ellis & Groll 2020).

Decennial redistricting presents both a rare opportunity for partisan mapmakers to bind firms to districts they represent and the incentives to exploit it. By contrast, non-partisan mapmakers, like redistricting commissions, have the same opportunity but very different incentives. We demonstrate that when given the opportunity, partisan legislators disproportionately allocate firms to their co-partisans, while bipartisan and independent commissions distribute firms more proportionately. Our results hold even when we consider that seats may be gerrymandered as well. They show that the institutional rules for redistricting—specifically variation in who draws the maps, parties or commissions—are a mechanism that permit parties to place firms in districts they control.

Our findings contribute important new evidence to the long-standing study of how redistricting shapes both economic and political outcomes (Nagaraj & Stern 2020; Artés et. al 2021). Existing theories of gerrymandering focus on voters and margins of safety in winning districts (e.g., Coate & Knight 2007; Gul & Pesendorfer 2010; Friedman & Holden 2008; Koltin & Wolitzky 2020; Owen & Grofman 1988). We show that there are other objects of political value worth capturing in legislative maps, namely firms. As such, our work suggests that gerrymandering needs to be studied as a multidimensional problem.

We also bring fresh evidence to theories of corporate political power. The dominant theory of firms and politics (Stigler 1971) posits that firms endeavor to

capture politicians, granting those corporations outsized influence in the political process. Our results suggest a two-way street where politicians also seek to bring firms under their patronage: To the extent partisan mapmakers are successful, it may systematically align major firms and the statewide majority party.¹

Methodologically, we adapt state-of-the-art simulation methods, rooted in outlier analysis (Ramachandran & Gold 2018). This approach is at the forefront of expert reports accepted by courts in high-profile partisan gerrymandering cases.² The novel part of our analysis is to consider the counterfactual distribution of firms in addition to the counterfactual distribution of voters.

The multidimensional nature of gerrymandering makes it difficult to distinguish between firm gerrymandering and seat gerrymandering. Mapmakers could over-allocate firms to their party (a) unintentionally as a byproduct of intentional seat gerrymandering, (b) intentionally in conjunction with intentional seat gerrymandering, or (c) intentionally *without* any seat gerrymandering.³ We present clear evidence that at least in some states, firm gerrymandering results are independent of seat gerrymandering. There are states (e.g. Pennsylvania) in which firms are overallocated to the mapmakers' party even controlling for the number of seats that the party wins. In other states (e.g. Texas), firms are gerrymandered

¹ Location-based business incentives are another tool politicians (rather than parties) use to try to align firms with their interests, enticing firms to move into their localities (Slattery & Zidar 2020; Slattery 2020); however, while firms can decline to locate in a politicians' district for a subsidy, they cannot decline to be redistricted.

² For a recent example see *League of Women Voters of Ohio v. Ohio Redistricting Commission* (2022). The approach has been adopted by courts across the US to evidence racial and partisan gerrymandering (Chen & Rodden 2015). Courts explicitly use the "extreme outlier approach" (*Rucho v. Common Cause*) employing "computers [that] can use census data" to "generate a hundred or a thousand different maps" (*Gonzalez v. City of Aurora*) and demonstrate that an "adopted map is a statistical outlier in contrast with other maps drawn utilizing traditional districting criteria" (*League of Women Voters v. Pennsylvania 2017*), directly affecting "the fortunes of political parties" (*Gill v. Whitford 2018*).

³ Cases (a) and (b) might at first seem to be observationally equivalent, but the two can be separated in some instances (by looking at conditional distribution of firm allocations fixing seats). Case (c) is distinct.

while seats are not. Even in states where we cannot distinguish between an intentional and unintentional firm gerrymander, the result itself (the alignment between firms and political parties at the state-level) has potentially important implications for the performance of democratic institutions.

The paper proceeds as follows. Section 2 lays out an explanatory framework. Section 3 introduces our approach with a tractable example. Section 4 explains how simulation methods allow us to apply our approach to real world data. Section 5 presents results. Section 6 discusses the implications for policy, practice, and research. Section 7 concludes.

2. PARTISAN INCENTIVES TO DRAW FIRMS INTO DISTRICTS

Why should partisan mapmakers care about whether their districts, and not their opponents', contain firms? And how do those incentives differ from non- or bi-partisan commissions? Partisan mapmakers differ from commission mapmakers in that they have incentives to stack the electoral deck in their favor. By contrast, commissions are generally designed to be more politically neutral. We would therefore expect a different allocation of firms in partisan drawn maps than in commission drawn maps if firms are of political value, just like we observe with voters. We proceed to explain that firms are of political value above and beyond voters for two main reasons: (i) electoral benefits, and (ii) power and prestige.

2.1 Electoral Benefits

First and foremost, firms assist with campaign fundraising (Bombardini & Trebbi 2011). Ricco Garcia,⁴ a Democratic political operative with extensive experience

⁴ Garcia, interviewed August 13, 2021, was general counsel/legislative director in 2017 for a member of the Texas House of Representatives Redistricting Committee; he was general counsel/legislative director in 2019 for a member of the Texas Senate Special Committee on Redistricting; and, in 2021 he was Deputy Chief of Staff for a Texas-based member of the US House of Representatives under redistricting threat.

on redistricting in Texas, argued that “Politicians are interested in the companies [being assigned to their district or party] for fundraising.” This claim is supported by a large amount of academic literature on corporations as a source of campaign finance, particularly to politicians representing districts where firms are located. There is a large set of research showing that corporate-linked PACs (along with employees and executives) give more money and give more often to politicians located in their home districts.⁵ In fact, Barack Obama notoriously helped gerrymander his Illinois state Senate district to include more wealthy, business-oriented donors (Lizza 2012).

The more firms a party allocates to their district, the more likely co-partisan politicians are to be able to fundraise effectively. More money can help the party win tight re-election races, can be built into “war chests” to stave off potential challengers from the other party, can be re-allocated to more marginal legislators within their own party, or can be transferred by politicians as “party dues” in exchange for advantageous Congressional committee assignments (Jenkins 2021).

In addition to being a source of money that parties can use to advertise their candidates, firms are visible actors in local economies, giving co-partisan politicians opportunities to attend events such as ribbon-cuttings. This can provide low-cost opportunities for politicians to advertise party platforms and connect with constituents who may be employees of these firms or otherwise aligned with business interests (e.g. Fenno 1977). In exchange, site visits from government officials can boost firms’ market valuations (Schuler et al. 2017). Overall, firms’ public events in home districts provide opportunities for parties and politicians

⁵ Gopojan (1984) finds that running in a “home district” of a firm is nearly as predictive of which candidates a PAC gives to as having key committee membership and is more important than candidate ideology. Regarding employees and executives, Ovtchinnikov and Pantaleoni (2012) find that individual constituents are more likely to make campaign contributions to politicians when they represent Congressional districts with a greater clustering of firms in a single industry, particularly when those politicians serve on relevant Congressional committees.

both to advertise themselves and to credit-claim for their activities in the district.⁶ Firms can also influence voters more directly to help politicians and parties through things like mobilizing their employees (Hertel-Fernandez 2018) and manipulating the timing of employment decisions (Bertrand et al. 2018).

2.2 Power and Prestige

Firms can also help politicians elevate their position *within their party*, an important criterion for advancing in Congress and to higher office. For example, politicians often receive committee appointments related to the sectors of the firms in their districts. Ricco Garcia notes that “one of the reasons firms are drawn into districts is to [help politicians] get on prestige committees.” This builds a symbiosis between firms and politicians: firm support helps politicians advance in seniority on relevant committees, which in turn improves the value of those firms’ privileged access to government services. Weingast and Marshall (1998) argue that “service to *local interests* attracts both votes and organized resources for the district's representative. Service to this group by an *outsider*, in contrast, attracts only the latter and may lose votes” (emphasis ours). Serving on prestige committees also helps politicians attract more campaign contributions from firms inside and outside of their districts (Grier & Munger 1991).

Finally, local businesses are a source of information for parties that can improve policymaking: politicians may trust information from firms in their districts because it comes from their constituency and is more closely linked to re-election prospects (Fenno 1977). Congressional staffers for both parties believe that local businesses can be one of the most valuable sources of information on

⁶ One redistricting consultant said he received requests (i) to split a major outdoor events venue that housed no voters across two districts so each representative could get free tickets; (ii) to draw a country club into a district, so a party member could get free membership; and (iii) keep a representative’s mother in his own district.

what is happening in their districts (Hertel-Fernandez, Mildenerger, & Stokes 2019), acting as “service bureaus” to supplement overworked legislative staff through information gather that enables them to sponsor more legislation and engage in more credit claiming (Hall and Deardorff 2006).

3. ILLUSTRATING SEAT AND FIRM GERRYMANDERING

Given that firms have value to politicians, we expect partisan mapmakers to consider them in their redistricting plans. Hence our core hypothesis is maps drawn by partisan redistricting bodies (as opposed to independent bodies) will disproportionately allocated firms to districts the majority party controls.⁷

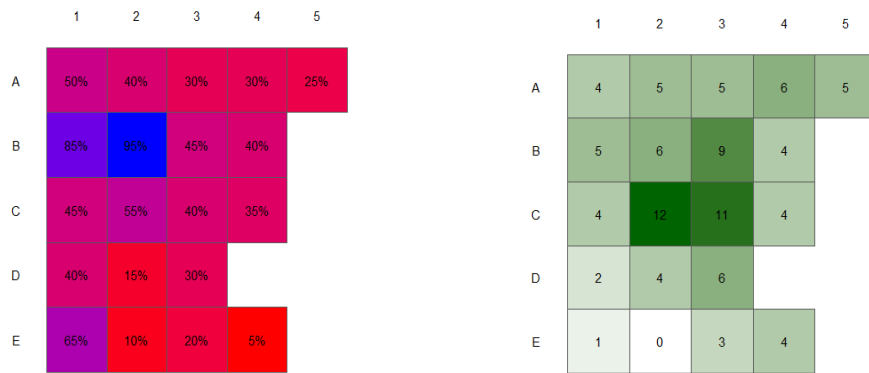
In this section we explore three core ideas: i) what firm gerrymandering might look like, ii) how it is different from seat gerrymandering, and iii) how both firm and seat gerrymandering might interact. We use a stylized example to show the intuition and set up our simulation approach.

Figure 1A introduces New Gerryland, a hypothetical state with 20 equal sized and equally-populated voting precincts to be allocated by a mapmaker into 5 electoral districts of 4 precincts each. Each precinct has a share of Democratic voters (Panel A) and a number of firms (Panel B). The top-left precinct (A1) has a 50% vote share for Democrats and 4 firms; the top-right precinct (A5) has a 25%

⁷ We do not know exactly what strategies are used in firm gerrymandering, nor does it matter for our conceptual introduction or empirical results. While seat and firm gerrymandering tends to move together, there is no reason to expect that strategies used to gerrymander firms are the same as the strategies used to gerrymander seats (i.e. drawing non-compact districts, “packing” some districts, and cracking other districts). We show in Figure 1I that there are trade-offs in seat gerrymandering and firm gerrymandering in practice, given tensions between the goals of each. In seat gerrymandering, the goal is to waste the out-party’s votes by crossing a threshold of own-party voters (Stephanopoulos & McGhee 2015). In firm gerrymandering, the goal is to maximize firms allocated to your own party, given that each firm has value. (There may be a few exceptions where particular firms or clusters of firms are toxic in general or toxic to the majority party in the district (McDonnell & Werner 2016).) Regardless of the exact strategies used to draw individual gerrymandered districts, we can still assess firm gerrymandering (either in conjunction with or separately from seat gerrymandering) in aggregate in state-wide redistricting plans.

vote share for Democrats and 5 firms. Overall, 40% of voters in New Gerryland are Democrats and there are 100 firms. In a completely proportional allocation, we would expect 2 Democratic and 3 Republican districts, with 40 firms in Democratic districts and 60 firms in Republican districts.⁸

Figure 1A - New Gerryland Precinct Map: Location and Attributes of Twenty Equal-population Voting Precincts to be allocated to Five Electoral Districts
Panel A - Vote Share by Precinct Panel B - Firm Counts by Precinct



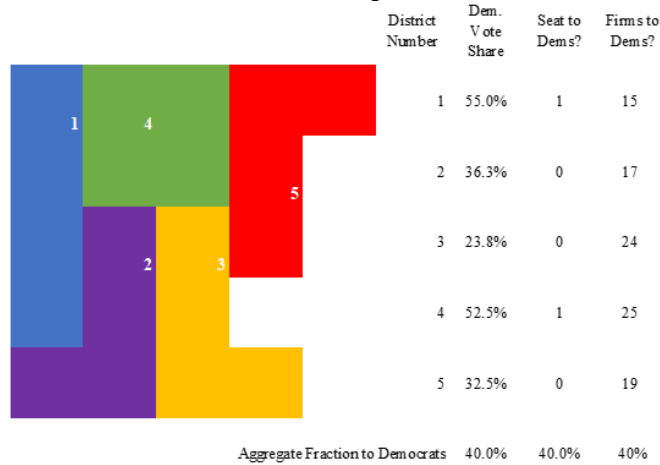
3.1 A State-wide Proportional Redistricting Plan

