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Recommended Citation

Baran, L., Forst, A., & Tony Via, M. (2022). Dual-class share structure and innovation. *Journal of Financial Research*, 1– 34. <https://doi.org/10.1111/jfir.12311>

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Dual-class share structure and innovation

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Abstract

Using a sample of dual-class firms matched with single-class firms possessing similar antitakeover protection, we find a positive association between disproportionate insider control and patent output, quality, creativity, research and development efficiency, and chief executive officer innovative risk taking. We also find, however, that the positive effects of disproportionate control on innovation are concentrated in financially constrained firms and firms in highly competitive industries, and that the positive effects dissipate within 10 years after the initial public offering. Most important, the positive effect of dual-class structures for innovation is conditional on the presence of innovative insiders in the firm. These findings imply that entrenchment through concentrated control in the hands of uniquely innovative corporate insiders provides a positive environment for innovativeness beyond the entrenchment effects of alternative antitakeover measures.

JEL CLASSIFICATION

G32, G34, O31, O32

1 | INTRODUCTION

Dual-class equity structures that enable corporate insiders to assert influence in the corporation disproportionate to that of outside shareholders have increased considerably in the US capital market in recent years. In 2019, 22.7% (38.2%) of all initial public offerings (IPOs; i.e., tech IPOs) in the United States were dual-class firms, compared to

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12.2% (14.3%) in 2009, 8.6% (5.9%) in 1999, and 6.0% (2.9%) in 1989 (Ritter, 2020, table 23).¹ Recent examples high-profile IPOs of US dual-class companies include Google, Facebook, Snap, and Lyft.

The surge in the number of publicly traded firms that feature disproportionate insider control has triggered extensive discussions within the investment community (Howell, 2017). The agency cost view (Adams & Ferreira, 2008; Gompers et al., 2010; Masulis et al., 2009) emphasizes that the entrenching properties of dual-class share structures insulate underperforming management from shareholder accountability and the market for corporate control. Consequently, disproportionate insider control enables the expropriation of private benefits of control by insiders at the expense of outside shareholders. Favoring this view and following an initiative led by the shareholder advocacy group Council of Institutional Investors, in July 2017 the equity index firms FTSE Russell, MSCI, and Standard & Poor's all adopted restrictions on the inclusion of dual-class firms in their benchmark indices.

By contrast, the innovation view emphasizes that dual-class structures allow companies to focus on long-term strategy, to reduce managerial myopia, and to better resist short-term expectations that often come with being publicly traded. In their seminal paper on dual-class firms, DeAngelo and DeAngelo (1985) posit that dual-class equity structures represent a beneficial hybrid between public and private ownership. They argue that a dual-class structure allows firms to maintain the benefits of private companies (such as autonomy and tolerance for innovative failure) while also allowing access to equity financing needed by companies facing financial constraints. In keeping with this perspective, a 2017 Nasdaq report supports dual-class structures as a way for investors to benefit from the successes of highly innovative firms.² However, the innovation view has seen little empirical evaluation and has not been satisfactorily examined (Bebchuk & Kastiel, 2017).

Using a comprehensive hand-collected sample of US dual-class firms, we address this empirical scarcity by examining the effects of dual-class share structures on the outputs of firm innovative efforts. Examining the outputs of innovation provides a more relevant picture of a firm's innovativeness than simply looking at innovative inputs, that is, research and development (R&D) spending, which may or may not result in successful outcomes. Examining the outputs of innovation also mitigates significant endogeneity concerns inherent in the most frequently used proxy for innovation, R&D spending. For example, Atanassov (2013) argues that R&D spending must be combined with other factors including human capital, effort, and creativity to result in innovation output.

Dual-class firms are virtually immune from hostile takeovers because typically the majority of shareholders within each class of shares must approve any takeover. When comparing dual-class firms to the universe of single-class firms, it is difficult, if not impossible, to distinguish with certainty whether any association between disproportionate insider control and innovation is due to the effect of antitakeover protection, or whether the effect is unique to dual-class equity structures as a specific and distinct corporate governance mechanism. In our primary analyses, we break new ground by comparing the innovative output of dual-class firms not to single-class firms in general, but to specific single-class firms that have adopted alternative, yet similarly effective, antitakeover provisions. We consider this approach a significant contribution to the literature on dual-class firms as well as entrenchment and innovation. It removes the inherent theoretical ambiguity of whether any observed impact of a dual-class share structure is due to the general effect of antitakeover protection and managerial entrenchment or is due to the specific disproportionate insider control enabled through a dual-class structure.

Overall, we find a positive association between disproportionate insider control and the number and quality of firms' innovative outputs, exploratory research, and the efficiency of R&D usage in generating innovation. In particular, we find that a 1 SD increase in disproportionate insider control is associated with an increase of at least 20% for all of our innovation measures relative to single-class firms entrenched through other antitakeover

¹<https://site.warrington.ufl.edu/ritter/ipo-data/>.

²From the Nasdaq 2017 report (Friedman, 2017): *One of America's greatest strengths is that we are a magnet for entrepreneurship and innovation.... Each publicly traded company should have flexibility to determine a class structure that is most appropriate and beneficial for them, so long as this structure is transparent and disclosed up-front so that investors have complete visibility into the company. Dual-class structures allow investors to invest side-by-side with innovators and high-growth companies, enjoying the financial benefits of these companies' success.*

provisions. This suggests that it is not just the antitakeover protection that comes with disproportionate insider control that positively influences firms' innovative output, but rather disproportionate control by specific corporate insiders appears to promote innovation beyond the impact of general antitakeover devices.

To gain further insights into the association between disproportionate insider control and innovation, we examine three moderating settings that may enhance, or diminish, the average positive association we find: financial constraints, industry competition, and time since IPO. We first consider financial constraints. Firms facing financial constraints face increased pressure to prioritize objectives and may find it challenging to maintain R&D spending at constant levels. Steady R&D spending is critical because cuts to the research budget could trigger the departure of key researchers who hold significant organizational capital (Eisfeldt & Papanikolaou, 2013). Accordingly, the ability of insiders holding disproportionate control to shrug off contravening short-term market pressures and stay focused on long-term growth (Jordan et al., 2016) and optimal innovation output should be most valuable when the firm's resources are scarce. Consistent with this conjecture, we find that the overall positive effect of dual-class share structure on innovation is driven primarily by the top quantile of financially constrained firms.

Second, we hypothesize that dual-class share structures, which concentrate corporate control in the hands of specific insiders, provide the greatest innovative benefits in industries with high competition. Chemmanur and Tian (2018) find generally that antitakeover provisions increase innovation in highly competitive industries. The ability of insiders to act quickly and decisively to capture innovative opportunities is likely most beneficial in highly competitive industries, which are characterized by low barriers to entry and an overall riskier environment that rewards firms that can adapt quickly (Li et al., 2019). Supporting this hypothesis, we find that the positive effect of dual-class on innovation occurs primarily in the high-competition quantile.

Third, we examine a time trend to determine whether the positive association between disproportionate insider control and innovative outputs is constant or changes with time. Johnson et al. (2015) find that takeover defenses enhance firm value post-IPO but that they become costly with time. Closely related to this finding, Cremers et al. (2020) find that dual-class firms have a higher valuation post-IPO than single-class firms but that the premium dissipates and becomes a discount about 6 years post-IPO. In our trend analysis, we similarly find that the superior innovativeness of dual-class firms decreases over time: The positive association between disproportionate insider control and innovativeness is limited to about 10 years post-IPO with negligible benefits thereafter.

The three moderating factors we identify suggest the presence of a strong individual effect underlying the positive association between disproportionate control and innovative outcomes. Insiders can successfully leverage dual-class share structures where close control is most beneficial for innovative outcomes, such as under financial constraints or in particularly competitive industries. In turn, the time trend in the benefits of dual-class structures for innovation is consistent with the departure of these highly influential individuals from the firm over time. Therefore, we next examine the impact of innovative individuals leading the firm and how their presence interacts with the use of a dual-class structure.

We first consider the joint effect of dual-class structures and innovative founders. Private firms tend to be more innovative (Bernstein, 2015; Ferreira et al., 2014) and are often led by innovative founders. However, the long, uncertain nature of innovation often increases the demand for more financing, which is best obtained from the public equity markets. This creates a conflict because of the threat of expropriation of the founder's ideas by new and more powerful vote-holding shareholders if the firm decides to go public (DeAngelo & DeAngelo, 1985). Dual-class structures appear to preserve conditions for entrepreneurial founders and executives to maximize their "private benefits of entrepreneurial control" such as independence and reputation (Aghion & Bolton, 1992; Sauermann & Cohen, 2010) while simultaneously affording them needed capital. We find that a dual-class structure is positively associated with innovation only when dual-class firms retain the involvement of a founder.

We also examine the innovative impact of individuals by exploring the propensity for key executives to file patents themselves and thereby create a "culture of innovation". We find that, relative to firms with alternative antitakeover protection, the top executives in firms characterized by disproportionate insider control are

more likely to file their own patents. Part of the increase in innovativeness is therefore directly attributable to the individual insiders leading the firm that hold disproportionate control rights.

One major empirical concern in any study examining the consequences of corporate governance arrangements is endogeneity; in particular, in our context, the endogeneity of ownership structure. The specifics of a firm's equity structure, including the rights and privileges of owners, are typically determined in conjunction with the firm's IPO. However, the same insiders that influence a firm's decision to go public with a dual-class structure also possess significant private information about the firm's innovation strategy and as well control the firms' R&D expenditures. Therefore, it is difficult to empirically disentangle whether dual-class firms are more innovative or whether innovative firms are more likely to choose a dual-class structure. Although a perfect solution to endogeneity may not exist, we attempt to mitigate these endogeneity concerns in four ways. First, in all of our analyses we exclude the first 2 years post-IPO. This excludes patents that were likely under development at the time of the IPO but that were filed shortly afterward. Second, based on the literature suggesting that innovative firms are more likely to adopt a dual-class structure (Bernstein, 2015; Chen et al., 2018), we add an analysis using a propensity-score-matched (PSM) sample of dual- and single-class firms where we additionally match firms on their "patent pipeline," that is, the firm's prior or ongoing innovation at the time of the IPO. In this sample, we ensure that dual- and single-class firms are equally innovative at the time of their public offering. We also employ a Heckman two-stage estimation approach (Heckman, 1979) in our analysis of only dual-class firms to control for sample-selection bias. Third, we examine changes in the innovativeness of firms that reclassify from a dual- to single-class structure. Fourth, we perform within-sample tests in our sample of only dual-class firms because any association between disproportionate control and innovativeness we find among dual-class firms cannot be due to systematic differences between dual- and single-class firms.