First, consider a mapmaker seeking to allocate both seats and firms proportionally to voters, such that Democrats win 2 of 5 seats and 40 of 100 firms Figure 1B provides an example of such an allocation. Districts 1 (blue) and 4 (green) are majority-Democratic, with 55.0% and 52.5% of the vote share respectively, and contain 15 and 25 firms. The bottom row in this table presents state-wide

⁸ The hypothetical map presents a simplified representation, but contains a number of realistic features with respect to the location of firms and voters. First, the state is not a perfect 4x5 rectangle, consistent with rough boundaries in many states. Second, like-minded ideological voters tend to be clustered closer to others with similar views. Third, firms and voters are clustered more densely together in some areas than others. Finally, there is a positive correlation between Democratic voters and firms within precincts; in the real world, this correlation arises from Democratic voters and corporate headquarters tending to reside in or near urban areas. Appendix A shows all 100 feasible redistricting plans for New Gerryland. Note that for simplicity, we exclude the possibility that two precincts could be contiguous if their corners touch.

summary statistics: the state-wide vote share, the percentage of districts won by Democrats, and the percentage of firms allocated to districts with a Democratic majority.⁹

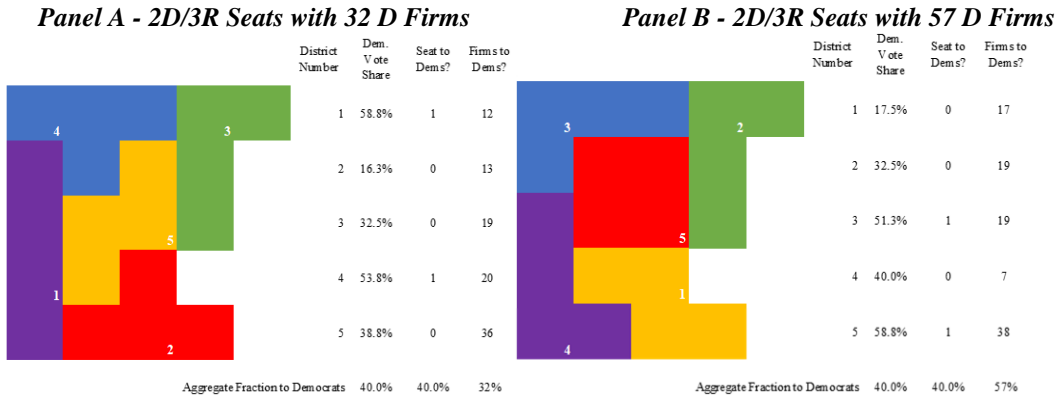
**Figure 1B - New Gerrymander Redistricting Plan 60:
Democrats win seats and firms equal to their vote share**



It is also possible to draw maps where seats are proportional to voters, but where the allocation of firms is not. In both panels of Figure 1C, Democrats win 2 of 5 seats, but their firm yield varies considerably. Plan 42 in Panel A yields 32 firms for Democrats while Plan 97 in Panel B yields 57, a large and politically meaningful difference: even when seat allocations must be proportional to vote shares, mapmakers can reallocate 25% of a state’s total firms from one party to another. Even plans that look neutral in seat allocations may favor one party in terms of firms, leaving room for mapmakers to gerrymander firms.

⁹ E.g. to calculate the percentage of firms a plan allocates to a Democratic majority district, we use the following operation = $(1 * 15 + 0 * 17 + 0 * 24 + 1 * 25 + 0 * 19) / 100 = 40\%$.

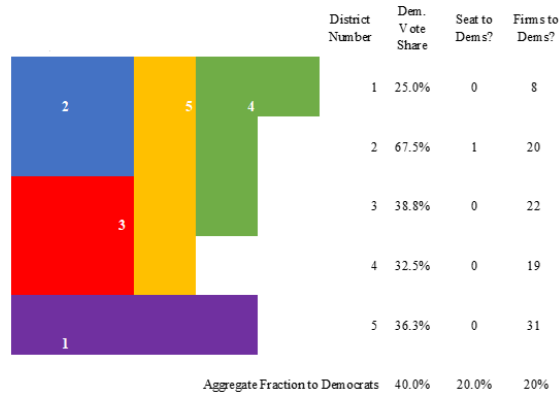
Figure 1C - New Gerrymand Redistricting Plan 41 and Redistricting Plan 97: Democrats win seats proportional to their vote share, but may receive disproportionately fewer firms (A) or more firms (B)



3.2 A Republican-biased Plan

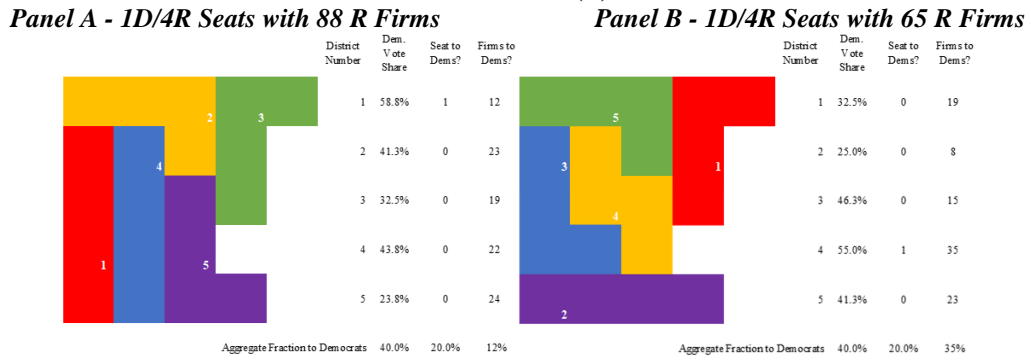
Now consider a biased mapmaker seeking to favor their party. Since Republicans control the majority of voters in our hypothetical state, what map might Republicans draw? They might prefer a plan that limits Democrats to 1 seat, giving Republicans 4 out of 5 seats and maximizing their delegation.

Figure 1D - New Gerrymand Redistricting Plan 20: Democrats win disproportionately few seats, and equally disproportionately few firms.



Plan 20, displayed in Figure 1D, is one such plan. It allocates 80 firms to Republicans (and 20 to Democrats), what we might expect from a 1D/4R split if seats were proportional to firms. Republicans strictly prefer Plan 20 to any plan giving them 3 seats: 68 firms is the most they can obtain with any 3-seat plan whereas in Plan 20 they receive 80 firms. But even among plans where Republicans win 4 seats, there is substantial variation in firm allocations: Plan 1, shown in Figure 1E Panel A, gives Republicans 88 firms, while Plan 48, shown in Panel B, gives them only 65 firms. The range of firm allocations is 23, similar to the range of 25 for 2D/3R plans. Therefore, firm gerrymandering may exist within extreme seat allocations.¹⁰

Figure 1E - New Gerryland Redistricting Plan 1 and Redistricting Plan 48: Democrats win disproportionately few seats, and even fewer firms (A) or a proportionate number of firms (B).



3.3 Full Distribution of Gerrymandering Possibilities

New Gerryland has only 20 precincts, so we can draw all 100 feasible redistricting plans and summarize their characteristics, sketching a possibilities' frontier for both seats and firms. This frontier identifies which outcomes might be

¹⁰ The comparison between the 1D/4R and 2D/3R plans illustrates that when a party wins an additional seat, they usually also win additional firms. A mapmaker trying to optimize their seats will tend to also accrue extra firms and vice versa, but optimizing one does not necessarily optimize the other.

gerrymandered by revealing if they are statistical outliers, falling in the extremes of the seat distribution, firm distribution, or the joint distribution of both.¹¹

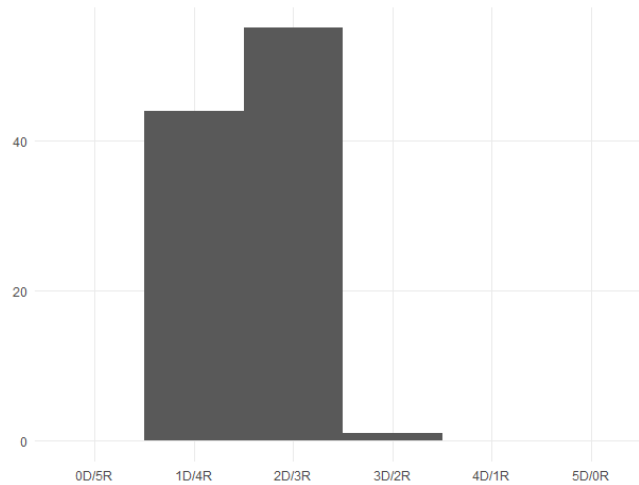
3.3.1 Seat Gerrymandering Defined

First, we look at the empirical distribution of seats. For each of 100 plans, we calculate how many seats Democrats would win and present that distribution on Figure 1F. Each bin represents a possible seat allocation, from 5 Republican to 5 Democratic seats; each bin's height represents how many possible plans result in that allocation. Although there are six conceivable outcomes, only three are feasible: 1D/4R, 2D/3R, and 3D/2R. The expected outcome of redistricting in New Gerryland is a 2D/3R plan—occurring in 55 out of 100 plans—consistent with an expectation that a neutral plan might allocate seats proportional to voters.

Which of the alternative outcomes might we call a *seat* gerrymander? A 1D/4R seat allocation biasing towards Republicans' arises in 44 out of 100 feasible plans so is relatively statistically likely, illustrating that not all deviations from that expectation are gerrymanders. A 3D/2R seat allocation biasing towards Democrats, however, only occurs once among all 100 feasible plans. Hence, the 3D/2R seat allocation falls at the 99th percentile of the seat distribution, providing compelling evidence of seat gerrymandering. According to outlier analysis standards, a one-sided p-value for a randomly selected plan being as, or more, favorable to Democrats than a 3D/2R realization is 0.01, while the p-value of selecting a random plan as or more favorable to Republicans as a 1D/4R seat allocation is 0.44.

¹¹This *outlier analysis* is routine in judicial proceedings when litigating redistricting lawsuits.

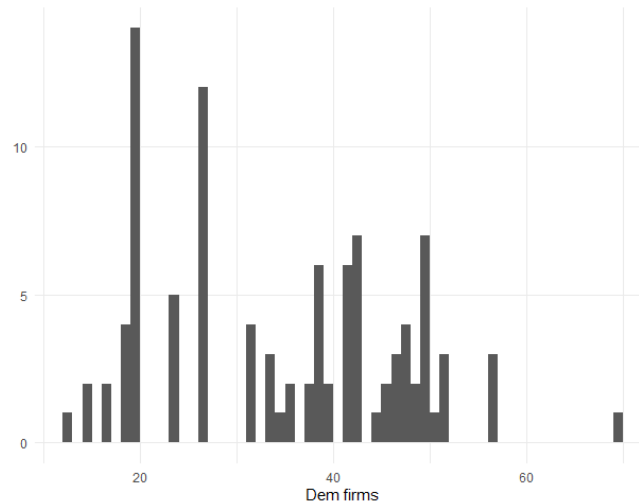
Figure 1F - New Gerrymander: Histogram of Seat Allocation in Population of Feasible Redistricting Plans



3.3.2 Firm Gerrymandering Defined

We can extend the same logic for *seats* to *firms* to help identify *firm* gerrymanders. Looking again at each of the 100 plans, we calculate how many firms fall into districts that Democrats win, presenting that distribution in Figure 1G. In a proportional plan, 40 firms would land in Democratic districts, which we find near the distribution median. The modal outcome, occurring in 14 distinct plans and represented by the tallest bar, places 20 firms in Democratic districts. A plan where Democrats receive the minimum possible 12 firms falls at the 99th percentile of Republican *firm gerrymandering*, while the plan where they receive the maximum possible 70 firms falls at the 99th percentile of Democratic *firm gerrymandering*. With a one-sided quantile threshold of 0.1 we can consider the 10 leftmost plans (out of 100) to be Republican firm gerrymanders and the 10 right-most plans to be Democratic firm gerrymanders. Hence, in New Gerrymander, any plan allocating 19 or fewer firms to Democrats is a firm gerrymander for Republicans and any plan allocating 51 or more firms to Democrats is a firm gerrymander for Democrats.

Figure 1G - New Gerrymandering: Histogram of Firm Allocations in Population of Feasible Redistricting Plans

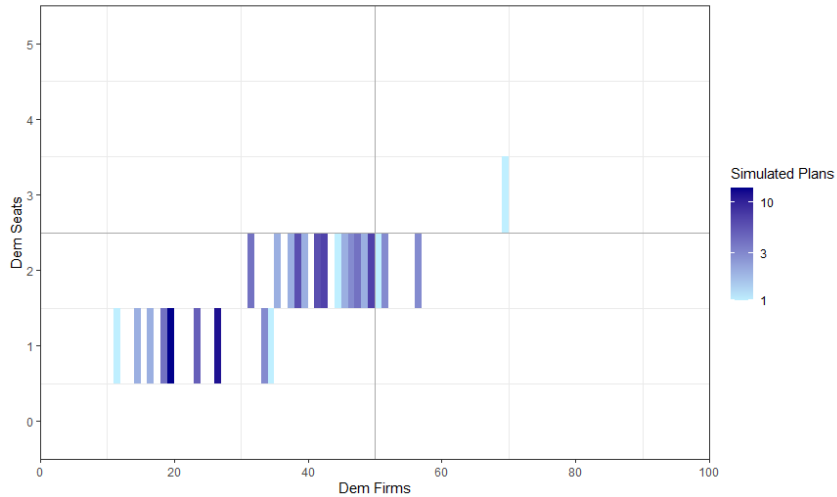


3.3.3 Joint Seat and Firm Gerrymandering

Firm and seat gerrymandering interact in important ways, apparent in the joint distribution of firms and seats in Figure 1H. The vertical axis indicates the number of seats allocated to Democrats, while the horizontal axis presents bins for the number of firms allocated to Democrats; darker bars indicate more frequent firm-seat combinations. The lightest bars appear in cells for 1D seat/12 Democratic firms and 3D seats/70 Democratic firms as these allocations only occur once among the 100 feasible redistricting plans.

In the top right of the figure is a plan that allocates 3 seats and 70 firms to Democrats. It is as extreme as possible on both dimensions, and therefore appears to be the optimal choice for Democrats. According to our definitions above, it is both a *seat* gerrymander (because there are 3 or more seats allocated to Democrats) and a *firm* gerrymander (because there are 51 or more Democratic firms). But importantly, because there is only one map allocating 3 seats to Democrats, we cannot positively conclude that by selecting this plan mapmakers *intentionally* maximized firms rather than targeting seats.

Figure 1H - Joint Distribution of Seat and Firm Allocation Pairs in Population of Feasible Redistricting Plans for New Gerryland



However, consider the most Republican extreme, a redistricting plan allocating only 1 seat and only 12 firms to Democrats.¹² In this case, we have new leverage to disentangle firm targeting from seat targeting. If Republicans were merely trying to maximize seats, they need not pick the most extreme plan in the bottom-left; there is a large range of options for how many firms they could obtain among the 44 plans that do so. These options form the *seat-conditional firm distribution*, supplying Democrats with anywhere from 12 to 35 firms, with 20 being both the mode and the median. If Republicans were to allocate exactly the minimum 12 firms to Democrats, that would evidence a *seat-conditional* firm gerrymander, or

¹² Note also that a given redistricting plan can be at extreme bounds and optimal on both dimensions (i.e. near the corners of the joint distribution) and be a joint firm and seat gerrymander (i.e. considering both dimensions) without necessarily being a seat or firm gerrymander by itself (i.e. when only accounting for statistical extremity in one dimension). This is because when we look at two dimensions the statistical rarity of any given cell representing a seat-firm allocation pairing can be taken into account rather simply a bin of either seats or firms which may have too many observations in it to declare it a gerrymander, e.g. as in the case of 1D/4R seat allocations not being a seat gerrymander given the frequency with which they arise.

firm targeting, since an allocation of firms as extreme occurs only 1 out of 44 times (p-value = 0.023) among the set of plans that yield 1D/4R seats.

It is a complex problem to disambiguate between seats and firms being targeted explicitly by mapmakers. If we define firm gerrymandering only as an extreme firm allocation relative to the *unconditional* full set of possible maps, we may miss cases where firms are targeted in *conditional* firm gerrymanders. Consider plans in the 2D/3R row. Given this allocation of seats, Democrats may yield anywhere from 32 to 57 firms. The 57-firm plan is extreme both overall/*unconditionally* and *conditional* on its firm allocation and is a Democratic firm gerrymander either way; however, a 32-firm plan is only extreme in the *conditional* distribution and is a Republican *conditional* firm gerrymander but not an *unconditional* one. Either a 32-firm allocation or a 57-firm allocation, nevertheless, provides strong evidence that mapmakers prized firms given some reason to select a 2D/3R plan. Hence, it is important to analyze both the overall/*unconditional* allocation of firms into districts and the allocation *conditional* on the number of seats in the enacted plan to detect whether firms were targeted by mapmakers.

Importantly, the New Gerryland example exposes that extreme outcomes on the firm distribution could be intentional (i.e., reflecting specific targeting by mapmakers) or merely a by-product of the mapmakers' focus on seats. Regardless of why a firm gerrymander occurs, an extreme, disproportionate allocation of firms to one party and/or firms being targeted by mapmakers is consequential: it structurally aligns those firms with the party in power that drew the lines, changing incentives for both firms and politicians. We consider the implications for various stakeholders in more detail in our discussion.

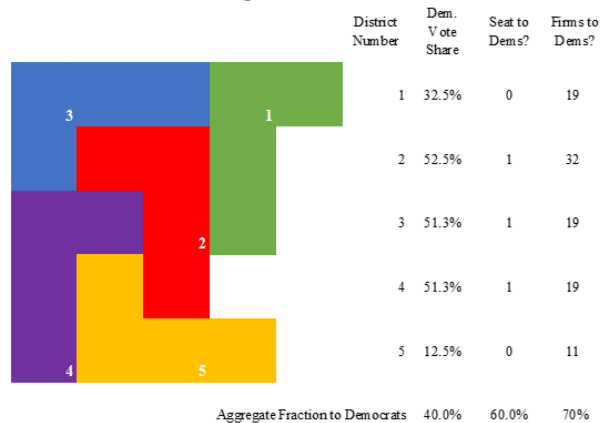
3.4 Picking the Optimal Plan?

We close this section by noting that mapmakers may not always want to select the

plan that maximizes both firms and seats for their party. It is easy to construct a case where the goals of the party directly conflict with the goals of individual incumbents, and to imagine how mapmakers' expectations about the future shape their redistricting decisions. For example, consider Figure 1I, New Gerryland Redistricting Plan 100; the plan maximizes both seats and firms for Democrats at 3 of 5 and 70 of 100 despite a minority of 40% of the voters.

While Democrats win three seats in this plan, their margins are slim. The safest seat is won by only 5 percentage points, and the others by less than 3; a normal-size national swing would endanger 2 of the 3 seats. Democratic incumbents or a risk-averse mapmaker might prefer 2 safe seats to 3 marginal ones, and may instead maximize the firms they yield conditional on winning just 2. On the other hand, Democratic mapmakers might have more optimistic expectations. If demographic changes in their marginal districts bode well, they might ambitiously opt to seize 3 seats after all, betting that they will become safer over time.

Figure 1I - Plan 100: Democrats win disproportionately many firms and seats, but their vote margins are narrow.



Redistricting is an idiosyncratic process, relying on political geography, incumbent demands, partisan constraints, judicial scrutiny, party power structures, and much more. It is impossible to capture the full complexity in a simplified

example like New Gerryland because different actors face different constraints when optimizing. Nevertheless we have outlined clear expectations about how partisan mapmakers might draw lines with firms in mind, expectations that we systematically test in Section 5 after explaining our methodology for constructing a counterfactual distribution.

4. METHODS: SIMULATING REDISTRICTING PLANS

In our New Gerryland example with only 20 precincts, we are able to enumerate the complete set of redistricting plans and identify optimal ones for different partisan actors. It is not feasible to identify every unique redistricting plan in the real world; there are too many ways to draw district boundaries in a given state.

Using real-world data with simulation methods, we can nevertheless randomly sample from the set of all redistricting plans and obtain the probability of any given seat or firm allocation; our inferences use those representative samples as a *null distribution* with which we conduct outlier analysis as above. There is a long literature using Monte Carlo methods (Chen & Rodden 2013; Tam Cho & Liu 2016; Cain et al. 2017; Chen & Stephanopoulos 2020; Fifield et al 2020) to study racial and partisan gerrymandering; we are the first to apply them to firms. We calculate p-values by quantifying how extreme an observed plan's allocation of firms is relative to the simulated null distribution of potential allocations of firms, indicating how likely it is that such an extreme outcome occurred by chance. If a partisan redistricting plan generates a firm allocation in the 500 most extreme allocations out of 50,000 simulated plans, the p-value for observing something as extreme by chance would be 0.01—strong evidence of firm gerrymandering.

4.1 Data

We conduct these simulations for 17 districting plans across 14 states (see Table 1). We selected these states through data availability considerations. To conduct these simulations we require precinct-level population (to satisfy One Person, One Vote requirements), racial and ethnic demographics (to satisfy Voting Rights Act compliance), and vote share (to calculate district winners) linked to precinct geographies¹³; we draw these data from the Metric Geometry and Gerrymandering Group’s MGGG States Project¹⁴. We link these data to the geolocated addresses of publicly-traded US firms’ headquarters acquired from the COMPUSTAT data set.¹⁵

Table 1: State districting plans in our analysis

State	Year	Type	Seats	Firms
AZ	2012	Commisison	9	109
GA	2012	Republican	14	175
IA	2012	Commisison	4	43
MA	2012	Democrat	9	541
MD	2012	Democrat	8	341
MN	2012	Republican	8	140
NC	2012	Republican	13	182
NC	2016	Court	13	182
NM	2012	Democrat	3	6
OH	2012	Commisison	16	243
OR	2012	Democrat	5	54
PA	2012	Republican	18	399
PA	2018	Court	18	399
TX	2012	Republican	36	715
VA	2012	Republican	11	224
VA	2016	Court	11	224
WI	2012	Republican	8	105

¹³ There is no room for error in this linkage: if some precincts are missing from either the geography or election results, the simulations will not be valid.

¹⁴ The MGGG Project collects data for states beyond the 12 we study, but the remaining data sets are not suitable for a variety of reasons: some have too few districts, or have election data from too late in the redistricting cycle (2018+ rather than 2012-2016).

¹⁵ We note that there are two primary reasons we focus on headquarters of publicly-traded firms. First, data availability constraints allow us to readily obtain a complete set of addresses for this set of firms’ headquarter locations (but not necessarily all ancillary or alternative facilities). Second, we believe these are probably the most valuable firms to politicians and also most likely their most valuable location, so if firms are gerrymandered, these should be the locations mapmakers prioritize.

4.2 Simulation Mechanics

Our simulation procedure follows the Sequential Monte Carlo (SMC) procedure of McCartan and Imai (2020). Considering a precinct map as a network with precincts as nodes and precinct adjacency as edges connecting those nodes, the process of generating a district map involves selectively removing edges of that network. Our simulation procedure has five steps. First, we create the precinct adjacency matrix from a state precinct map.¹⁶ Second, we conduct the SMC procedure, drawing 50,000 plans per state, with constraints for compactness, contiguity, county boundaries, and majority-minority districts, thereby ensuring that each district we draw is legally valid¹⁷. Third, we overlay each generated plan with our data set of geolocated firms. Fourth, we infer expected two-party vote shares for every district in every plan. Finally, we assign firms to parties based on district vote shares.¹⁸

4.2.1 Estimating District Vote Shares

In estimating vote share for simulated districts, researchers typically make a number of key assumptions. Consider the 2012 Congressional districts for a given state. Once we simulate 50,000 plans, we must identify how many seats Democrats are expected to win in each plan. To do this, we identify how each precinct voted in the 2012 House of Representatives elections, then sum each party's vote in each district in each plan. We make a *district invariance assumption*: a precinct's vote is invariant to the district that precinct is in.¹⁹

¹⁶ The *redist* R package includes tools for correcting imperfect precinct geometries with incomplete adjacency matrices by suggesting neighboring precincts. This helps account for states with discontinuous segments like the Hawaiian Islands or Michigan's Upper Peninsula.

¹⁷ Our simulation results are generally robust to simulation parameters; setting constraints to extreme values rarely moves our substantive *p*-values into or out of significant ranges.

¹⁸ We give expanded details of this procedure in Appendix 3.

¹⁹ This assumption may not hold if different districts feature candidates of different quality: in the extreme case, some districts might not have a candidate for one of the two parties at all.

Moreover, for some states, precinct-level vote totals for the election of interest may not be publicly available, and researchers may use 2012 Presidential vote share or 2014 House of Representatives vote share to infer how precincts would vote under simulated plans in the 2012 House of Representatives. Using these introduces new assumptions: for the 2012 Presidential election results, that vote share is invariant to the ballot item, and for 2014 House of Representatives election results, that vote share is stable over time.²⁰ To weaken our reliance on these assumptions, rather than use a single election to infer precinct-level vote, we average the precinct-level vote for as many elections as we have available to produce an estimate of a precinct's latent vote share for each party.²¹

4.2.2 Assigning Firm Allocations to Parties

Having identified the partisan balance of each district in each simulated plan, we can calculate any number of test statistics to capture seat or firm gerrymandering. Just as we calculate the number of seats that Democrats win to measure seat gerrymandering, our primary test statistic of firm gerrymandering calculates the proportion of firms that fall in districts with a simple Democratic majority.

In states where Democrats draw the lines, we expect that the *realized* proportion of firms in Democratic districts will be much higher than in the modal simulated plan, and in states where Republicans draw the lines, the realized plan will give more firms to their districts than the modal simulated plan. As well, in states redistricted by non-partisan or bipartisan agents, the realized proportion of firms in Democratic districts should be closer to the modal simulated plan.

²⁰ Both the election invariance and ballot item invariance assumptions may not hold. The correlation between ballot items is strong but imperfect, threatening the ballot item invariance assumption; and while vote shares are often stable over time, there are both systematic differences between Presidential and midterm elections and secular national swings that threaten the election invariance assumption.

²¹ Appendix 2 details election aggregations for each state.

5. RESULTS: EXTREME FIRM ALLOCATIONS

Our core analysis parallels our approach to detect firm gerrymandering in New Gerryland. First, we look for unconditional firm gerrymandering across 14 states, comparing the firm allocations in their enacted plans to the distribution of simulated allocations. Next, we examine three states (Oregon, Pennsylvania, and Texas) in detail, showing different possibilities for how seat and firm gerrymandering interact in practice.²²

5.1 Comparing Simulated Plans to Enacted Plans

Figure 2 displays the simulated distribution of firms located in districts won by Democrats across 14 states; these are our *null distributions*. We present one histogram for each of the 14 states (covering 17 redistricting plans) in our sample.