Taken together, our study contributes to at least three strands of literature. First and foremost, we contribute to the literature that argues dual-class firms represent a beneficial hybrid between public and private ownership (DeAngelo & DeAngelo, 1985). Second, we contribute to studies that examine antitakeover protection effects on corporate innovation (e.g., Chemmanur & Tian, 2018) by demonstrating a distinct dual-class effect beyond a general entrenchment effect. Finally, we contribute to the literature that examines factors that motivate managerial commitment to long-term innovation by providing a "tolerance for failure" (Manso, 2011).

2 | LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 | Disproportionate insider control and its distinction from other antitakeover measures

Numerous studies have examined the effects of antitakeover devices on innovation; however, they have produced mixed results (Adams & Ferreira, 2008). On the one hand, some studies find that takeover protection has a positive effect on innovation (Baranchuk et al., 2014; Chemmanur & Tian, 2018). These papers argue that entrenchment reduces myopic pressures on management, thus allowing them to focus on long-term projects such as innovation. The entrenchment effect of antitakeover protection might also improve innovation under the career concerns (Bernstein, 2015) or tolerance for failure (Manso, 2011) hypotheses.

On the other hand, many studies find that antitakeover protection either has no effect on or is actually detrimental to innovation (Atanassov, 2013; Chen, 2012). Specifically, managerial entrenchment may deter innovation under the quiet life hypothesis (Bernstein, 2015) or because of the agency problem, incomplete contracting, or asymmetric information views (Atanassov, 2013).

The debate whether the entrenchment effects of antitakeover measures are on average positive or negative suggests that antitakeover protection alone represents an insufficient condition for long-term value creation via

innovation. Along these lines, Manso (2011) suggests that although entrenchment is an important facilitator for innovation, it is effective only if coupled with other incentives designed to promote firm value creation and avoid managerial shirking.

We propose that disproportionate insider control is fundamentally different from other common takeover defenses. Although standard antitakeover measures, such as poison pills or staggered boards, make it more difficult, if not impossible, for any outsider to gain majority control of the firm, many dual-class firms are immune from takeovers for the exact opposite reason: Majority control is already vested in certain individuals. Thus, although the result—the firm is protected from hostile takeovers—is the same, both are distinct mechanisms: One makes attaining concentrated ownership difficult; the other embraces it.

Although it is the nature of all antitakeover measures to facilitate “external entrenchment” (i.e., protection of the firm and its management against outside interference in the form of hostile takeovers), dual-class structures also convey “internal entrenchment” (i.e., insulation of management from internal opposition by diminishing shareholder democracy). For example, at Facebook's May 2019 shareholder meeting, an overwhelming majority (68%) of votes were cast in favor of retaining Mark Zuckerberg as chief executive officer (CEO) but removing him as chairman of the board. However, the superior voting rights of insiders, including Zuckerberg, facilitated an effortless defeat of the shareholders' proposal to split the roles of CEO and chairman (Kozlowska, 2019). Neither a staggered board nor a poison pill would have protected Zuckerberg from an ouster brought about not by a hostile takeover attempt but by plain shareholder democracy; however, his disproportionate control rights did.

In addition, disproportionate insider control may shelter management more effectively than other antitakeover measures from hostile boards. Although outside board members generally have been considered beneficial for firm performance, there is a significant empirical literature suggesting that they may not be beneficial for innovation (Balsmeier et al., 2017; Faleye et al., 2011). However, dual-class companies not only fall under the “controlled companies” exemption of the Sarbanes–Oxley Act and are not required to have a majority of independent directors, but their enhanced voting rights also allow insiders to disproportionately influence, if not entirely determine, the outcome of board elections.

Moreover, apart from the enhanced protection against threats to management from hostile boards, concentrated control in the hands of select insiders may have positive effects for innovation not shared by other takeover measures. Insiders who exercise long-term control provide long-term stable management. As much as shareholder democracy is diminished, the ability to push aside internal challenges ensures that employees and outside parties are more likely to deal with the same management and same corporate strategies for an extended period (Anderson & Reeb, 2003). This constancy of engagement facilitates deeper business relationships and the development of enhanced trust over time. Moreover, a relationship with improved implicit contracting is less costly than one with complete explicit contracting (Andres, 2008). Taken together, the benefits of stable management conveyed by internal entrenchment in firms characterized by disproportionate insider control may contribute to an enhanced innovative environment beyond that provided by alternative antitakeover measures. Consequently, we form our first main hypothesis:

H1: Disproportionate insider control is positively associated with innovation output, quality, creativity, and efficiency as measured by patents, citations, explorative patents, and R&D efficiency relative to other high-antitakeover firms.

2.2 | Individual-specific incentives for innovation and dual-class structures

Prior research indicates that private firms are more innovative, and this is often a consequence of the many benefits that staying private provides to their leaders. For example, Ferreira et al. (2014) suggest that public firms are less

likely to engage in product market innovation than private firms and that private firms produce higher quality explorative patents; conjectures for which empirical support is provided in Bernstein (2015). Indeed, Bernstein (2015) finds that public firms have lower innovation quality and more exploitative patents than private firms because of managerial career concerns and many other agency problems induced by public equity markets. Privately held firms, often controlled by their innovative founders and free from the scrutiny and discipline of the public markets, enable their leaders to maximize their private benefits of entrepreneurial control, which can also maximize long-term firm value. These personal intangibles include reputation and human capital (Aghion & Bolton, 1992), autonomy (Sauermann & Cohen, 2010), and career concerns (Holmstrom, 1999), all of which theoretically favor the development of higher quality innovations.

Private firms also support an entrepreneurial individual's pursuit of personal intangibles by providing an enhanced tolerance for failure (Manso, 2011) and an extended permissible time frame to allow success to materialize (e.g., by not having to focus on quarterly/annual earnings). Innovation is inherently a long, risky endeavor with the potential for many setbacks before success. Manso (2011) argues that this failure tolerance not only motivates innovation, but also leads to higher quality explorative patents as opposed to exploitative patents (as defined in March, 1991). However, innovative founders may lose significantly from going public, as they risk the expropriation of their own individual research streams (DeAngelo & DeAngelo, 1985) by vote-yielding outside shareholders who may be able to gain control of the firm and may aggressively oppose the founder/manager.

These points beg the question: If managers' private benefits of entrepreneurial control, their ability to maintain a long-term focus, and their freedom from expropriation are such important ingredients for innovation, why does a firm not just stay private to maximize its innovative potential? The answer is the need for financing. The long, uncertain nature of innovation may require numerous cash infusions. Many innovative firms face a dilemma over whether they should (1) go public to enhance their access to equity financing, with a consequence of diluting control of the founders of the firm and risking expropriation, or (2) keep founders in control by staying private but then being underfunded and stifling the firms' growth and innovative potential. Both options pose serious threats to the conditions that encourage innovative risk taking. It is for this conflict that DeAngelo and DeAngelo (1985) bring to the fore the idea that dual-class structures create a beneficial hybrid between public and private ownership: firms that are publicly traded yet privately controlled. Using the same logic, Chemmanur and Jiao (2012) suggest that dual-class structures may be beneficial for R&D-intensive firms with high near-term uncertainty. Taken together, disproportionate insider control might engender the best of both worlds for innovative founders by allowing them to establish internal entrenchment and maintain many of the benefits of private control (i.e., reduced short-term pressure, tolerance for failure, individual control incentives, etc.) while allowing access to more extensive equity markets.

By contrast, these conjectures suggest that dual-class share structures that are not established by innovative founders to overcome the drawbacks of both private and public ownership structures may not be beneficial for innovation. In fact, it is unreasonable to believe that merely by recapitalizing into a dual-class equity structure, successful innovation would spontaneously materialize. In these cases, it is likely that dual-class structures are chosen by insiders who wish to "have their cake and eat it too," that is, to divest shares while maintaining control and hence create the ability to expropriate outside shareholders. This is one of the major concerns of dual-class structures (Howell, 2017; Masulis et al., 2009). We thus form our second main hypothesis:

H2: Disproportionate insider control is positively associated with innovation primarily when innovative individuals are leading the firm.

3 | DATA AND DESCRIPTIVE STATISTICS

We combine data from several sources in the 2000–2008 sample period. We primarily obtain patent information from the National Bureau of Economic Research (NBER) patent database from 1976 to 2006. In addition, we use the Kogan et al. (2017) patent database, which enables us to extend our sample to 2008.³

We compile our sample of dual-class firms between 2000 and 2008 following the methods of Gompers et al. (2010) as described in Baran and Forst (2015). From the list of potential dual-class firms, we eliminate foreign and financial firms and manually verify the dual-class status from the US Security and Exchange Commission's (SEC) EDGAR database from proxy statement and/or 10-Ks. Following Gompers et al. (2010), we include as insider ownership any shares owned by officers and directors, family members of insiders, and trusts for the benefit of family members. We obtain firm financial information from Compustat and market data from the Center for Research in Security Prices (CRSP).

3.1 | Disproportionate insider control measure

Our measure of disproportionate insider control is WEDGE, defined as the difference between insider voting rights and insider cash-flow rights (Gompers et al., 2010). Insider voting rights are measured as board election rights (Baran & Forst, 2015), which measure the proportion of all board seats controlled by insiders from both the number of votes per share of each class of stock and disproportionate board election rights. Insider cash-flow rights are the percentage of shares of each class held by insiders weighted by the dividend rights per class.