Recall that we simulate 50,000 constitutionally valid redistricting plans for each state by allocating precincts to districts. This *null distribution* represents our expectations for how firms are allocated across districts if districts were drawn in an *as-if random* way, using knowledge only of precinct populations and racial composition and considering only the constitutional constraints of compactness, contiguity, minimizing county splits, and the Voting Rights Act (VRA).²³

These histograms in Figure 2 display the proportion of firms that we expect to fall in districts won by Democrats, in 5% bins. The vertical dashed line represents the actual enacted plans. The mass under the distribution to the left or right of the vertical line tells us how extreme an enacted redistricting plan is compared to simulations. If 50% of plans land both to the right and left of the enacted plan,

²² Appendix 4 contains an extreme-bounds analysis using different assumptions about marginal districts, confirming the robustness of our results.

²³ We may expect some natural constraints around the redistricting plans that can be drawn if, for instance, more Democrats live near firm headquarters than Republicans because Democrats and firms' headquarters locate in urban areas (Rodden 2010). Our simulations account for this aspect of political and economic geography.

that enacted plan falls on the simulated median; it meets our expectations under the null distribution and we might conclude that firms are not gerrymandered. If 90% of simulated redistricting plans fall to the right (left) of the vertical line representing the enacted plan, then that plan biases in favor of locating firms in Republican (Democratic) districts, suggesting that factors other than constitutional requirements are influencing firm placement.

If an enacted plan falls in the bottom 1% of the null distribution, it means that out of every 100 simulated redistricting plans such a Republican-biased plan appears only once—or that it happened fewer than 500 times out of 50,000 simulations. Likewise if a plan falls at the 99th percentile, then out of every 100 simulated plans, we only observe one plan as extreme in its bias toward Democrats. We can interpret these numbers as p-values: they encode how extreme an observed plan is relative to a null distribution and form the basis for our statistical inference.

Row 1 of Figure 2 shows states in which Democrats controlled the redistricting process. In each of these states, the distribution of simulated plans is skewed to the right—almost no simulation allocates more than 40% of the firms to Republicans in these states—indicating that due to the geography of voters, more firms fall naturally into Democratic districts. However, we observe that the enacted plans (dotted vertical lines) consistently fall near the right edge of the simulated distribution: Democrats place a disproportionate number of firms in districts they control in states where they draw the lines, beyond what the skewed natural geography of firms and voters might dictate.

States in Row 2 of Figure 2 use some form of a commission to decide district boundaries, which, presumably, would generate less gerrymandered outcomes as they should not exploit redistricting as a mechanism to bind firms to politicians' districts. Consistent with this expectation, we find the enacted plan falls at a global or local mode in these states. The enacted plan sits at the center of the

distribution and the global mode in both Arizona and Ohio where the simulated distributions are relatively symmetric. In Iowa, which only has 4 districts (complicating inference) and where firms are situated in a relatively compact area, the enacted plan falls at a local mode, albeit to the left of the global mode.

Figure 2 - Distributions of the Fraction of Firms assigned to Democratic Districts by State arising from our Simulations



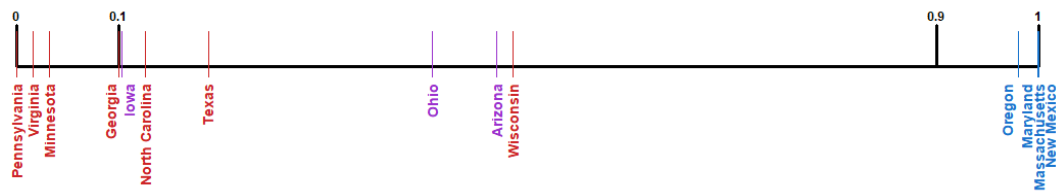
Notes: these null distributions are based on our simulated data. The vertical dotted lines represent 2012 enacted plans, while the vertical dashed lines represent plans that were redrawn after courts struck earlier plans after 2012.

Row 3 contains states where Republicans led redistricting. In these cases, the realized plans fall to the left of the realized distributions, giving more firms to Republicans than we might expect. This result is, again, consistent with the idea that the party drawing the lines places a disproportionate number of firms in districts they control, compared to the expectation provided by the natural geography of firms and voters.

Row 4 displays plans in states where Republicans drew the lines in 2012 that were later redrawn subsequent to judicial rulings. Here we have two vertical lines: the dotted line corresponds to the original plan, while the dashed line corresponds to those resulting from court orders. In each of these states, consistent with results in Row 3, the party-drawn 2012 enacted plans placed a higher number of firms in Republican districts than the null expectation. When courts ordered new plans, the new plans shifted firm allocations towards the median of the simulated distribution; fewer firms fell into Republican districts, most visibly in Pennsylvania.²⁴

We summarize these findings in Figure 3, collapsing each state’s originally enacted plans onto a single graph displaying quantile values comparing those plans to the simulated null distributions²⁵. For example, a value of 0.25 means that in 25% of simulated plans the same number or fewer firms than in the enacted plan are placed in Democratic districts. Hence, a plan with a value close to 0 favors Republicans while a value close to 1 favors Democrats.

Figure 3: Plans drawn by Republicans (Democrats) put fewer (more) firms in Democratic districts compared to simulated plans.



Note: Red indicates Republican mapmakers; Blue indicates Democratic mapmakers; and Purple indicates Commission-drawn maps.

²⁴ The gains to Democrats were fairly marginal in Virginia and North Carolina where Republicans drew the revised maps subject to Voting Rights Act challenges on select districts. The gains to Democrats were greater in Pennsylvania where the court mandated a plan more consistent with partisan requirements in the state constitution. The skew towards favoring Democrats in the redrawn Pennsylvania plan might be explained by a Democratic majority on the state Supreme Court.

²⁵ We calculate these quantiles as the N of simulated plans with as many as (or fewer) firms going to Democrats as the enacted plan, divided by the N of simulated plans.

The results reveal a consistent pattern. When Republicans draw the lines, firms end up in Republican districts beyond what we would expect in the absence of firm gerrymandering (generally with a quantile < 0.1). Similarly, when Democrats draw the lines, firms end up in Democratic districts beyond what we would expect in the absence of firm gerrymandering (generally with a quantile > 0.9). In the case of commissions, enacted plans fall towards the middle of the distribution. In the three states where commissions draw the lines, the enacted plan falls between 0.1 and 0.9—exactly what we would expect if commissions allocated firms to districts in a neutral manner while accounting for the co-locations of firms and voters.²⁶

Taking this together, Figure 3 tells us that firms appear to be gerrymandered when partisans draw the maps, even taking into account the underlying co-location of firms' headquarters and voters with tendencies towards either party. It also suggests that when commissions draw the maps, they tend not to gerrymander firms, suggesting no interest in exploiting redistricting as a mechanism to allocate firms to politicians' districts. We can combine these independent state-level tests into a global p-value (Caughey et al. 2017), testing the sharp null that *no states* have firm gerrymandering. Our theory tells us that in states drawn by Democrats, we expect quantiles in the right tail, and the opposite for Republicans, so first we convert quantiles to one-sided p-values. In states with plans drawn by commission, we expect quantiles close to 0.5, so we convert those to p-values by subtracting 0.5 such that if an enacted plan produces the simulated modal number of firms for Democrats, its p-value would be 0. Following Caughey et al. (2017), we then take the Fisher product and calculate a global p-

²⁶ Iowa ends up with a p-value of 0.103, as firms skew towards Republicans; however, this may be in part due to seats skewing towards Democrats.

value of 3.29×10^{-9} providing strong statistical evidence that firm gerrymandering exists in at least some states.

5.2 Optimizing for Seats, Firms, or Both

Having established *unconditional* firm gerrymandering exists, we turn to *conditional* firm gerrymandering for evidence that mapmakers specifically target firms. As we show in New Gerryland, identifying when firms are targeted is challenging since acquiring more seats generally leads to acquiring more firms.

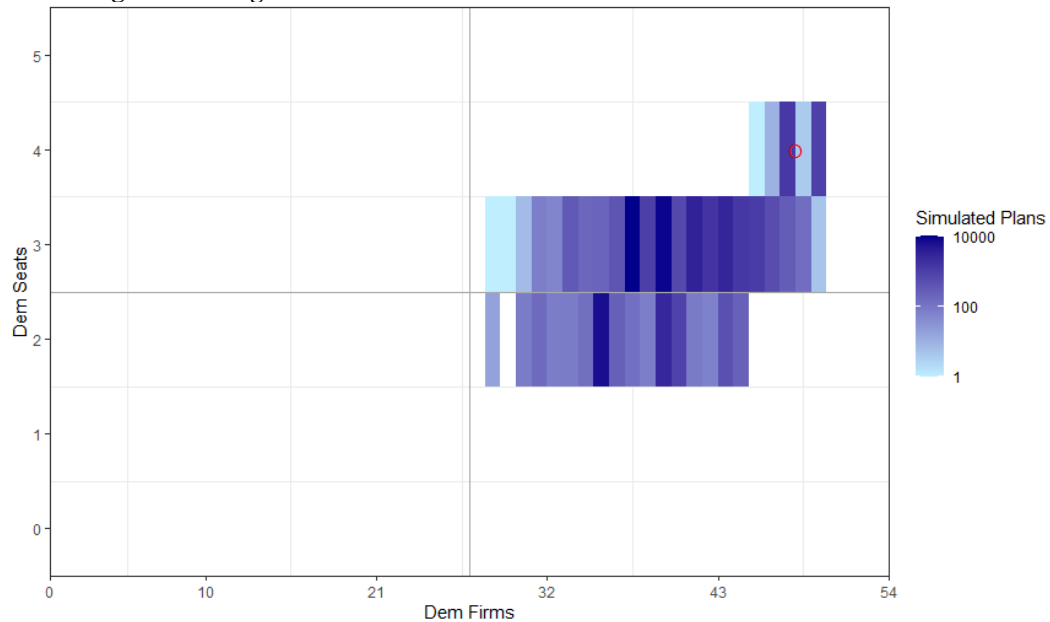
To show some ways that firm gerrymandering appears in practice, we provide three case studies—Oregon, Pennsylvania, and Texas—working through both (i) joint distributions of firm-and-seat allocations, and (ii) conditional distributions of firm allocations, holding the number of seats fixed. Oregon provides a case where firm and seat targeting by mapmakers may be observationally equivalent.

Pennsylvania shows that even when there is an extreme partisan seat gerrymander, we can sometimes still disentangle seat gerrymandering from firm gerrymandering. Finally, in Texas, we show that mapmakers can produce firm gerrymanders even in the absence of seat gerrymanders.

5.2.1 Oregon: When Firm Targeting and Seat Targeting are Observationally Equivalent

Figure 4 presents the simulated joint distribution of seat (vertical axis) and firm (horizontal axis) allocations in Oregon. Each bar is a unique combination of firms and seats; darker bars indicate a higher proportion of simulated plans with that allocation. The red circle marks the enacted plan drawn by Democrats in 2012.

Figure 4 - Oregon's Joint Distribution of Firms and Seats from Simulation



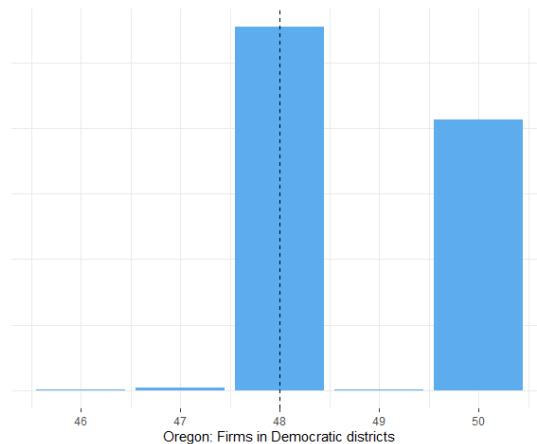
In Oregon in 2012, there were 5 seats and 54 firms to be allocated. No simulated plan granted Democrats more than 4 seats or 50 firms. In practice, Democratic mapmakers enacted a plan allocating 4 seats and 48 firms to their party, achieving the maximum number of feasible seats and an unusually large number of firms.

Is this a seat gerrymander, a firm gerrymander, both, or neither? The answer is both: it is a seat gerrymander since allocating 4 seats to Democrats occurs in only 4.9% of simulations; it is a firm gerrymander since allocating 48 firms to Democrats occurs in only 2.4% of simulations.

Nevertheless, any plan that allocates 4 seats to Democrats *must also* allocate at least 46 firms to Democrats, so observing a plan with 4 seats and 48 firms does not require deliberate firm gerrymandering. The extreme allocation of firms we observe in Oregon might be a consequence of mapmakers' maximizing seats.