3.2 | Innovation measures

We use two main measures of innovation: (1) number of PATENTS, which measures the quantity of innovative output, and (2) patent CITATIONS, which measures the quality of innovative output. We further classify patents as EXPLORATIVE or EXPLOITATIVE following Fitzgerald et al. (2021) and He et al. (in press), respectively. EXPLORATIVE patents represent new areas of innovation with greater potential and are considered more creative, whereas EXPLOITATIVE patents continue to develop current areas of innovation and are considered less creative. In robustness tests, we also use measures of patent ORIGINALITY and GENERALITY, which measure the breadth of patent technology classes cited by the patent and the breadth of patent technology classes that later cite this patent, respectively. We also control for R&D spending as an input to innovation in all of our models, except those where the dependent variable is scaled by R&D, and examine the efficient use of R&D spending in producing PATENTS and CITATIONS. Our results hold with and without including R&D. The Appendix provides definitions for all variables.

3.3 | Sample construction: High-antitakeover firms

To determine the effect of dual-class share structures on innovation, we must first inoculate our sample from related antitakeover devices chosen before the IPO. For example, Chemmanur et al. (2022) find that pre-IPO innovation increases antitakeover protection at the IPO and creates a positive association of antitakeover protection on innovation in the 2 years following the IPO. In addition, it is important to compare dual-class firms to

³We begin our sample in 2000 due to limitations from our dual-class database and conclude our sample in 2008 due to limitations on available patent data. Although the Kogan et al., (2017) sample extends to 2010 by patent grant, our evaluation of patent filings limits our sample to 2008.

other firms with high antitakeover protection because of the nonmonotonic effects of antitakeover protection on firm performance (Obaydin et al., 2021). As previously noted, dual-class share structures are distinct from other antitakeover measures in that they accomplish takeover protection by enabling control of the firm by specific individuals. To show that our findings are indeed due to the form of entrenchment created by dual-class structures (i.e., entrenchment through disproportionate insider control), we construct a sample consisting of dual- and single-class firms in the 75th percentile of G-index values (Gompers et al., 2003).⁴ This sample includes 2274 dual-class firm-years for 431 dual-class firms and 2930 single-class firm-years for 539 single-class firms with high antitakeover protection. It stands to reason that all firms included in our sample hence possess a similarly low probability of hostile takeovers, that is, similar levels of external entrenchment. Thus, by construction, any effect of WEDGE on innovation should not be simply due to antitakeover protection, which both dual- and single-class firms in this sample feature. For robustness and use in some tests, we also construct a subsample of this primary sample that includes only patenting firms.⁵

3.4 | Descriptive statistics

Panel A of Table 1 provides descriptive statistics for our variables of interest. Panel B provides descriptive statistics and test of differences in means between dual- and single-class firms in the full sample. As shown in Panel A, in the average dual-class firm, insiders possess 56.8% of the voting rights but are entitled to only 30.1% of the firm's cash-flow rights. Insiders have on average 26.7% higher voting rights than cash-flow rights as indicated by WEDGE, which indicates the extent of disproportionate insider control as the difference between the voting rights held by insiders and their economic interest in the firm. In single-class firms, governed by the one-share/one-vote principle, voting rights and economic interest are proportionate and WEDGE is 0 by construction. We observe that values for WEDGE are similar between the full and patenting samples.

As shown in Panel B of Table 1, univariate tests suggest that single-class firms (with high antitakeover protection) have significantly more patents and citations overall, as well as more explorative and exploitative patents, than dual-class firms. However, dual-class firms produce significantly more patents for each dollar of R&D spending. With respect to control variables, dual-class firms are significantly younger, have less revenue and R&D spending,⁶ and have lower return on assets (ROA) and tangible assets. Because dual-class firms are significantly smaller, observing a higher number of patents in single-class firms is consistent. Multivariate tests are necessary to establish the true relation between disproportionate control and innovation. We also observe that two financial constraint proxies, WW_INDEX (Whited & Wu, 2006) and HM_INDEX (Hoberg & Maksimovic, 2015), are significantly lower for dual-class firms.

4 | MAIN RESULTS AND IDENTIFICATION

4.1 | Disproportionate insider control and innovation activities

We begin our investigation by estimating baseline regressions examining the effect of disproportionate insider control (specifically, WEDGE) on various measures of innovation in our dual-class and high-antitakeover single-class firm sample. If disproportionate insider control enables a higher tolerance for failure of risky innovative projects,

⁴We alternatively define high-antitakeover single-class firms as those with an E-index (Bebchuk et al., 2009) of 4 or more. We do not present these results for parsimony, but they are robust and available upon request.

⁵We define a patenting firm as a firm that has filed at least one patent in the last 10 years. This sample includes 886 dual-class firm-years for 224 dual-class patenting companies and 1811 single-class firm-years for 365 single-class patenting firms.

⁶In untabulated results for the patenting dual-class and high-antitakeover single-class firms, we find no significant difference in R&D spending between the groups. Other univariate differences are largely similar.

TABLE 1 Descriptive statistics of dual- and single-class firms

<i>Panel A: Dual-class firms and excess control</i>									
Variable	Full sample				Patenting sample				
	Mean	SD	P25	P75	Mean	SD	P25	P75	
INSIDER_VOTING_RIGHTS	0.568	0.003	0.369	0.762	0.531	0.003	0.328	0.730	
INSIDER_CASH_FLOW_RIGHTS	0.301	0.002	0.125	0.449	0.279	0.002	0.110	0.414	
WEDGE	0.267	0.002	0.123	0.393	0.253	0.002	0.121	0.367	
<i>Panel B: Full sample: Dual-class and high-antitakeover-protection single-class firms</i>									
	Dual-class firms				Single-class firms				Diff
	Mean	SD	P25	P75	Mean	SD	P25	P75	
PATENTS	2.371	21.100	0.000	0.000	7.689	0.650	0.000	1.000	***
CITATIONS	2.936	26.370	0.000	0.000	8.788	0.727	0.000	0.176	***
EXPLORATIVE	0.332	3.480	0.000	0.000	0.863	0.083	0.000	0.000	***
EXPLOITATIVE	0.503	5.750	0.000	0.000	1.713	0.124	0.000	0.000	***
PATENTS/R&D	0.085	0.320	0.000	0.036	0.060	0.002	0.000	0.054	*
CITATIONS/R&D	0.104	0.520	0.000	0.030	0.071	0.002	0.000	0.048	
STATE_ANTI	2.221	1.870	1.000	4.000	2.806	0.021	1.000	5.000	
SALE	6.345	1.730	5.324	7.422	7.642	0.013	6.774	8.515	***
ROA	0.083	0.250	0.061	0.156	0.133	0.001	0.088	0.174	***
CAPEX	0.050	0.060	0.017	0.062	0.051	0.000	0.022	0.066	
R&D	104.179	1129.880	0.000	6.846	186.287	9.267	0.000	68.940	***
CASH	0.092	0.120	0.014	0.122	0.078	0.001	0.016	0.105	***
TANGIBLE	0.271	0.210	0.106	0.382	0.307	0.002	0.132	0.456	***
SALES_GROWTH	0.066	0.300	-0.020	0.143	0.065	0.002	-0.003	0.148	
AGE	2.581	0.770	1.946	3.258	3.178	0.006	2.773	3.664	***
HERFINDAHL	2.629	2.110	1.163	3.373	2.104	0.019	0.855	2.667	

Note: Panel A reports descriptive statistics for all dual-class and patenting dual-class firm-years between 2000 and 2008. The dual-class full sample includes 2274 firm-years for 431 firms, and the dual-class patenting sample includes 886 firm-years for 224 firms. Panel A presents the variables related to insider board control rights and dividend rights in dual-class firms. Panel B reports statistics for dual-class firms and high-antitakeover-protection single-class firms in the full sample. The single-class firm sample includes 2930 firm-years for 539 firms. Panel B presents six measures of innovation activities as well as firm control variables. All variables are defined in the Appendix. We conduct a t-test for the differences between the mean values for the dual- and single-class firms and indicate significant differences in the final column of Panel B.

* $p < 0.10$; *** $p < 0.01$.

we expect a positive association between WEDGE and the number, quality, creativity, and efficiency of patents. We follow Acharya and Xu (2017) and Baranchuk et al. (2014) and estimate the following regression model:

$$\begin{aligned}
 \text{INNO_ACTIVITY} = & \beta_0 + \beta_1 \text{WEDGE}_{i,t} + \beta_2 \text{STATE_ANTI} + \beta_3 \text{HERFINDAHL}_{i,t} \\
 & + \beta_4 \text{ROA}_{i,t} + \beta_5 \text{CAPEX}_{i,t} + \beta_6 \text{SALES}_{i,t} + \beta_7 \text{AGE}_{i,t} + \beta_8 \text{CASH}_{i,t} \\
 & + \beta_9 \text{TANGIBLE}_{i,t} + \beta_{10} \text{SALES_GROWTH}_{i,t} + \beta_{11} \text{R\&D}_{i,t} \\
 & + \beta_k \text{YEAR} + \beta_l \text{INDUSTRY} + \varepsilon.
 \end{aligned} \tag{1}$$

The dependent variable, INNO_ACTIVITY, represents the following alternative measures of innovative activities: PATENTS, CITATIONS, EXPLORATIVE, EXPLOITATIVE, PATENTS/R&D, and CITATIONS/R&D (as defined in the Appendix). We control for numerous factors that affect innovation activities: state antitakeover index, Herfindahl index, ROA, capital expenditures to total assets, log of sales, log of firm age, ratios of both cash and tangible assets to total assets, first difference in the log of sales as sales growth, and R&D. We also include industry and year fixed effects.⁷

Panel A of Table 2 presents the results of our estimation of Model (1) in our sample of dual-class and high-antitakeover single-class firms. We find a positive and statistically significant relation between WEDGE and all innovation measures (except EXPLOITATIVE) in the full sample. The positive and statistically significant relation between WEDGE and PATENTS and CITATIONS supports H1 and indicates a positive effect of disproportionate control on innovation output and quality. In addition, the dual-class structure should reduce short-term market pressure and allow firms to focus on long-term value creation and riskier, more explorative innovation. We distinguish between highly and less creative patents by separately examining EXPLORATIVE and EXPLOITATIVE patents. We find that WEDGE is positively and significantly related only to the riskier EXPLORATIVE patents and is unrelated to the less risky and less creative EXPLOITATIVE patents, with both results supporting H1. We find similar support for H1 in terms of R&D efficiency with respect to both patents and citations. We scale PATENTS and CITATIONS by R&D similar to Hirshleifer et al. (2013) to capture the firm's efficient use of R&D to produce a patent that receives future citations. Panel B presents results for our estimation of Model (1), but using a sample of only patenting dual-class and high-takeover-protection single-class firms to rule out the possibility that the results are affected by the inclusion of firms that do not produce any innovative outputs. Results in our patenting-firm-only sample are generally stronger and confirm those reported in Panel A.

These results are not only statistically significant but economically significant as well. In untabulated standardized regression coefficients, we find that a 1 SD in WEDGE increases PATENTS by 26.3%, CITATIONS by 21.4%, EXPLORATIVE by 31.3%, PATENTS/R&D by 22.25%, and CITATIONS/R&D by 20.26% of the respective variable sample means in the full sample. In Online Appendix Table IA.1, we demonstrate that our results are robust to excluding extreme levels of citations, originality, and generality.

4.2 | Selection model, pre-IPO innovation controls, and descriptive statistics

Similar to prior studies examining dual-class share structures, we conduct a robustness test to control for sample-selection bias and the joint determination problem of dual-class structure and innovation. To control for factors known to affect the decision to adopt a dual-class structure of shares at IPO, we follow the literature and create a PSM sample of dual- and single-class firms based on the selection model in Gompers et al. (2010). Specifically, we estimate a probit regression that models the choice to adopt a dual-class structure at the IPO as a function of proxies for the level of private benefits of control after the IPO.⁸

An important addition we make to our selection model is to supplement the set of variables from Gompers et al. (2010) with two variables that capture the strength of firms' existing innovation pipelines. Often firms go public when significant innovations have recently been achieved or are about to occur (Bernstein, 2015). In addition, Chen et al. (2018) find that the choice of ownership structure in IPO firms is affected by prior firm innovation. This creates an endogeneity problem because any positive association between disproportionate insider ownership and innovation may not be due to dual-class structures fostering innovation but is simply due to innovative firms being

⁷Industry fixed effects are based on Fama & French, (1997) 48 industry classifications. We base test statistics on Huber–White heteroskedasticity-consistent standard errors for consistency with most related studies (Arugaslan et al., 2010; Baranchuk et al., 2014).

⁸For brevity, we refer to Gompers et al., (2010) for an explanation of the rationale of all variables included in the selection model.

more likely to choose dual-class structures. Additionally, the choice to adopt antitakeover protection at the IPO is influenced by innovation activity before the IPO (Chemmanur & Tian, 2018).

However, it is difficult to estimate innovation pre-IPO, as most data sets covering publicly traded firms report firm financials and insider profiles only post-IPO. However, a unique aspect of the patent database of Kogan et al. (2017) and

TABLE 2 Regression analysis of innovation activities

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	PATENTS/R&D	CITATIONS/R&D
<i>Panel A: Full sample</i>						
WEDGE	2.9814** (2.50)	2.9752** (2.36)	0.3647** (2.50)	0.4292 (1.33)	0.0938*** (2.91)	0.1022** (2.06)
STATE_ANTI	-0.0533 (-0.76)	0.0045 (0.04)	0.0106 (0.86)	-0.0016 (-0.08)	0.0021 (0.91)	0.0034 (0.73)
HERFINDAHL	-0.1831*** (-2.81)	-0.2135* (-1.92)	-0.0202** (-2.16)	-0.0305* (-1.68)	-0.0011 (-0.46)	-0.0023 (-0.57)
ROA	0.1526 (0.17)	-0.1134 (-0.09)	0.0620 (0.63)	-0.1938 (-0.78)	0.0265 (1.62)	0.0421*** (1.80)
CAPEX	5.2230 (1.57)	9.0342 (1.49)	1.0507*** (2.83)	1.3931*** (1.78)	-0.0437 (-0.23)	0.1124 (0.37)
R&D	0.0002 (1.55)	0.0002 (1.41)	0.0000 (0.80)	0.0000 (0.66)		
SALES	-0.3235** (-2.53)	-0.3199 (-1.62)	-0.0055 (-0.25)	-0.0899*** (-2.65)	-0.0039 (-0.97)	-0.0094 (-1.14)
AGE	-0.0900 (-0.37)	-0.5965 (-1.55)	0.0134 (0.38)	0.1876*** (2.93)	-0.0198* (-1.81)	-0.0299* (-1.93)
CASH	4.5615** (2.39)	6.7523** (2.35)	-0.2520 (-1.00)	0.6665 (1.40)	-0.0628 (-1.42)	-0.0754 (-0.90)
TANGIBLE	-1.3911 (-1.33)	-1.0061 (-0.58)	-0.3847*** (-3.79)	-0.5030* (-1.75)	0.1418** (2.34)	0.1352 (1.51)
SALES_GROWTH	-0.5311 (-1.01)	-0.1592 (-0.19)	0.0041 (0.04)	-0.1863 (-1.19)	0.0019 (0.07)	0.0421 (1.06)
Industry/year	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R ²	0.1121	0.0739	0.0546	0.0721	0.1086	0.0617
N	5204	5204	5204	5204	2070	2070
<i>Panel B: Patenting sample</i>						
WEDGE	6.9389*** (2.88)	7.3038** (2.56)	0.8347** (2.46)	0.8231 (1.41)	0.1138** (2.48)	0.1309* (1.86)

(Continues)

TABLE 2 (Continued)

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	PATENTS/R&D	CITATIONS/R&D
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry/year	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.1697	0.1019	0.0669	0.1227	0.1464	0.0828
N	2671	2671	2671	2671	1739	1739

Note: This table reports results for both the full sample (Panel A) of dual-class and high-antitakeover-protection single-class firms and the subset of patenting firms (Panel B). The dependent variables are six measures of innovation activities: patents, citations, explorative patents, exploitative patents, patents scaled by R&D, and citations scaled by R&D. In each model, the main variable of interest is the wedge between the insider voting and cash-flow rights. For both panels, we also control for the number of state antitakeover statutes from Cremers and Sepe (2017), Herfindahl index, return on assets (ROA), capital expenditures to assets, R&D to assets, log of sales, log of firm age, cash to assets, percentage of tangible assets, and sales growth, as well as industry (Fama & French, (2017), Herfindahl index, return on assets (ROA), capital expenditures to assets, R&D to assets, log of sales, log of firm age, cash to assets, percentage of tangible assets, and sales growth, as well as industry (Fama & French, 1997) and year controls. All variables are defined in the Appendix. We report t-statistics based on robust (Huber–White) standard errors in parentheses.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

the NBER database is that they are matched to firms using the patent grant date, not the patent filing date. During our sample period, the average patent pendency was over 3 years, meaning the average patent granted even 3 years post-IPO was likely filed before the IPO. This provides us with a substantial number of patents that we can identify with a filing date before the IPO date. In addition, limiting our sample to post-2000 also gives us several advantages in terms of identifying pre-IPO innovation. First, the American Inventors Protection Act of 1999 led to the mandatory publication of patents within 18 months of filing regardless of whether the patent had been granted, allowing roughly half of the pending patents at the time of the IPO to have their entire processes publicly available to outsiders. Second, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS agreement) in 1994 and 1999 allowed provisional patents to be quickly filed and the term “patent pending” to be used for marketing purposes and the licensing and distribution of new products. This also enabled firms with recently developed innovations to fully reveal their information in road shows before the IPO.

Given the availability of pre-IPO patent data and these regulatory changes, we control for the patent pipeline in our selection model to address concerns of reverse causality. Specifically, in our selection model we include the number of patents that were filed but not yet granted at the time of the IPO (Baranchuk et al., 2014) plus the number of patents filed within 1 year of the IPO, as these patents are likely to be based on R&D in progress at the time of the IPO. In addition, we include R&D/Assets in the IPO year to capture the input measure of future patents at the time of the IPO. We also exclude from analysis the first 2 years after the IPO to further mitigate the concern that our results are driven by the selection bias to a dual-class share structure by innovative firms. We thus use the following selection model, which incorporates (1) the patent pipeline measures of innovation proxied by pre-IPO patent filings and pre-IPO R&D spending and (2) the matching variables in the selection model of Gompers et al. (2010):

$$\begin{aligned} \text{Pr}(\text{DC}) = & \beta_0 + \beta_1 \text{PATENTS}_i + \beta_2 \text{R\&D_IPO}_i + \beta_3 \text{NAME}_i + \beta_4 \text{MEDIA}_i \\ & + \beta_5 \text{SALES_RANK}_i + \beta_6 \text{PROFIT_RANK}_i + \beta_7 \% \text{FIRMS}_i + \beta_8 \% \text{SALES}_i \\ & + \beta_9 \text{SALES/REGION_SALES}_i + \beta_{10} \text{STATE_ANTI} + \beta_k \text{LISTING_YEAR}_i \\ & + \beta_j \text{INDUSTRY}_i + \varepsilon. \end{aligned} \quad (2)$$

The dependent variable DC is equal to 1 for firms with a dual-class structure, and 0 otherwise. Table 3 presents the results of the selection model. For our patent pipeline measures, we find that the number of patents in the pipeline at IPO is a marginally significant predictor of dual-class status in the full sample only after controlling for all