In New Gerrymandering, we examined the *joint distribution* of firm allocations (Figure 1H). Doing so taught us that to learn whether firms are targeted, we must dive deeper into the conditional distributions of firms holding seats fixed. Figure 5 presents that data for Oregon, focusing on the 2,434 plans that allocate exactly 4 seats to Democrats, as in the enacted plan. While we previously found that Oregon is an *unconditional* firm gerrymander, looking at the 4-seat *conditional* distribution, we cannot say that firms were targeted over and beyond seats due to the natural geography of firms and voters. The range of feasible firm allocations is so narrow in the *conditional* distribution—from 46-50 firms—that variation within it may not be politically or economically meaningful.²⁷

Figure 5 - Oregon's Distribution of Firms conditional on Four Democratic Seats as in Enacted Plan



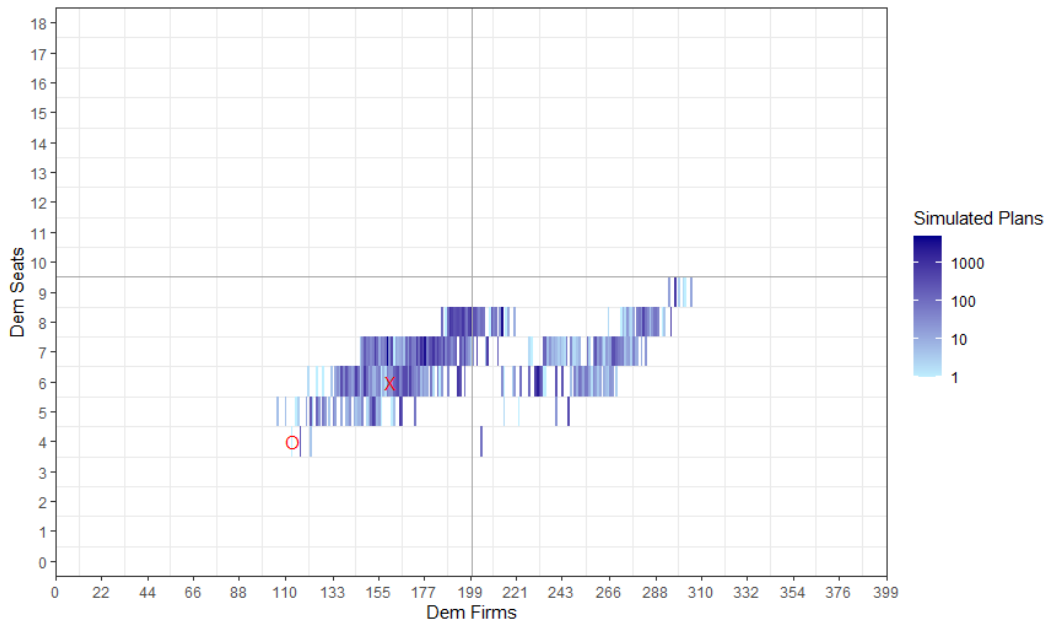
5.2.2 Pennsylvania: Optimizing for Firms and Seats

In Pennsylvania, by contrast, we can show more conclusively that mapmakers targeted firms above and beyond seats: Republican mapmakers strictly maximized

²⁷ The p-value is 0.574 for 48 Democratic firms in the 4-seat conditional distribution; 1,387 of the 2,434 plans give Democrats 48 firms and 11 give them fewer firms. Even if Democrats selected a 4-seat plan with all 50 firms, we could not conclude that firms were targeted independent of seats, as that allocation occurs in 1,032 plans.

their allocation of firms *conditional on* seizing the maximum feasible number of seats. Figure 6 presents the simulated joint density of seat and firm allocations in Pennsylvania.²⁸ In Pennsylvania, there are 18 seats and 399 firms to be allocated by Republicans, who might want to maximize their share of both. The simulated range of seats allocated to Democrats is 4 to 9; the range for firms is 107 to 306.

Figure 6 - Pennsylvania’s Joint Distribution of Firms and Seats from Simulation

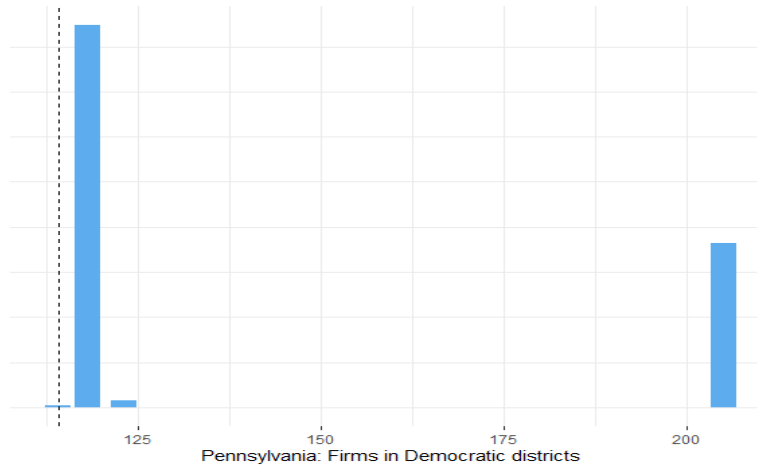


In 2012, Republican mapmakers allocated the lower bound of 4 seats to Democrats. This is a Republican seat gerrymander, with a p-value of 0.0006, as only 308 out of 50,000 plans have 4 Democratic majority districts. Republican mapmakers allocated only 114 firms to Democrats in the same plan. This also a clear *unconditional* Republican firm gerrymander, with a p-value of 0.0002, as only 10 of 50,000 plans give fewer firms to Democrats. Moreover, the 2012

²⁸ As noted earlier, PA has two enacted plans in the 2010 cycle. The original plan drawn by Republicans in 2012, marked with an “O”, and a revised plan drawn by the State Supreme Court in 2018, marked with an “X”, which shifted seats and firms to Democrats.

Pennsylvania map is a *conditional* firm gerrymander as well. Figure 7 shows the conditional distribution of firms Democrats could receive if they win 4 seats, which occurs in only 308 of 50,000 of simulated; in this distribution the range of firm allocations spans from 114 to 205. The enacted plan which allocates only 114 firms to Democrats is therefore the *most* extreme conditional allocation of firms possible: there are no simulated plans out of the 308 that are more extreme, suggesting that Pennsylvania mapmakers targeted firms above and beyond seats.

Figure 7 - Pennsylvania's Distribution of Firms conditional on Four Democratic Seats as in Enacted Plan



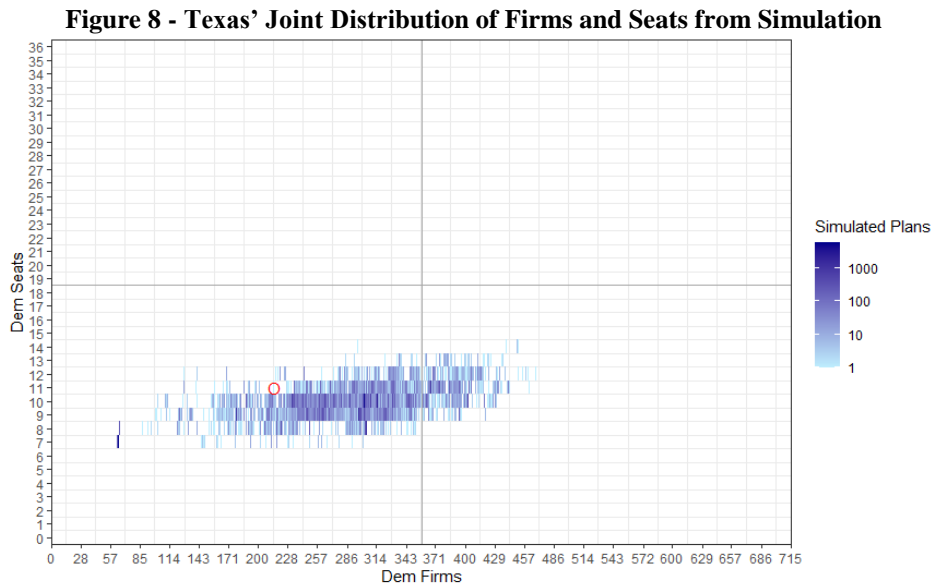
5.2.3 Texas: Ceding Seats While Capturing Firms

In Texas, Republican mapmakers chose *not* to maximize their seat allocation. Texas is not an outlier in this respect: we see partisan seat maximization in fewer than half of the states we study.²⁹ Looking at firm gerrymandering, we find little

²⁹ While beyond this paper, there are reasons why mapmakers (i) may not gerrymander seats, and/or (ii) not gerrymander firms *unconditionally* given constraints, but (iii) nonetheless gerrymander firms *conditionally*. Mapmakers might, for example, refrain seat maximization to focus on incumbent protection, generating safe districts for co-partisans that can withstand demographic change (Forgette & Platt 2005).

evidence of Texas being an *unconditional* firm gerrymander (p-value of 0.187), but we find strong evidence of it being a *conditional* firm gerrymander.

Figure 8 presents the simulated joint distribution of firm and seat allocations in Texas. There are 36 seats and 715 firms to allocate; Democrats may capture from 7 to 14 seats and from 64 to 469 firms. The enacted plan drawn by Republicans yields 11 seats to Democrats, which is surprisingly *above* the modal simulation outcome. A standard notion of partisan gerrymandering would therefore reject the claim that Texas' map was gerrymandered to favor Republicans in terms of seats.

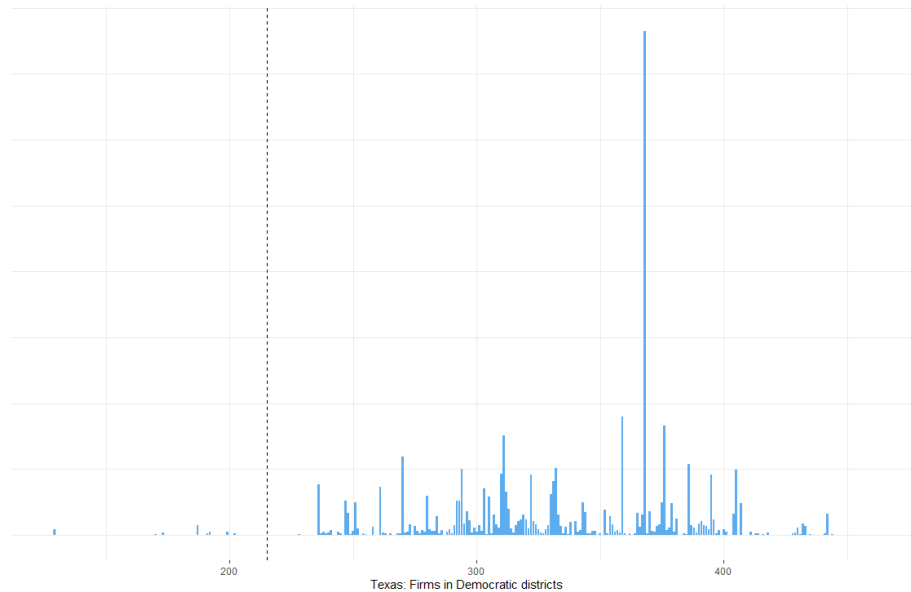


However, examining firm allocations suggests otherwise. The 215 firms that the 2012 enacted plan allocated to Democrats is substantially lower than the mean of 268 or the median of 303, suggesting that the Republican mapmakers preferred to over-allocate firms to themselves rather than seats.

Examining Texas' *conditional* firm distribution (Figure 9), moreover, provides strong evidence that Texas is a firm gerrymander. Fixing the Democrats to 11 seats, the conditional distribution of firms ranges from 129 to 463, covering over 45% of the entire range. The 215 firms given to Democrats in the enacted plan

falls far to the left within this distribution ($p=0.011$). Even though Republicans chose a relatively bipartisan allocation of seats, conditional on that choice, they allocated far more firms to themselves than can be explained by random chance.

Figure 9 - Texas' Distribution of Firms conditional on Eleven Democratic Seats, as in Enacted Plan



6. DISCUSSION

We find that when partisans control the redistricting process, firms are over-allocated to the mapmakers' party. We also find that while firm gerrymandering occurs in instances when seats are gerrymandered, it also occurs in instances when seats are *not* gerrymandered. Having established that firm gerrymandering is systematic, we show that it is also widespread. While 8 of the 11 states we consider satisfy our definitions of firm gerrymandering, only 5 are partisan seat gerrymanders under an equal standard of evidence; firm gerrymandering therefore cannot simply be a byproduct of seat gerrymandering.

We may also be interested how many firms are gerrymandered *nationwide*. Compared to the median number of firms in our simulated counterfactuals, we find that the mapmakers' party received 324 more firms than we would expect. This is approximately 12% of the 2,800 firms in our sample of states where partisans draw the lines. In practice, however, all of these firms are not available to be reallocated in a partisan firm gerrymander given both (i) the constraints of the natural geography of firms and voters and (ii) that parties only want to acquire more (not fewer) firms. By calculating the simulated *range* of firms – the minimum and maximum number of firms a party receives in our simulations – we estimate that parties acquire approximately 49% of the 665 firms that can be feasibly gerrymandered to their advantage.³⁰

Why might firm gerrymandering be more common than seat gerrymandering? First, there is more opportunity to gerrymander firms, as firms exceed seats.³¹ Second, while the most extreme seat allocation is not always a seat gerrymander, the most extreme firm allocation is always a firm gerrymander in our sample.³²

6.1 Implications for Politicians, Firms, and Voters

While the prevailing wisdom is that firms capture politicians (Stigler 1971), our results suggest that politicians (and political parties) also capture firms (McChesney 1997): drawing firms into majority party districts creates a structural alignment between firms and the majority party in the state, regardless of which party is in the majority. While, in some instances, we do not have the statistical leverage to make an inference that firm gerrymandering is distinct from

³⁰ 665 is the sum, across the states in our sample, of the maximum minus the minimum count of firms allocated to Democrats.