TABLE 3 Propensity-score-matched (PSM) sample-selection model

Panel A: Selection model results					
Variable	Full sample	Patenting sample			
Patent pipeline at IPO variables					
PATENTS	0.0003*	0.0003			
	(0.0002)	(0.0002)			
R&D_IPO	-0.1436	0.2492			
	(0.1785)	(0.2154)			
Other dual-class determinants					
NAME	0.2851***	0.4468***			
	(0.0303)	(0.0578)			
MEDIA	1.2943***	1.2041***			
	(0.0684)	(0.1956)			
SALES_RANK	0.0083***	0.0087***			
	(0.0005)	(0.0010)			
PROFIT_RANK	-0.0003	-0.0040			
	(0.0004)	(0.0008)			
%FIRMS	-4.6537***	-10.6356***			
	(1.0652)	(1.9797)			
%SALES	4.4489***	9.6087***			
	(0.7748)	(1.4329)			
SALES/REGION_SALES	-0.0345	-0.2925***			
	(0.0571)	(0.1133)			
STATE_ANTI	-0.0027	0.0300			
	(0.0105)	(0.0193)			
IPO year/industry	Yes	Yes			
N	34,228	13,164			
R ²	0.1083	0.1089			
Panel B: Descriptive statistics of full-sample PSM					
Variable	Dual class		Single class		Difference
	Mean	Median	Mean	Median	
PATENTS	4.7026	0.0000	8.8550	0.0000	
R&D_IPO	0.0219	0.0000	0.0216	0.0000	
NAME	0.2751	0.0000	0.2511	0.0000*	
MEDIA	0.0626	0.0000	0.0749	0.0000	
SALES_RANK	69.0029	78.0000	68.1743	75.0000	
PROFIT_RANK	61.0200	72.0000	60.6131	70.0000	

(Continues)

TABLE 3 (Continued)

<i>Panel B: Descriptive statistics of full-sample PSM</i>					
Variable	Dual class		Single class		Difference
	Mean	Median	Mean	Median	
FIRMS	0.0349	0.0189	0.0359	0.0221	
SALES	0.0424	0.0168	0.0432	0.0205	
SALES/REGION_SALES	0.0815	0.0019	0.0741	0.0169	
STATE_ANTI	1.5967	1.0000	1.5751	1.0000	
<i>Panel C: Descriptive statistics of patenting PSM</i>					
Variable	Dual class		Single class		Difference
	Mean	Median	Mean	Median	
PATENTS	13.0096	0.0000	15.2647	0.0000	
R&D_IPO	0.0508	0.0165	0.0484	0.0128	
NAME	0.2755	0.0000	0.2812	0.0000	
MEDIA	0.0303	0.0000	0.0178	0.0000	
SALES_RANK	66.6652	80.0000	66.6776	71.0000	
PROFIT_RANK	58.2011	73.0000	59.1289	66.0000	
%FIRMS	0.0375	0.0207	0.0385	0.0211	
%SALES	0.0473	0.0219	0.0477	0.0219	
SALES/REGION_SALES	0.0682	0.0016	0.0725	0.0023	
STATE_ANTI	1.7066	1.0000	1.6241	1.0000	

Note: This table reports the results of the selection model from Gompers et al. (2010) augmented with variables to control for the innovation pipeline of firms at the time of the IPO. We implement the model in two samples: full sample and subset of patenting firms. The model has two variables to control for the joint determination of dual-class structure and future innovation: PATENTS and R&D_IPO. In addition, we include NAME, MEDIA, SALES_RANK, PROFIT_RANK, FIRMS, SALES, SALES/REGION_SALES, and STATE_ANTI as defined in Gompers et al. (2010). All variables are defined in the Appendix. The models also include dummy variables for the IPO year and Fama–French (1997) industries. Panel A reports coefficients, with standard errors in parentheses. Panels B and C report the means and medians for the selection model variables for both samples. We conduct a *t*-test for the differences between the mean values for dual- and single-class firms and indicate significant differences in Panels B and C.

p* < 0.10; **p* < 0.01.

other factors from Gompers et al. (2010). Innovativeness does not appear to be a primary driving force behind many firms' decision to use a dual-class structure.

We then create a PSM sample of dual- and single-class firms using Model (2) similar to Gompers et al. (2010), Baran and Forst (2015), and Masulis et al. (2009). Specifically, using Model (2), we estimate the probability that a firm will adopt a dual-class structure on an annual basis. We then match single- and dual-class observations without replacement on the closest estimated probability of choosing a dual-class structure. This process creates a matched sample of firms with similar characteristics, including a similar patent pipeline, with the exception that one sample has elected a dual-class equity structure and the other has not. In our full sample, we have a mix of innovative and noninnovative firms. We therefore construct an additional PSM sample of only patenting dual- and single-class firms using the same selection model. This mitigates the concern that our results are affected by differences in the observable firm characteristics on which the samples are matched. Panels B and C of Table 3 present the mean and median selection model variables for the full and patenting PSM samples, respectively. Aside from a marginally

significant difference in NAME in the full sample, all *t*-tests show insignificant differences in mean selection model characteristics. We also use Model (2) to implement a two-stage methodology (Heckman, 1979) to control for sample-selection bias in our dual-class-only sample. From this we include the inverse Mills ratio derived from the estimation of Model (2) as an additional control in our tests that use only our sample of dual-class firms (see Table 5 later).

4.3 | Innovation in our PSM sample

Table 4 presents results of our estimation of Model (1) in the two PSM samples. Similar to the results in Table 2, we report a positive and statistically significant relation between WEDGE and PATENTS, CITATIONS, EXPLORATIVE,

TABLE 4 Innovation activities in the propensity-score-matched (PSM) samples

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	N	PATENTS/ R&D	CITATIONS/ R&D	N
Panel A: Innovation activities: Full PSM sample								
WEDGE	3.8433***	4.0060**	0.3921**	0.6459	4051	0.0784*	0.1163*	1450
	2.65	2.39	2.18	1.63		1.80	1.72	
Adj. R ²	0.0383	0.0222	0.0425	0.0183		0.0669	0.0427	
Panel B: Innovation activities: Patenting PSM sample								
WEDGE	9.6082***	6.2613	1.0730**	1.1480	1431	0.1786***	0.1774*	974
	3.05	1.26	2.34	1.49		3.42	1.84	
Adj. R ²	0.1178	0.0777	0.0464	0.0700		0.1968	0.0854	

Note: This table reports results for the full PSM (Panel A) and patenting (Panel B) samples of dual- and single-class firm-years between 2000 and 2008 based on the selection model in Table 4. The dependent variables are six measures of innovation activities: PATENTS, CITATIONS, EXPLORATIVE, EXPLOITATIVE, PATENTS/R&D, and CITATIONS/R&D. We report only the coefficients for WEDGE, but all control variables remain as in prior tests. All variables are defined in the Appendix. We report *t*-statistics based on robust (Huber–White) standard errors in parentheses.

p* < 0.10; *p* < 0.05; ****p* < 0.01.

TABLE 5 Within dual-class sample analysis of innovation activities

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	PATENTS/R&D	CITATIONS/R&D
WEDGE	4.8795***	5.7583***	0.5014***	0.8065**	0.1082**	0.1419*
	(3.05)	(3.32)	(2.95)	(2.02)	(2.17)	(1.72)
Inverse Mills ratio	−0.4234	0.3295	−0.1202*	−0.1920	−0.0243	−0.0144
	(−0.73)	(0.39)	(−1.70)	(−1.32)	(−0.66)	(−0.29)
Industry/year	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R ²	0.1114	0.0631	0.0460	0.0627	0.1539	0.0682
N	2274	2274	2274	2274	712	712

Note: This table reports the results of a within-sample analysis of only dual-class firms to remove the concern that our results on the effect of WEDGE (defined in the Appendix) are driven by systematic differences between dual- and single-class firms not removed in the propensity-score-matching process. We include the inverse Mills ratio to control for sample-selection bias. We report *t*-statistics based on robust (Huber–White) standard errors in parentheses.

p* < 0.10; *p* < 0.05; ****p* < 0.01.

and both PATENTS/R&D and CITATIONS/R&D in the full PSM sample (Panel A) and the patenting PSM sample (Panel B). The less risky EXPLOITATIVE patents are not related to WEDGE in either matched sample. This finding supports H1 with respect to a positive effect of disproportionate control on innovation output, quality, creativity, and efficiency similar to our main sample with high-antitakeover-protection single-class firms. Thus, even when matching dual-class firms with single-class firms that have both a similar level of patent pipeline at IPO and other characteristics known to influence the dual-class structure at IPO, our results are nearly identical.

4.4 | Dual-class recapitalizations

Another method occasionally used to address endogeneity concerns in dual-class studies is to examine changes around dual-class recapitalizations (e.g., Jordan et al., 2016). This alternative is less viable for our study for at least a couple of reasons. First, innovation activity has been shown to decline with firm age (Balasubramanian & Lee, 2008; Helwege et al., 2007; Huergo & Jaumandreu, 2004). Therefore, a decrease in innovation following a firm's change from dual-class to single-class structure could simply be due to the passage of time rather than the removal of disproportionate insider control. Second, the unification event is not exogenous and is typically associated with other significant structural changes in the firm. For instance, mergers, bankruptcies, and the departure of the firms' original founders (who, as our results suggest, play an important role for the firm's innovativeness) could drive the unification. Thus, it is less likely that an analysis of unifications would allow for reliable interpretations in the context of our study.

With these caveats, we nevertheless examine changes in innovation around dual-class unifications for robustness and for consistency with the approaches in other studies. We hand collect a sample of 54 firms that reclassify from a dual- to single-class structure in our sample period and analyze changes in patenting around the reclassification event. Figure 1 shows a decrease in the number of PATENTS and CITATIONS after dual-class firms recapitalized to single class. The results are similar if we scale both measures by assets. Although we interpret this

FIGURE 1 Innovation activities around dual-class recapitalizations. In our sample period of 2000–2008, 54 dual-class firms recapitalized to a single-class structure. This figure displays the average number of patents and citations per firm the year before the recapitalization and the year after the recapitalization. The recapitalization year is excluded [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/jfr.12311)]

result with caution, these findings are consistent with Jordan et al. (2016) who find that reclassifying firms have lower R&D intensity after the unification. Thus, this analysis provides further support for our overall findings.