³¹ Firms are at least twice as numerous (often orders of magnitude more numerous) than seats for every state in our sample.

³² This happens because extreme seat allocations occur relatively more frequently than extreme firm allocations; the seat allocation distribution has fatter tails.

seat gerrymandering, whether or not firm gerrymandering occurs intentionally is irrelevant to the structural alignment it creates. Among the many important implications of a systematic lock-in between firms and majority party politicians, some are testable while others are consistent with findings in existing literature.

From an officeholders' perspective, a structural alignment with firms could solidify the incumbency advantage and diminish political competition: existing officeholders will have advantages in tapping firms, their executives, and employees for campaign contributions and other electoral benefits. Whether having more firms in a district increases the incumbency advantage is an important testable implication of our results that is left for future research.

From a firms' perspective, alignment with politicians may increase access reduce the need to lobby (Faccio and Parsley 2009).³³ Their long-term ties with firms gives politicians strong incentives to oblige firms' interests even when they don't lobby, helping to explain a long-standing puzzle in the literature that asks why only approximately 10% of firms ever lobby (deFigueiredo & Richter 2014; Kerr et al. 2014).³⁴ By contrast, firms drawn into *minority* party districts may have to spend *more* on lobbying, lacking a natural ally in power who is predisposed to listen, helping explain why firms tend to prefer the majority party (Barber 2016). This is a second testable implication of our paper.

From a citizen's perspective, both the diminished political competition and politicians' incentives to focus on policies that benefit firms in their district may alter the quality of representation. It may lead both parties to act in more pro-business ways at the expense of labor-oriented voters. Out-party voters located

³³ Payson (2020), e.g., shows city governments spend less on lobbying when they align politically with state representatives.

³⁴ More firms are gerrymandered than lobby. Up to 52% of the gerrymanderable firms in our sample are, in fact, gerrymandered; only 10% of publicly-traded firms lobby.

near firms the majority party has captured, in particular, may not have a member of Congress advocating for them. This is a third testable implication of our paper.

Our results point to gerrymandering extending far beyond voters. Politicians will seek to incorporate into their districts anything that gives them advantages or status--and this may stretch well beyond firms as well to things like universities, military bases, ports, airports, stadiums, national parks, and hospitals.³⁵ Likewise, politicians may also seek to keep undesirable things like waste facilities or troublesome constituents outside of their districts. Politicians gain power from *all* the contents of their districts, and future research could benefit from peeling back the onion a bit further as gerrymandering might not be only about maximizing seats, but rather maximizing structural power of the party derived from districts.

6.2 Limitations and Opportunities for Future Research

Recognizing the assumptions and simplifications we made in this work will provide ways to deepen a new literature on firm gerrymandering and provide entry points to contribute separately to the existing literatures on (i) partisan gerrymandering, and (ii) firms and politics.

First, we treat all publicly traded firms as homogeneous and of equal value. Future research can address: (i) variability between firms on attributes like size, political activity, and reputation, and (ii) differential value to politicians and parties in acquiring clusters of firms over single (valuable) firms. Some firms may be more valuable to politicians in credit claiming, for example, if they have strong reputations among voters or are perceived as being bedrocks of the district's economy³⁶; other firms, by contrast, may be toxic to politicians (McDonnell & Werner 2016). Politicians may also extract more value from having a coherent set

³⁵ We have modest evidence that hospitals are in fact gerrymandered as well.

³⁶ Larger employee bases and more active firm Political Action Committees (PACs) may also make certain firms more valuable to politicians.

of firms by industry. This allows a representative to focus their advocacy, build expertise, and improve their chances of joining desired committees. By contrast, an incoherent set of firms, say petroleum with green energy, might inhibit a representative from taking consistent policy positions, undermining their standing with voters. Alternatively, there may be some value to having a diverse industry profile in a political district to weather common economic shocks.

Second, not all firms are equally possible to gerrymander. While our analysis estimates whether and how many firms are gerrymandered, we cannot account for *which* firms are gerrymandered in practice. Flipping the unit of analysis to the firm might reveal the consequences to firms of being drawn into an unexpected district, and yield insights into which firms politicians choose to capture.

Third, we focus on firm gerrymandering at a state-level rather than within specific districts, but individual districts may have been gerrymandered even if the allocation of firms (and/or seats) is not extreme at the state-level. For example, we might expect majority party to locate firms in the districts of more powerful politicians or to incumbents under threat. A district level analysis could unpack other aspects of firm gerrymandering (e.g. are firms more likely to be gerrymandered if they are near borders of existing districts?).

Fourth, our test statistic emphasizes party-wellbeing, not individual politician utility: redistricting battles *within* parties may explain some of the idiosyncratic state outcomes (e.g., why we don't more states select the most extreme seat and firm gerrymanders available?). The answer may reflect individual politicians' priorities, including district safety over firm count, having their residence in the same district as a desired firm, or preferred constituencies more granular than simply party registration. Relatedly, parties may reallocate firms from disloyal incumbents to those seen as rising stars, a pattern our analysis cannot observe.

Fifth, we do not consider how mapmakers choose to trade-off between firms and seats, in particular safe seats, and how that decision may be shaped by their

expectations about demographic changes. For instance, how many out-party voters will an incumbent accept to gain an additional firm? Are incumbents willing to accept smaller margins when they anticipate favorable demographic changes, or does myopia prevent more long-term optimal districting?

Sixth, this research focused on firm allocation outcomes, rather than the process of allocating firms by self-interested partisan mapmakers. Future research may explore the map creation process and factors weighed in it in more detail. For instance, to what degree is deference on particular firms' allocation to specific politicians' districts honored if the pair had a prior geographic tie? To what extent do firms lobby to be included in specific districts—and do they typically do so when they want to stay in the same politician's district or when they want to move to another politician's or another party's? Finally, to what extent do firms select their headquarters locations based on likely electoral district map outcomes? Addressing these questions could yield a more complete and comprehensive theory of economic gerrymandering.

7. CONCLUSION

In this paper, we contribute to the theory of gerrymandering by incorporating firms. Empirically, we demonstrate that firm gerrymandering occurs when politicians have the opportunity. By simulating counterfactual allocations of firms to districts, and comparing enacted plans to those null distributions, we show that majority parties drawing the lines capture more firms than would have occurred by chance. Courts and commissions, by contrast, allocate firms to parties' districts more neutrally. Such allocations could improve the function of democracy by eliminating a structural alignment between firms and state majority parties. Our results are also important for the literature on firms and politics. We show that the relationship between firms and politicians is central to the redistricting process. Political mapmakers determine which politician each firm

must rely on as their gatekeeper to the political process, exposing that the relationship between firms and politicians goes both ways: firms not only capture politicians, but also politicians capture firms. Furthermore, our theorizing and empirical approach generalizes to other objects of desire to political mapmakers, suggesting that the phenomenon affects the structural roots of democracy in deeper and more subtle ways than previously recognized, opening up a variety of new avenues for research.

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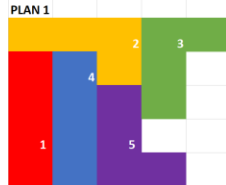
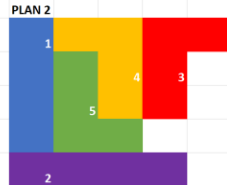


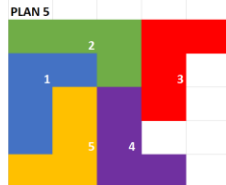
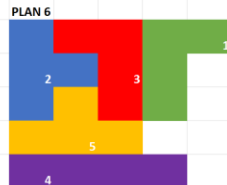
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APPENDICES FOR ONLINE PUBLICATION

APPENDIX 1: NEW GERRYLAND

This appendix includes graphical depictions of all 100 feasible redistricting plans for New Gerryland along with summary statistics describing firm and seat allocations for the entire plan and the numerical values associated with vote shares and firm counts in each of the five districts.

The purpose of displaying this is to show that even though plans may have ostensibly equivalent seat and vote allocations, they are in fact quite different from each other when considering how electorally safe certain districts are, how many firms are in safe versus competitive districts, and even physically where the districts are located.

PLAN 1				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 2				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?				
				1	0.5875	1	12					1	0.55	1	15				
				2	0.4125	0	23					2	0.25	0	8				
				3	0.325	0	19					3	0.325	0	19				
				4	0.4375	0	22					4	0.3875	0	30				
				5	0.2375	0	24					5	0.4875	0	28				
				Aggregate Dem Share			0.4	0.2	0.12					Aggregate Dem Share			0.4	0.2	0.15
PLAN 3				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 4				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?				
				1	0.25	0	8					1	0.25	0	8				
				2	0.4	0	28					2	0.325	0	19				
				3	0.3125	0	21					3	0.35	0	33				
				4	0.55	1	15					4	0.6625	1	17				
				5	0.4875	0	28					5	0.4125	0	23				
				Aggregate Dem Share			0.4	0.2	0.15					Aggregate Dem Share			0.4	0.2	0.17
PLAN 5				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 6				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?				
				1	0.6625	1	17					1	0.325	0	19				
				2	0.4125	0	23					2	0.6875	1	19				
				3	0.325	0	19					3	0.3875	0	30				
				4	0.2375	0	24					4	0.25	0	8				
				5	0.3625	0	17					5	0.35	0	24				
				Aggregate Dem Share			0.4	0.2	0.17					Aggregate Dem Share			0.4	0.2	0.19

PLAN 7					PLAN 8								
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?					
1	0.3125	0	21		1	0.325	0	19					
2	0.25	0	8		2	0.3875	0	30					
3	0.4	0	28		3	0.6875	1	19					
4	0.35	0	24		4	0.1625	0	13					
5	0.6875	1	19		5	0.4375	0	19					
Aggregate Dem Share				0.4	0.2	0.19	Aggregate Dem Share				0.4	0.2	0.19
PLAN 9					PLAN 10								
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?					
1	0.1625	0	13		1	0.175	0	17					
2	0.3125	0	21		2	0.675	1	20					
3	0.4	0	28		3	0.4	0	7					
4	0.6875	1	19		4	0.425	0	31					
5	0.4375	0	19		5	0.325	0	25					
Aggregate Dem Share				0.4	0.2	0.19	Aggregate Dem Share				0.4	0.2	0.2
PLAN 11					PLAN 12								
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?					
1	0.175	0	17		1	0.325	0	19					
2	0.675	1	20		2	0.4	0	7					
3	0.3125	0	20		3	0.175	0	17					
4	0.4	0	7		4	0.425	0	37					
5	0.4375	0	36		5	0.675	1	20					
Aggregate Dem Share				0.4	0.2	0.2	Aggregate Dem Share				0.4	0.2	0.2
PLAN 13					PLAN 14								
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?					
1	0.1625	0	13		1	0.4125	0	11					
2	0.325	0	25		2	0.1625	0	13					
3	0.675	1	20		3	0.3125	0	20					
4	0.425	0	31		4	0.4375	0	36					
5	0.4125	0	11		5	0.675	1	20					
Aggregate Dem Share				0.4	0.2	0.2	Aggregate Dem Share				0.4	0.2	0.2
PLAN 15					PLAN 16								
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?					
1	0.675	1	20		1	0.325	0	25					
2	0.1625	0	13		2	0.675	1	20					
3	0.325	0	19		3	0.425	0	31					
4	0.425	0	37		4	0.25	0	8					
5	0.4125	0	11		5	0.325	0	16					
Aggregate Dem Share				0.4	0.2	0.2	Aggregate Dem Share				0.4	0.2	0.2
PLAN 17					PLAN 18								
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?					
1	0.675	1	20		1	0.325	0	19					
2	0.25	0	8		2	0.25	0	8					
3	0.3125	0	20		3	0.325	0	16					
4	0.325	0	16		4	0.675	1	20					
5	0.4375	0	36		5	0.425	0	37					
Aggregate Dem Share				0.4	0.2	0.2	Aggregate Dem Share				0.4	0.2	0.2