4.5 | Within dual-class sample tests

One possible concern with the reliability of results obtained from the analysis of a PSM sample is that the results could be driven by systematic differences between dual- and single-class firms that we do not control for in our selection model. Analyzing the effect of disproportionate insider control on innovation within the sample of dual-class-only firms ensures that unobserved differences between dual- and single-class firms do not drive our results. Therefore, we reestimate Model (1) using a sample of dual-class-only firms. To control for sample-selection bias, we include the inverse Mills ratio derived from our estimation of Model (2) for each sample. Table 5 reports the results. Similar to the results in Table 2, we find positive coefficients on WEDGE for all six measures of innovative output. Hence, our dual-class-only sample tests confirm support for H1.

5 | MODERATING EFFECTS OF FINANCIAL CONSTRAINTS, COMPETITION, AND TIME SINCE IPO

Although our initial results suggest that disproportionate insider control is positively associated with innovative outcomes, numerous prior studies find that dual-class share structures have detrimental effects on firm value. Indeed, dual-class structures are heterogeneous across industries and firm types, and therefore differential effects of disproportionate control on innovation may exist depending on the circumstance of each company. We next examine three moderating settings in which disproportionate insider control may be particularly valuable for enhancing firms' innovative capabilities: financial constraints, industry competitiveness, and time since IPO.

5.1 | Moderating effect of financial constraints

Among firms that face financial constraints, we expect firms featuring disproportionate insider control to be relatively more innovative for two main reasons. First, disproportionate insider control allows firms to go public and thus gain greater access to equity financing, while providing them the innovative advantages typically possessed only by private firms (Burkart & Lee, 2008). Given the potential for underinvestment in R&D due to financial constraints that DeAngelo and DeAngelo (1985) caution against, Acharya and Xu (2017) argue that going public may be especially beneficial for firms in innovative industries that are dependent on external financing. Steady funding of R&D is of particular importance because researchers' salaries make up a significant portion of R&D expenditures (Goolsbee, 1998). The know-how of these researchers represents significant organizational capital that is at risk. Researchers may leave the firm at any time when they fear uncertain job prospects, which would result in the loss of their often irreplaceable knowledge (Eisfeldt & Papanikolaou, 2013). For this reason, firms' ability to maintain R&D funding at constant levels even when facing adverse financial conditions is critical to preventing key employees from leaving the firm (Brown & Petersen, 2011).

Second and just as important, the key innovative researchers at private firms are often leaders/founders of the firm. Disproportionate insider control protects innovative leaders against the expropriation of their own research streams by outside shareholders (DeAngelo & DeAngelo, 1985) and insulates them from internal challenges. The extra funding available for research from public equity is of no use without dual-class protection, which provides firms with the powerful ability to make R&D a priority and to maintain constant and steady levels of R&D spending even in the face of financial constraints.

To explore the moderating effect of financial constraints, we partition our sample by the level of financial constraint using the WW_INDEX from Whited and Wu (2006) and the text-based analysis measure (HM_INDEX) of Hoberg and Miksimovic (2015). We also split the sample by external-finance-dependent (EFD) and internal-finance-dependent (IFD) industries following Acharya and Xu (2017). Table 6 reports the results of our reestimation of Model (1) splitting the full sample and patenting samples by the annual median value of each proxy into higher and lower financially constrained firms. For all measures of financial constraint and in both the full and patenting samples in Panels A and B, we find that WEDGE has a positive and significant coefficient for the dependent variables PATENTS and CITATIONS. WEDGE has a consistent positive effect in most higher financial constraint subgroups for the EXPLORATIVE patents but not for the less risky EXPLOITATIVE patents. Similarly, PATENTS/R&D and WEDGE are positively related in the higher financial constraint subgroups. There are no consistent significant effects in the lower financial constraint subsample. These results suggests that the positive effect of disproportionate insider control on innovation is indeed driven by financially constrained firms that, absent the insulation of innovative leaders from external pressures, might find it most difficult to stay a strategic course and not give in to short-term competing demands.

5.2 | Moderating effect of industry competitiveness

Industry competition is arguably another important moderating factor in the relation between disproportionate insider control and innovativeness. March (1991) theorizes that competition should lead to more creative and valuable explorative innovation. However, innovative firms must invest heavily to grow quickly enough to stay technologically competitive and maintain market share and firm value. This suggests access to public equity markets is important, which dual-class structures provide while protecting innovative leaders from the disciplinary role of product market competition (Sassi et al., 2019). In addition, Li et al. (2019) note that in competitive industries, the benefits of quick action due to CEO power outweigh the costs. Beyond the generally positive effects of antitakeover protection for innovation in competitive industries observed by Chemmanur and Tian (2018), we therefore expect an incrementally positive effect of disproportionate insider control for innovation relative to other antitakeover measures.

In Table 7, we examine the effects of disproportionate insider control on innovation after partitioning the sample by the median values of various proxies for industry competition. We use three measures of competition from Hoberg and Phillips (2010): (1) Herfindahl-type index using a fixed industry classification (FIC), (2) measure of firm competitive power within an FIC industry using the square of the percentage of market share held by the firm, and (3) simple count of the frequency of competitors within an FIC industry. We find for both the full and patenting samples in Panels A and B that the effect of WEDGE on PATENTS, CITATIONS, EXPLORATIVE, PATENTS/R&D, and CITATIONS/R&D is confined to the high-industry-competition subsamples. In addition, in the high-market-power and high-number-of-competitor subsamples, WEDGE is positively associated with EXPLOITATIVE as well where we find a negative effect in the lower competition subgroups. Overall, these results support that relative to other antitakeover provisions, a dual-class share structure is particularly beneficial in promoting innovation in competitive industries, that is, in an environment in which the ability of management to respond quickly and decisively provides a particular advantage.

5.3 | Moderating effect of time since IPO

We next examine time since the firm's IPO as a moderating factor for the effectiveness of disproportionate insider control for innovation. Previous work finds that innovation varies inversely with firm age

TABLE 6 Innovation activities by financial constraints

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	N	PATENTS/ R&D	CITATIONS/ R&D	N
<i>Panel A: Full sample by financial constraint subgroups</i>								
Higher financial constraints								
WW_INDEX								
WEDGE	8.5612*** (2.76)	8.8854*** (2.63)	0.7683** (2.12)	1.2448 (1.57)	1587	0.0739* (1.79)	0.0880 (1.43)	750
Adj. R ²	0.0897	0.0522	0.0207	0.0562		0.1392	0.0489	
HM_INDEX								
WEDGE	6.5818*** (3.20)	8.3270*** (3.54)	0.7170** (2.54)	1.2680** (2.10)	1821	0.1422** (2.03)	0.2563 (1.64)	707
Adj. R ²	0.1333	0.0825	0.0374	0.0838		0.1155	0.0392	
High EFD_INDUSTRY								
WEDGE	6.8312*** (2.86)	6.6440*** (2.71)	0.7392*** (2.65)	0.9782 (1.53)	2644	0.0679** (2.38)	0.0593* (1.76)	1463
Adj. R ²	0.1162	0.0783	0.0828	0.0747		0.1735	0.1103	
Lower financial constraints								
WW_INDEX								
WEDGE	-0.1195 (-0.27)	-0.1059 (-0.18)	0.0939 (1.11)	-0.0967 (-0.87)	3573	0.0926* (1.85)	0.0924 (1.60)	1295
Adj. R ²	0.2431	0.1553	0.1726	0.1442		0.1243	0.1145	
HM_INDEX								
WEDGE	1.5466 (0.77)	0.3409 (0.16)	0.2901 (1.49)	-0.1226 (-0.24)	2211	0.1260** (2.03)	0.0861 (1.29)	929
Adj. R ²	0.1005	0.0899	0.0686	0.0619		0.1120	0.1050	
Low EFD_INDUSTRY								
WEDGE	-0.3969 (-0.96)	0.2584 (0.28)	0.0501 (0.36)	-0.0495 (-0.35)	2560	0.2527* (1.77)	0.3736 (1.39)	607
Adj. R ²	0.1244	0.0667	0.0134	0.0934		0.1044	0.0475	
<i>Panel B: Patenting sample by financial constraint subgroups</i>								
Higher financial constraints								
WW_INDEX								
WEDGE	13.1034** (2.32)	14.6235** (1.99)	1.2863 (1.62)	0.6232 (0.59)	780	0.0573 (0.95)	0.0978 (0.89)	583
Adj. R ²	0.1674	0.0794	0.0230	0.1444		0.1694	0.0611	

(Continues)

TABLE 6 (Continued)

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	N	PATENTS/ R&D	CITATIONS/ R&D	N
HM_INDEX								
WEDGE	11.9258*** (2.89)	17.4967*** (2.91)	1.2850** (2.53)	1.6754* (1.72)	878	0.1606* (1.71)	0.2996 (1.42)	576
Adj. R ²	0.2061	0.1044	0.0526	0.1404		0.1298	0.0467	
High EFD_IDUSTRY								
WEDGE	13.1034** (2.32)	14.6235** (1.99)	1.2863 (1.62)	0.6232 (0.59)	780	0.0573 (0.95)	0.0978 (0.89)	583
Adj. R ²	0.1674	0.0794	0.0230	0.1444		0.1694	0.0611	
Lower financial constraints								
WW_INDEX								
WEDGE	-0.1015 (-0.09)	-0.0240 (-0.01)	0.2688 (1.23)	-0.1419 (-0.44)	1847	0.1479** (2.09)	0.1467* (1.80)	1131
Adj. R ²	0.2655	0.1645	0.1894	0.1501		0.1581	0.1429	
HM_INDEX								
WEDGE	1.5319 (0.49)	-1.4948 (-0.41)	0.6908 (1.39)	-1.1655** (-2.05)	1178	0.1406* (1.80)	0.0890 (1.02)	783
Adj. R ²	0.2521	0.1942	0.0648	0.2512		0.1773	0.1466	
Low EFD_IDUSTRY								
WEDGE	-0.1015 (-0.09)	-0.0240 (-0.01)	0.2688 (1.23)	-0.1419 (-0.44)	1847	0.1479** (2.09)	0.1467* (1.80)	1131
Adj. R ²	0.2655	0.1645	0.1894	0.1501		0.1581	0.1429	

Note: We partition the full and patenting samples by the median annual value of three financial constraint proxy variables and by industry-level financial dependence. Panel A presents the full sample, and Panel B presents the patenting firm sample. We include WW_INDEX (Whited & Wu, 2006), HM_INDEX (Hoberg & Maksimovic, 2015), and low and high EFD_IDUSTRY (Acharya & Xu, 2017; Rajan & Zingales, 1998). All variables are defined in the Appendix. We replicate the methodology of Table 2 but report only the main coefficients of interest for each financial constraint measure. We report t-statistics based on robust (Huber–White) standard errors in parentheses.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

(Balasubramanian & Lee, 2008; Huergo & Jaumandreu, 2004). Also, Johnson et al. (2015) find that takeover defenses enhance firm value post-IPO but that they become costly as a firm matures and ownership becomes more dispersed (Helwege et al., 2007).⁹ Because the original founders' incentives change following the IPO, and because management turnover is inevitable over time, the innovative management that originally initiated the dual-class share structure is not with the firm perpetually into the future. The investment community and recent congressional actions also appear to recognize that young public firms are special. For instance, although it never became law, the Fostering Innovation Act of 2017 would have created an exemption from certain requirements

⁹Comparable results have been found for dual-class firms (Cremers et al., 2020; Kim & Michaely, 2019).