PLAN 19					PLAN 20					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
1	0.675	1	20		2	0.25	0	8		
2	0.3125	0	20		3	0.3875	0	22		
3	0.25	0	8		4	0.325	0	19		
4	0.375	0	30		5	0.3625	0	31		
5	0.3875	0	22							
Aggregate Dem Share		0.4	0.2	0.2	Aggregate Dem Share		0.4	0.2	0.2	
PLAN 21					PLAN 22					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
1	0.3625	0	25		4	0.25	0	8		
2	0.325	0	25		2	0.4625	0	15		
3	0.675	1	20		3	0.325	0	19		
4	0.3875	0	22		4	0.5375	1	20		
5	0.25	0	8		5	0.425	0	38		
Aggregate Dem Share		0.4	0.2	0.2	Aggregate Dem Share		0	0.2	0.2	
PLAN 23					PLAN 24					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
1	0.5375	1	20		4	0.25	0	8		
2	0.35	0	24		2	0.3625	0	25		
3	0.4	0	33		3	0.3875	0	22		
4	0.4625	0	15		4	0.3125	0	21		
5	0.25	0	8		5	0.6875	1	24		
To Dems		0.4	0.2	0.2	Aggregate Dem Share		0.4	0.2	0.24	
PLAN 25					PLAN 26					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
1	0.25	0	8		4	0.175	0	17		
2	0.325	0	16		2	0.4	0	7		
3	0.3125	0	21		3	0.3125	0	21		
4	0.425	0	31		4	0.6875	1	24		
5	0.6875	1	24		5	0.425	0	31		
Aggregate Dem Share		0.4	0.2	0.24	Aggregate Dem Share		0.4	0.2	0.24	
PLAN 27					PLAN 28					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
1	0.3125	0	21		3	0.25	0	8		
2	0.1625	0	13		2	0.3125	0	20		
3	0.4125	0	11		3	0.575	1	24		
4	0.6875	1	24		4	0.4	0	33		
5	0.425	0	31		5	0.4625	0	15		
Aggregate Dem Share		0.4	0.2	0.24	Aggregate Dem Share		0.4	0.2	0.24	
PLAN 29					PLAN 30					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
1	0.325	0	19		5	0.4	0	28		
2	0.25	0	8		2	0.175	0	17		
3	0.3875	0	30		3	0.4	0	7		
4	0.7125	1	27		4	0.3125	0	21		
5	0.325	0	16		5	0.7125	1	27		
Aggregate Dem Share		0.4	0.2	0.27	Aggregate Dem Share		0.4	0.2	0.27	

PLAN 31	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 32	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.3125	0	21		1	0.325	0	19
	2	0.25	0	8		2	0.1625	0	13
	3	0.4	0	28		3	0.3875	0	30
	4	0.7125	1	27		4	0.7125	1	27
	5	0.325	0	16		5	0.4125	0	11
Aggregate Dem Share		0.4	0.2	0.27	Aggregate Dem Share		0.4	0.2	0.27
PLAN 33	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 34	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.4	0	7		1	0.3125	0	21
	2	0.175	0	17		2	0.7125	1	27
	3	0.325	0	19		3	0.4125	0	11
	4	0.7125	1	27		4	0.1625	0	13
	5	0.3875	0	30		5	0.4	0	28
Aggregate Dem Share		0.4	0.2	0.27	Aggregate Dem Share		0.4	0.2	0.27
PLAN 35	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 36	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.4125	0	23		1	0.325	0	19
	2	0.4	0	7		2	0.325	0	7
	3	0.625	1	27		3	0.4125	0	23
	4	0.325	0	19		4	0.7	1	27
	5	0.2375	0	24		5	0.2375	0	24
Aggregate Dem Share		0.4	0.2	0.27	Aggregate Dem Share		0.4	0.2	0.27
PLAN 37	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 38	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.4125	0	23		1	0.6	1	27
	2	0.325	0	19		2	0.4625	0	15
	3	0.25	0	8		3	0.25	0	8
	4	0.7	1	27		4	0.325	0	25
	5	0.3125	0	23		5	0.3625	0	25
Aggregate Dem Share		0.4	0.2	0.27	Aggregate Dem Share		0.4	0.2	0.27
PLAN 39	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 40	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.25	0	8		1	0.6	1	27
	2	0.3125	0	20		2	0.325	0	19
	3	0.375	0	30		3	0.3625	0	31
	4	0.4625	0	15		4	0.25	0	8
	5	0.6	1	27		5	0.4625	0	15
Aggregate Dem Share		0.4	0.2	0.27	Aggregate Dem Share		0.4	0.2	0.27
PLAN 41	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 42	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.5875	1	12		1	0.35	0	24
	2	0.1625	0	13		2	0.1625	0	13
	3	0.325	0	19		3	0.3625	0	31
	4	0.5375	1	20		4	0.5375	1	20
	5	0.3875	0	36		5	0.5875	1	12
Aggregate Dem Share		0.4	0.4	0.32	Aggregate Dem Share		0.4	0.4	0.32

PLAN 43	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 44	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.125	0	11		1	0.5875	1	12
	2	0.5875	1	12		2	0.5375	1	20
	3	0.325	0	19		3	0.125	0	11
	4	0.425	0	38		4	0.35	0	24
	5	0.5375	1	20		5	0.4	0	33
	Aggregate Dem Share	0.4	0.4	0.32		Aggregate Dem Share	0.4	0.4	0.32
PLAN 45	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 46	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.4	0	7		1	0.25	0	8
	2	0.325	0	19		2	0.4125	0	23
	3	0.175	0	17		3	0.325	0	16
	4	0.4125	0	23		4	0.325	0	19
	5	0.6875	1	34		5	0.6875	1	34
	Aggregate Dem Share	0.4	0.2	0.34		Aggregate Dem Share	0.4	0.2	0.34
PLAN 47	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 48	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.325	0	19		1	0.325	0	19
	2	0.4125	0	23		2	0.25	0	8
	3	0.1625	0	13		3	0.4625	0	15
	4	0.4125	0	11		4	0.55	1	35
	5	0.6875	1	34		5	0.4125	0	23
	Aggregate Dem Share	0.4	0.2	0.34		Aggregate Dem Share	0.4	0.2	0.35
PLAN 49	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 50	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.3125	0	20		1	0.3625	0	31
	2	0.575	1	24		2	0.1625	0	13
	3	0.4	0	33		3	0.3125	0	20
	4	0.5875	1	12		4	0.5875	1	12
	5	0.125	0	11		5	0.575	1	24
	Aggregate Dem Share	0.4	0.4	0.36		Aggregate Dem Share	0.4	0.4	0.36
PLAN 51	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 52	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.5375	1	23		1	0.3125	0	21
	2	0.3125	0	21		2	0.55	1	15
	3	0.55	1	15		3	0.25	0	8
	4	0.3625	0	17		4	0.5375	1	23
	5	0.2375	0	24		5	0.35	0	33
	Aggregate Dem Share	0.4	0.4	0.38		Aggregate Dem Share	0.4	0.4	0.38
PLAN 53	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 54	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.375	0	30		1	0.6	1	27
	2	0.3125	0	20		2	0.5875	1	12
	3	0.5875	1	12		3	0.125	0	11
	4	0.125	0	11		4	0.325	0	25
	5	0.6	1	27		5	0.3625	0	25
	Aggregate Dem Share	0.4	0.4	0.39		Aggregate Dem Share	0.4	0.4	0.39

PLAN 55	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 56	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.325	0	19		1	0.125	0	11
	2	0.5875	1	12		2	0.5125	1	19
	3	0.3625	0	31		3	0.675	1	20
	4	0.6	1	27		4	0.325	0	25
	5	0.125	0	11		5	0.3625	0	25
Aggregate Dem Share		0.4	0.4	0.39	Aggregate Dem Share		0.4	0.4	0.39
PLAN 57	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 58	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.675	1	20		1	0.3125	0	20
	2	0.325	0	19		2	0.675	1	20
	3	0.5125	1	19		3	0.375	0	30
	4	0.3625	0	31		4	0.125	0	11
	5	0.125	0	11		5	0.5125	1	19
Aggregate Dem Share		0.4	0.4	0.39	Aggregate Dem Share		0.4	0.4	0.39
PLAN 59	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 60	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.25	0	8		1	0.55	1	15
	2	0.55	1	15		2	0.3625	0	17
	3	0.325	0	19		3	0.2375	0	24
	4	0.35	0	33		4	0.525	1	25
	5	0.525	1	25		5	0.325	0	19
Aggregate Dem Share		0.4	0.4	0.4	Aggregate Dem Share		0.4	0.4	0.4
PLAN 61	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 62	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.325	0	25		n1	0.25	0	8
	2	0.55	1	18		n2	0.55	1	18
	3	0.3625	0	25		n3	0.5125	1	24
	4	0.25	0	8		n4	0.375	0	30
	5	0.5125	1	24		n5	0.3125	0	20
Aggregate Dem Share		0.4	0.4	0.42	Aggregate Dem Share		0.4	0.4	0.42
PLAN 63	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 64	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.325	0	19		1	0.25	0	8
	2	0.55	1	18		2	0.55	1	15
	3	0.25	0	8		3	0.325	0	19
	4	0.3625	0	31		4	0.5125	1	27
	5	0.5125	1	24		5	0.3625	0	31
Aggregate Dem Share		0.4	0.4	0.42	Aggregate Dem Share		0.4	0.4	0.42
PLAN 65	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 66	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.325	0	25		1	0.25	0	8
	2	0.3625	0	25		2	0.55	1	15
	3	0.55	1	15		3	0.3125	0	20
	4	0.25	0	8		4	0.5125	1	27
	5	0.5125	1	27		5	0.375	0	30
Aggregate Dem Share		0.4	0.4	0.42	Aggregate Dem Share		0.4	0.4	0.42

PLAN 67	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 68	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.3	0	25		1	0.35	0	24
	2	0.35	0	24		2	0.25	0	8
	3	0.25	0	8		3	0.5375	1	20
	4	0.55	1	28		4	0.5625	1	23
	5	0.55	1	15		5	0.3	0	25
Aggregate Dem Share		0.4	0.4	0.43	Aggregate Dem Share		0.4	0.4	0.43
PLAN 69	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 70	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.35	0	24		1	0.325	0	19
	2	0.25	0	8		2	0.5625	1	23
	3	0.5125	1	19		3	0.25	0	8
	4	0.5875	1	24		4	0.325	0	30
	5	0.3	0	25		5	0.5375	1	20
Aggregate Dem Share		0.4	0.4	0.43	Aggregate Dem Share		0.4	0.4	0.43
PLAN 71	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 72	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.25	0	8		1	0.3125	0	21
	2	0.5875	1	24		2	0.3625	0	25
	3	0.325	0	30		3	0.125	0	11
	4	0.325	0	19		4	0.5125	1	19
	5	0.5125	1	19		5	0.6875	1	24
Aggregate Dem Share		0.4	0.4	0.43	Aggregate Dem Share		0.4	0.4	0.43
PLAN 73	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 74	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.325	0	19		1	0.5875	1	12
	2	0.25	0	8		2	0.1625	0	13
	3	0.55	1	15		3	0.325	0	19
	4	0.325	0	30		4	0.4125	0	23
	5	0.55	1	28		5	0.5125	1	33
Aggregate Dem Share		0.4	0.4	0.43	Aggregate Dem Share		0.4	0.4	0.45
PLAN 75	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 76	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.55	1	15		1	0.25	0	8
	2	0.3125	0	21		2	0.55	1	15
	3	0.3625	0	25		3	0.3	0	25
	4	0.525	1	31		4	0.3125	0	21
	5	0.25	0	8		5	0.5875	1	31
Aggregate Dem Share		0.4	0.4	0.46	Aggregate Dem Share		0.4	0.4	0.46
PLAN 77	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 78	District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
	1	0.5875	1	32		1	0.3	0	25
	2	0.55	1	15		2	0.25	0	8
	3	0.3125	0	20		3	0.5625	1	23
	4	0.3	0	25		4	0.575	1	24
	5	0.25	0	8		5	0.3125	0	20
Aggregate Dem Share		0.4	0.4	0.47	Aggregate Dem Share		0.4	0.4	0.47

PLAN 79					PLAN 80					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
3	0.5875	1	12		2	0.3125	0	20		
1	0.325	0	19		5	0.55	1	18		
4	0.4125	0	23		3	0.25	0	8		
5	0.55	1	35		4	0.35	0	24		
2	0.125	0	11		3	0.5375	1	30		
Aggregate Dem Share				0.4	0.4	0.47	Aggregate Dem Share			
PLAN 81					PLAN 82					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
2	0.25	0	8		1	0.3125	0	21		
4	0.5875	1	25		2	0.5875	1	25		
5	0.3125	0	23		3	0.325	0	7		
3	0.3125	0	21		4	0.2375	0	24		
1	0.5375	1	23		5	0.5375	1	23		
Aggregate Dem Share				0.4	0.4	0.48	Aggregate Dem Share			
PLAN 83					PLAN 84					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
3	0.1625	0	13		3	0.1625	0	13		
4	0.3125	0	20		2	0.4375	0	19		
5	0.55	1	18		4	0.55	1	18		
1	0.5375	1	30		5	0.525	1	31		
2	0.4375	0	19		1	0.325	0	19		
Aggregate Dem Share				0.4	0.4	0.48	Aggregate Dem Share			
PLAN 85					PLAN 86					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
3	0.325	0	19		1	0.55	1	18		
2	0.525	1	31		2	0.25	0	8		
5	0.55	1	18		3	0.325	0	19		
4	0.25	0	8		4	0.5625	1	32		
1	0.35	0	24		5	0.3125	0	23		
Aggregate Dem Share				0.4	0.4	0.49	Aggregate Dem Share			
PLAN 87					PLAN 88					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
1	0.5875	1	25		1	0.55	1	18		
5	0.325	0	7		2	0.325	0	19		
4	0.2375	0	24		3	0.325	0	7		
2	0.325	0	19		4	0.5625	1	32		
3	0.525	1	25		5	0.2375	0	24		
Aggregate Dem Share				0.4	0.4	0.5	Aggregate Dem Share			
PLAN 89					PLAN 90					
District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?		
5	0.25	0	8		4	0.325	0	19		
3	0.3125	0	23		3	0.25	0	8		
4	0.6	1	31		5	0.525	1	25		
2	0.325	0	19		4	0.5875	1	25		
1	0.5125	1	19		2	0.3125	0	23		
Aggregate Dem Share				0.4	0.4	0.5	Aggregate Dem Share			