TABLE 7 Innovation activities by industry competition

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	N	PATENTS/ R&D	CITATIONS/ R&D	N
<i>Panel A: Full sample by industry competition</i>								
Higher industry competition								
HERFINDAHL								
WEDGE	4.7359** (2.47)	3.5601* (1.86)	0.6568*** (2.80)	0.8379 (1.55)	3262	0.0835** (2.40)	0.0627 (1.48)	1278
Adj. R ²	0.1287	0.0931	0.0884	0.0826		0.1502	0.1014	
MARKET_POWER								
WEDGE	8.0389*** (3.03)	7.2552*** (2.67)	0.8250*** (2.63)	1.6586** (2.25)	2789	0.1503*** (4.04)	0.1325*** (3.12)	1174
Adj. R ²	0.1156	0.0780	0.0795	0.0723		0.1568	0.0937	
NUM_FIRMS_INDUSTRY								
WEDGE	5.7829*** (3.03)	5.2975*** (2.71)	0.5800** (2.58)	1.1439** (2.17)	3283	0.1375*** (3.87)	0.1216*** (2.92)	1155
Adj. R ²	0.1148	0.0782	0.0801	0.0707		0.1814	0.0992	
Lower industry competition								
HERFINDAHL								
WEDGE	-0.3007 (-0.39)	1.4567 (1.00)	-0.1137 (-1.20)	-0.2436 (-1.30)	1999	0.0458 (0.92)	0.0778 (0.85)	815
Adj. R ²	0.0680	0.0389	0.0075	0.0633		0.0839	0.0364	
MARKET_POWER								
WEDGE	-1.3661*** (-3.49)	-0.7429 (-0.91)	-0.0389 (-0.53)	-0.5344*** (-3.25)	2472	-0.0008 (-0.02)	0.0327 (0.41)	919
Adj. R ²	0.1446	0.0735	0.0283	0.0927		0.1030	0.0506	
NUM_FIRMS_INDUSTRY								
WEDGE	-1.9802*** (-3.23)	-1.0538 (-0.83)	-0.0437 (-0.39)	-0.7019*** (-2.72)	1978	0.0119 (0.23)	0.0360 (0.48)	938
Adj. R ²	0.1380	0.0688	0.0242	0.0874		0.0989	0.0515	
<i>Panel B: Patenting sample by industry competition</i>								
Higher industry competition								
HERFINDAHL								
WEDGE	10.5765*** (2.62)	7.8403* (1.85)	1.4746*** (2.60)	1.3676 (1.40)	1660	0.0532 (1.40)	0.0429 (0.84)	1126
Adj. R ²	0.1942	0.1244	0.1072	0.1441		0.1783	0.1187	

(Continues)

TABLE 7 (Continued)

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	N	PATENTS/ R&D	CITATIONS/ R&D	N
MARKET POWER								
WEDGE	21.6738*** (3.92)	21.2621*** (3.40)	2.0565*** (2.78)	3.5260*** (2.72)	1467	0.1724*** (3.73)	0.1668*** (2.76)	989
Adj. R ²	0.1973	0.1211	0.1048	0.1534		0.1918	0.1147	
NUM_FIRMS_INDUSTRY								
WEDGE	17.6344*** (3.72)	17.2092*** (3.22)	1.6543*** (2.64)	2.7411** (2.48)	1503	0.1468*** (3.26)	0.1416** (2.37)	969
Adj. R ²	0.1902	0.1159	0.1020	0.1496		0.2235	0.1225	
Lower industry competition								
HERFINDAHL								
WEDGE	0.6969 (0.36)	5.4415 (1.44)	-0.1888 (-0.92)	-0.4275 (-0.92)	1037	0.1098 (1.31)	0.1345 (1.16)	634
Adj. R ²	0.1082	0.0626	0.0089	0.0813		0.1605	0.0779	
MARKET POWER								
WEDGE	-3.6305*** (-3.59)	-2.1561 (-1.06)	-0.1753 (-0.98)	-1.4397*** (-3.33)	1230	-0.0134 (-0.20)	0.0043 (0.05)	771
Adj. R ²	0.1746	0.0782	0.0275	0.1044		0.1662	0.0850	
NUM_FIRMS_INDUSTRY								
WEDGE	-3.6677*** (-3.16)	-2.0774 (-0.92)	-0.1376 (-0.65)	-1.2998*** (-2.69)	1194	0.0197 (0.30)	0.0339 (0.39)	791
Adj. R ²	0.1715	0.0792	0.0286	0.1019		0.1527	0.0836	

Note: We partition the full and patenting samples by the median industry value of three proxies for industry competition: HERFINDAHL, MARKET_POWER, NUM_FIRMS_INDUSTRY. Panel A presents the full sample, and Panel B presents the patenting firm sample. The higher (lower) industry competition subgroups represent firms above (below) the sample median for NUM_FIRMS_INDUSTRY and below (above) the sample median for HERFINDAHL and MARKET_POWER. We report only the coefficient on WEDGE, but all firm controls from our main model are included except for HERFINDAHL. All variables are defined in the Appendix. We report *t*-statistics based on robust (Huber-White) standard errors in parentheses. **p* < 0.10; ***p* < 0.05; ****p* < 0.01.

of the Sarbanes-Oxley Act for small, newly public firms for the first 5 years since their IPO. In addition, in July 2016 a consortium of prominent CEOs and investment managers recommended (Peregrine, 2016):

*Dual-class voting is not a best practice. If a company has dual-class voting, which sometimes is intended to protect the company from short-term behavior, the company should consider having specific sunset provisions based upon time or a triggering event, which eliminate dual-class voting.*¹⁰

¹⁰The list of principles is available at <http://www.governanceprinciples.org/>.

TABLE 8 Innovation activities by firm age

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	PATENTS/R&D	CITATIONS/R&D
<i>Panel A: Full sample by firm age</i>						
Firm age 4–10 years						
WEDGE	5.5811*** (3.24)	5.5404** (2.47)	0.5345* (1.81)	0.2196 (1.27)	0.4613*** (3.08)	0.6585** (2.41)
Adj. R ²	0.1916	0.1482	0.0372	0.0536	0.1258	0.0969
N	1163	1163	1163	1163	387	387
Firm age 11+ years						
WEDGE	1.0524 (0.76)	0.8147 (0.60)	0.2065 (1.33)	0.3657 (0.83)	0.0525* (1.69)	0.0560 (1.57)
Adj. R ²	0.1467	0.1087	0.1048	0.0931	0.1633	0.1331
N	3761	3761	3761	3761	1581	1581
<i>Panel B: Patenting sample by firm age</i>						
Firm age 4–10 years						
WEDGE	15.6704*** (3.00)	12.8114* (1.89)	1.1749 (1.23)	0.3873 (0.66)	0.3516*** (2.83)	0.4333* (1.92)
Adj. R ²	0.2540	0.2180	-0.0001	0.0559	0.2421	0.1456
N	442	442	442	442	298	298
Firm age 11+ years						
WEDGE	0.5261 (0.26)	0.5340 (0.23)	0.2923 (1.14)	0.2621 (0.40)	0.0321 (0.92)	0.0378 (0.86)
Adj. R ²	0.2714	0.1696	0.1572	0.1755	0.1859	0.1473
N	2132	2132	2132	2132	1373	1373

Note: We partition the full and patenting samples by the number of years past IPO: 4–10 years and 11+ years. We replicate the methodology in Table 2 but report only the main coefficients of interest for each age group. Panel A presents the full sample, and Panel B presents the patenting firm sample. All variables are defined in the Appendix. We report t-statistics based on robust (Huber-White) standard errors in parentheses.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Similarly, recent research suggests that it may be beneficial to institute phase-out requirements that would limit dual-class share structures to a specific period following the firm's IPO (Bebchuk & Kastiel, 2017; Cremers et al., 2020).

To evaluate whether the effect of disproportionate insider control on firm innovation is constant or changes over time, we partition our sample into two groups: 4–10 years, and 11+ years post-IPO.¹¹ Panels A and B of Table 8 report the results of this analysis for the full and patenting samples, respectively. Reestimating Model (1) split by age groups, we find that the coefficient on WEDGE is positively associated with PATENTS, CITATIONS,

¹¹All of our analyses exclude the first 2 years after IPO, and in forming these subgroups, we also eliminate years 0–3 from the analysis. By including only patents filed at least 4 years after IPO, we further alleviate concerns that reverse causality fully explains our results. We also use continuous firm age and in untabulated tests find a negative and significant interaction between firm age and WEDGE for all innovation measures except EXPLORATIVE.

EXPLORATIVE, PATENTS/R&D, and CITATIONS/R&D in the 4–10 years group but not in 11+ years group. The results indicate that the positive effect of disproportionate insider control on firms' innovation is strongest for younger firms. These findings support studies that find that the negative effect of WEDGE on firm value is either not present or in firms just after IPO (Cremers et al., 2020; Kim & Michaely, 2019).