PLAN 91				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 92				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
				1	0.325	0	19					1	0.325	0	19
				2	0.5125	1	19					2	0.5125	1	19
				3	0.325	0	7					3	0.2375	0	24
				4	0.6	1	31					4	0.525	1	31
				5	0.2375	0	24					5	0.4	0	7
Aggregate Dem Share					0.4	0.4	0.5	Aggregate Dem Share					0.4	0.4	0.5
PLAN 93				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 94				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
				1	0.525	1	32					1	0.35	0	24
				2	0.325	0	19					2	0.5125	1	19
				3	0.25	0	8					3	0.5625	1	33
				4	0.5125	1	19					4	0.25	0	8
				5	0.3875	0	22					5	0.325	0	16
Aggregate Dem Share					0.4	0.4	0.51	Aggregate Dem Share					0.4	0.4	0.52
PLAN 95				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 96				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
				1	0.35	0	24					1	0.175	0	17
				2	0.1625	0	13					2	0.35	0	24
				3	0.5625	1	33					3	0.5625	1	33
				4	0.5125	1	19					4	0.5125	1	19
				5	0.4125	0	11					5	0.4	0	7
Aggregate Dem Share					0.4	0.4	0.52	Aggregate Dem Share					0.4	0.4	0.52
PLAN 97				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 98				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
				1	0.175	0	17					1	0.5125	1	19
				2	0.325	0	19					2	0.325	0	19
				3	0.5125	1	19					3	0.5875	1	38
				4	0.4	0	7					4	0.325	0	16
				5	0.5875	1	38					5	0.25	0	8
Aggregate Dem Share					0.4	0.4	0.57	Aggregate Dem Share					0.4	0.4	0.57
PLAN 99				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?	PLAN 100				District Number	Dem. Vote Share	Seat to Dems?	Firms to Dems?
				1	0.325	0	19					1	0.325	0	19
				2	0.1625	0	13					2	0.525	1	32
				3	0.5125	1	19					3	0.5125	1	19
				4	0.4125	0	11					4	0.5125	1	19
				5	0.5875	1	38					5	0.125	0	11
Aggregate Dem Share					0.4	0.4	0.57	Aggregate Dem Share					0.4	0.6	0.7

APPENDIX 2: DATA

If we had perfect data, we would check for firm gerrymandering in every state for every districting plan produced. However, data ability strictly limits the set of plans we can analyze. Our simulation procedure requires the following data:

1. Precinct shapefiles
2. Precinct-level vote outcomes
3. Precinct-level population and minority population

Ideally, the precinct-level vote outcome data would include the vote share for the House of Representatives or state legislators since those are the elected officials most impacted by redistricting. However, that data is rare. For most states, precinct-level election data includes presidential election results and possibly senate or gubernatorial results as well. For 2012, only Wisconsin, Maryland, and Minnesota make available House of Representatives data that are linked to precinct shapefiles. As well, even in states where House of Representatives data are available, many House elections are often uncontested, making those results useless for estimating latent two-party vote share.

To overcome this difficulty, we calculate an average two-party vote share using the closest available elections. We detail which elections we use for each state below.

Table A1: Elections aggregated for vote outcomes.

State	Year	Elections Used
AZ	2012	House 2018, Governor 2018, State Senate 2018, Secretary of State 2018
GA	2012	President 2016, Senate 2016
IA	2012	President 2008, President 2012, President 2016
MA	2012	President 2012, Senate 2012, Senate 2013, Senate 2014, President 2016
MD	2012	President 2012, Senate 2012, House 2012, Governor 2014
MN	2012	President 2012, Senate 2012, House 2012, State Senate 2012
NC	2012	Senate 2010, Governor 2012, President 2012, Senate 2014
NC	2016	President 2016, Senate 2016, Governor 2016, Senate 2014
NM	2012	Attorney General 2018, Senate 2018, President 2016, Secretary of State 2016
OH	2012	President 2016, Senate 2016, House 2016, State Senate 2016
OR	2012	Secretary of State 2016, Attorney General 2016, Governor 2016, House 2016, President 2016
PA	2012	President 2012, Senate 2012, President 2016, Senate 2016
PA	2018	President 2012, Senate 2012, President 2016, Senate 2016
TX	2012	President 2012, Senate 2012, Senate 2014, Governor 2014
VA	2012	President 2016, House 2016, House of Delegates 2017, House 2018
VA	2016	President 2016, House 2016, House of Delegates 2017, House 2018
WI	2012	President 2012, House 2012, President 2016, House 2016

APPENDIX 3: SIMULATIONS

We note in Section 4 that our procedure follows five steps:

1. Generate a precinct adjacency matrix from a state precinct map.
2. Conduct the Sequential Monte Carlo sampler, drawing 50,000 plans per state.
3. Overlay each generated plan with our data set of geolocated firms
4. Infer expected two-party vote shares for every district in every plan.
5. Finally, we assign firms to parties based on district vote shares.

Here we detail our methodological choices in Steps 1 through 5.

A3.1 Generating an Adjacency Matrix

The first step in our simulation procedure is to generate a precinct adjacency matrix for every state in our sample. For most states, we perform this step using the “`redist_map`” function from the `redist` library in R, verifying using the “`check.contiguity`” function from the `geomander` library to ensure that our adjacency matrices are complete.

However, for a number of state shapefiles (Maryland, Ohio, Wisconsin) we perform additional manual preprocessing to correct imperfect shapefiles. For these cases, we manually add edges between precincts using the “add.edge” function. In cases of an island precinct with no connections to any mainland precinct, we select the three closest mainland precincts and add edges to those.

A3.2 Running the SMC Sampler

We run the SMC procedure using the “redist_smc” function from the redist library. The key inputs to this function are the adjacency matrix from A3.1, a vector indicating the population of each precinct, the number of districts to allocate precincts into, the number of simulated plans to create, and the population tolerance: the maximum allowable deviation from equal population in each district. In reality this population deviation must be strictly minimized; we use a tolerance of 1% for computational efficiency. We also compute 50,000 plans for each state-year.

Like all simulations, SMC involves a number of hyperparameters which affect the speed, efficiency, and validity of the simulated districts. One such hyperparameter is a vector identifying which county each precincts falls into; if provided, the SMC function tries to minimize county splits, but providing it also helps to speed up the sampler. We provide this vector whenever it is available.

The remaining hyperparameters relate to simulation constraints, and in all cases we follow best practices as outlined by the authors of the redist library. We add a constraint for compactness, set to a strength of 1, such that more compact districts are preferred. For states that are bound by the Voting Rights Act, we also add a set of constraints to accommodate the requirement that majority-minority districts be created if possible. For this constraint we supply a vector enumerating the minority population in each precinct, a threshold of 0.55 indicating that a majority-minority district must be created if it is possible to reasonably produce a

district with 55% minority population, and a strength parameter, which we vary across states.

We design these constraints to be conservative in the creation of majority-minority districts. The redist authors suggest that to set the strength parameter in the VRA constraint, test increasing the value until the sampling efficiency drops to less than 75%. We follow this guidance, resulting in strength parameters that range from 5 to 100. Notable is that the redist authors often use strength parameters of 1,000 or more.

A3.3 Overlaying Maps with Firms

The output of the previous step is a set of 50,000 precinct assignments: which district each precinct falls into for each hypothetical map. This makes it easy to assign firms to districts: since firms fall neatly into precincts, it is possible to merge the firm location data set with the precinct assignment data set without requiring any spatial merge functions.

A3.4 Inferring Two-Party Vote Share

To determine which party is likely to control each hypothetical district in each hypothetical map, we calculate a measure meant to capture overall latent Democratic vote share for each precinct. Ideally we would use the House of Representatives election immediately following the introduction of new maps, but that precinct-level data is not always available, and in some cases races may be uncontested. Therefore we average both the Democratic and Republican vote shares for a number of available elections to produce a more robust measure of latent Democratic preference at the precinct level. For example, in Oregon we average the Democratic and Republican vote counts for the President, House, Governor, Attorney General, and Secretary of State in 2016. For the complete details of which elections we aggregate for each state, see Appendix 2.

Having produced these expected vote counts, we aggregate our data set to the district*map level by summing the expected Democratic and Republican votes

within each hypothetical district, then determining which party has more latent support in those hypothetical districts.

A3.5 Assigning Firms to Parties

Finally, we are left with a data set of 50,000 sets of districts, the count of how many firms are in those districts, and the latent Democratic vote share for each district. We can then aggregate up to the map-level and calculate how many firms are won by Democrats in each simulated redistricting plan.

APPENDIX 4: Robustness

4.1. Maps that are robust to swings in vote share

Our analyses thus far assume that mapmakers draw lines with foreknowledge of how a district will vote. For most cases this assumption is safe: mapmakers have detailed data on the districts they are drawing, and only 31 Congressional elections, or 7.1%, were won by a margin of less than 5 percentage points in 2012. But if mapmakers lose a district that they have drawn expecting to win or vice versa, then their gerrymanders could appear either less effective or more effective than they intended. More generally, mapmakers want to both win as many seats as possible and to win them comfortably, two goals that often conflict. Drawing many districts that they expect to win narrowly may backfire during a swing in voter preferences (Gul & Pesendorfer 2010).

To capture this consideration, we conduct a bounding exercise. We imagine 5 percentage-point uniform shocks to vote share in both directions and reexamine firm gerrymandering in these extreme scenarios: at the lower bound, the outparty wins all districts won by a margin slimmer than 55-45; at the upper bound, the mapmaker's party wins them.³⁷ If firms appear to be gerrymandered in favor of the mapmaker's party even when the outparty gains an extra 5% of the vote, we

³⁷ In this analysis, we leave the counterfactual distribution unchanged, i.e. it represents firm allocations going to the party with a simple majority in each district of each redistricting plan. Leaving this counterfactual unperturbed will lead to a relatively conservative test.

can conclude that firm gerrymandering is not the result of swing districts and secular shocks to vote share.³⁸

Table 2 displays quantile values for these bounds relative to each state's counterfactual distribution. Column 2 contains reference values for firm quantiles obtained in our core analysis, presented visually in Figure 3. Column 1 displays the lower bound from the exercise, and Column 3, the upper bound.

³⁸ We define marginal seats as those with a predicted district vote share falling within the 45% - 55% interval. Defining marginal seats as those in an interval this wide will lead to relatively conservative results in our bounding exercise.

Table A2 - Quantiles of Firms Allocations by State from Bounding Exercise

		Quantile of Firm Allocation in 2012 assuming 'marginal' seats lead to outcome at:		
State	Type	Lower Bound	Baseline	Upper Bound
PA	Rep	0.0002	0.0002	0.976
VA	Rep	0.000	0.016	0.251
MN	Rep	0.020	0.032	0.125
GA	Rep	0.063	0.099	0.099
IA	Commission	0.103	0.103	0.103
NC	Rep	0.126	0.126	0.126
TX	Rep	0.187	0.187	0.194
OH	Commission	0.407	0.407	0.407
AZ	Commission	0.401	0.469	0.469
WI	Rep	0.486	0.486	0.486
OR	Dem	0.174	0.976	0.976
MD	Dem	0.999	0.999	0.999
MA	Dem	1.000	1.000	1.000
NM	Dem	1.000	1.000	1.000

Notes:

The lower bound is the quantile of the enacted plan when Republicans are given all of the firms located in marginal (45-55) districts.

The baseline is the quantile of the enacted plan when the party with the simple majority is given firms in marginal (45-55) districts.

The upper bound is the quantile of the enacted plan when Democrats are given all of the firms located in marginal (45-55) districts.

This analysis exposes how robust the mapmakers' choice of a redistricting plan is relative to a counterfactual world in which firms in all other potential redistricting plans are allocated by simple majority. In the majority of states (e.g. Iowa, Maryland, Massachusetts, New Mexico, North Carolina, Ohio, Texas, and Wisconsin) both bounds are equivalent to the reference point because mapmakers enacted a plan with no firms in marginal seats. In other states, one bound may equal the baseline, while the other may not, reflecting that firms only reside in marginal districts of one party in the enacted plan. In a few states (e.g. Oregon, Pennsylvania, and Virginia), we see a large range in quantiles obtained at

different bounds, indicating that a large number of firms reside in the few districts we classified as marginal. The quantity of firms in marginal districts could represent geographic constraints or mapmakers' appetite for risk.³⁹

Taken together, these results show that our finding that firms are gerrymandered does not hinge on assumptions we made about the treatment of marginal seats. Following Caughey et al. (2017), as above, we calculate a global p-value for the bounding analysis of 9.55×10^{-5} , indicating strong statistical evidence that firm gerrymandering exists in at least some states even when actual election results bias against the existence of firm gerrymandering in enacted plans.⁴⁰

³⁹ We note that the choice of an enacted plan is endogenous to the mapmakers' appetite for risk: risk tolerant mapmakers may focus on the lower bound, while risk averse mapmakers may focus on the upper bound subject to other tradeoffs.

⁴⁰ In constructing this global p-value, we assume: when Democrats draw maps, they lose all marginal districts to Republicans; when Republicans draw maps, they lose all marginal districts to Democrats; and, when commissions draw maps the election outcome falls farthest from neutrality given marginal district outcomes.