These results suggest that a maximum of 10 years post-IPO may be an appropriate termination date for a dual-class structure in a sunset provision, which is similar to the recommendations from Council of Institutional Investors (CII), which advocates for a 7-year cutoff. Our results are also similar to the mean sunset provision among dual-class firms going public with time-based sunsets already in place, which averaged 10.3 years, 9.5 years, and 7.0 years in 2017–2019 according to CII.

5.4 | Moderating effects in our PSM sample

Table 9 presents the results of our estimation of Model (1) in the full PSM sample. Similar to Table 4, we partition the sample by financial constraints and industry competition. We find that the results are concentrated in firms facing higher financial constraints and industry competition. For parsimony, we tabulate the results only for these higher quantiles. Likewise, we explore the impact of time since IPO and find a significant relation between WEDGE and innovative output, quality, creativity, and efficiency for firms 4–10 years past IPO. Taken together, these results from our PSM sample provide robustness to our prior findings regarding the significance of the three moderating factors we explore.

6 | IMPACT OF EMPOWERING SPECIFIC INNOVATIVE LEADERS

The three moderating effects—financial constraints, industry competitiveness, and time since IPO—all suggest that disproportionate insider control may not be a sufficient condition for enhanced innovation but that the circumstances matter. It appears corporate insiders can successfully leverage dual-class share structures to enhance innovativeness when close control is most beneficial for innovative outcomes, such as when the firm faces financial constraints or a particularly competitive environment. The decline in the usefulness of disproportionate control for enhanced innovative outcomes over time suggests the importance of highly influential individuals for innovative gains. As such individuals lose their momentum or leave the firm over time, the positive effect of disproportionate insider control on innovation diminishes.

The importance of an individual effect is consistent with the nature of disproportionate insider control as a means of entrenchment. Distinct from general antitakeover measures that protect whoever happens to be at the helm, dual-class structures uniquely place control in the hands of specific insiders, the holders of the superior class of shares. Disproportionate control in the hands of innovative individuals allows firms to overcome shortcomings of both private and public forms of ownership, as previously discussed, and enable the pursuit of a personal agenda of greater investments in long-term projects with uncertain future payoffs (while also providing effective antitakeover protection). By contrast, disproportionate control in the hands of individuals lacking innovative talents may not provide benefits for innovation but in the worst case enable the extraction of excess rents to the detriment of outside shareholders (Masulis et al., 2009). In the next two sections we consider the impact of disproportionate insider control and two unique proxies for empowered innovative leaders: (1) founder involvement and (2) inventor executives.

6.1 | Founder involvement

The early literature suggests that the choice of equity structures that enable disproportionate insider control is closely connected to the empowerment of founders for the purpose of long-term investment (DeAngelo &

TABLE 9 Innovation activities in the propensity-score-matched (PSM) samples: Moderating effects

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	N	PATENTS/ R&D	CITATIONS/ R&D	N
<i>Panel A: High financial constraints: Full PSM sample</i>								
WW_INDEX								
WEDGE	10.5394*** (3.34)	11.3250*** (3.25)	0.7723* (1.95)	1.8382** (2.17)	1978	0.0600 (0.99)	0.1326 (1.42)	831
Adj. R ²	0.0295	0.0150	0.0156	0.0128		0.0808	0.0337	
HM_INDEX								
WEDGE	5.2261* (1.86)	6.0210 (1.64)	0.4766 (1.32)	1.0586 (1.20)	1575	0.0143 (0.10)	0.1510 (0.72)	620
Adj. R ²	0.0411	0.0297	0.0640	0.0120		0.0499	0.0439	
Low EFD_INDUSTRY								
WEDGE	9.9255*** (3.61)	10.5502*** (3.46)	0.8271** (2.56)	1.5028** (2.07)	2128	0.0735** (2.47)	0.0926** (2.01)	1028
Adj. R ²	0.0459	0.0269	0.0699	0.0322		0.1302	0.0654	
<i>Panel B: High competition: Full PSM sample</i>								
HERFINDAHL								
WEDGE	6.8755*** (3.01)	6.4180*** (2.66)	0.7070** (2.51)	1.1407* (1.69)	2278	0.0821** (2.13)	0.1144** (1.97)	852
Adj. R ²	0.1028	0.0744	0.0718	0.0341		0.1585	0.0838	
MARKET_POWER								
WEDGE	10.7571*** (3.61)	11.2672*** (3.41)	0.9558*** (2.65)	1.9548** (2.33)	1980	0.1482*** (3.66)	0.1814*** (2.98)	828
Adj. R ²	0.0465	0.0292	0.0691	0.0321		0.1291	0.0655	
NUM_FIRMS_INDUSTRY								
WEDGE	7.7426*** (3.41)	8.0323*** (3.19)	0.6934** (2.54)	1.3220** (2.07)	2538	0.1205*** (3.13)	0.1491** (2.55)	911
Adj. R ²	0.0462	0.0292	0.0672	0.0331		0.1260	0.0629	
<i>Panel C: By firm age: Full PSM sample</i>								
Firm age 4–10 years								
WEDGE	5.3710** (2.28)	6.5689** (2.56)	0.6240* (1.69)	-0.0344 (-0.08)	1314	0.3567*** (3.05)	0.5065** (2.37)	417
Adj. R ²	0.1370	0.1906	0.0244	0.0156		0.0845	0.0636	
Firm age 11+ years								
WEDGE	2.5033	1.2880	0.2992	1.0615**	2330	0.0127	0.0043	873

(Continues)

TABLE 9 (Continued)

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	N	PATENTS/ R&D	CITATIONS/ R&D	N
	(1.44)	(0.65)	(1.64)	(2.00)		(0.38)	(0.08)	
Adj. R ²	0.0556	0.0193	0.0412	0.0426		0.1268	0.0516	

Note: We examine the two PSM samples of dual-class and single-class firm-years between 2000 and 2008 based on the selection model in Table 4. The dependent variables are six measures of innovation activities: PATENTS, CITATIONS, EXPLORATIVE, EXPLOITATIVE, PATENTS/R&D, and CITATIONS/R&D. Panels A and B presents results from the above-median financial constraint and competition subgroups, respectively, for the full sample. Panel C subdivides the full PSM sample into firm-years past the IPO: 4–10 years and 11+ years past. We report coefficients only for WEDGE but all control variables remain as in prior tests. All variables are defined in the Appendix. We report t-statistics based on robust (Huber–White) standard errors in parentheses.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

DeAngelo, 1985). Relatedly, Denis and Denis (1994) find that the choice of majority ownership is related to owner-specific characteristics rather than firm-specific characteristics. They also find that most majority-owned firms are managed by the founder of the firm. Similarly, Taylor and Whittred (1998) suggest the value of a dual-class firm is highly dependent on the human capital of the founding shareholders. By contrast, Bebchuk and Kastiel (2017, p. 612) highlight the scarcity of empirical support for the founder empowerment view, although they argue:

The expected benefits from long-term insulation are likely to be large or even positive only when the controller is a fitting leader for the company. Since the passage of time makes the controller less likely to be the fittest leader of the company...the expected benefit from long-term insulation is also likely to decline over time.

Our findings of the moderating effect of age already highlight this sentiment. Similarly, Cremers et al. (2020) find that the value premium for dual-class firms shortly after IPO is related to the founders' unique vision and skills. In this section, we seek to provide further empirical support for the conjecture that founder involvement is a significant driver of the positive relation between a dual-class structure and the outputs of innovation.

Using the full and patenting samples, we examine whether the positive effect of disproportionate control on innovation is driven partially by the involvement of one or more of the original founders. To this end, we hand collect data from SEC filings and Internet searches to determine whether the original founder(s) of the firm are still involved with the firm as a top executive or members of the board (FOUNDER_INVOLVED). The variable equals 1 if at least one original founder is still involved with the firm, and 0 otherwise. We reestimate Model (1) after augmenting it with FOUNDER_INVOLVED as well as its interaction with WEDGE. Results reported in Table 10 indicate that the effect of WEDGE when control is not in the hands of the original founder has no significant effect on the six innovation measures. However, $WEDGE \times FOUNDER_INVOLVED$ is positively associated with PATENTS, CITATIONS, EXPLOITATIVE, PATENTS/R&D, and CITATIONS/R&D in both samples. The significant interaction indicates that the average positive association between WEDGE and innovation that we previously document is driven by firms in which disproportionate control is concentrated in the hands of the original founder. This finding is consistent with our conjecture that the close involvement of key innovative leaders is an important requirement for the positive effect of disproportionate control on innovation. Absent the personal involvement of founders, disproportionate insider control does not enhance firm innovation. These results complement our prior findings by highlighting that disproportionate control is beneficial only in the hands of the right person.

TABLE 10 Innovation activities: Founder involvement

Variable	PATENTS	CITATIONS	EXPLORATIVE	EXPLOITATIVE	PATENTS/ R&D	CITATIONS/ R&D
Panel A: Full sample						
WEDGE	0.4402 (0.57)	0.0970 (0.11)	0.2393 (1.58)	-0.2356 (-1.36)	-0.0123 (-0.39)	-0.0326 (-0.82)
FOUNDER_INVOLVED	-0.4926 (-0.99)	-0.2056 (-0.32)	-0.0765 (-1.31)	-0.0846 (-0.53)	0.0181 (1.41)	0.0271 (1.32)
WEDGE × FOUNDER_ INVOLVED	6.2126** (2.39)	6.7197** (2.50)	0.3628 (1.23)	1.5625** (2.11)	0.2416*** (3.33)	0.3024*** (2.91)
Adj. R ²	0.1123	0.0743	0.0534	0.0740	0.1185	0.0686
N	5225	5225	5225	5225	2091	2091
Panel B: Patenting sample						
WEDGE	1.5852 (0.75)	0.2986 (0.12)	0.6772 (1.50)	-0.4786 (-1.12)	0.0213 (0.55)	-0.0038 (-0.08)
FOUNDER_INVOLVED	-0.0185 (-0.02)	0.6327 (0.54)	-0.1081 (-1.11)	0.0814 (0.31)	0.0416*** (2.84)	0.0506** (2.09)
WEDGE × FOUNDER_ INVOLVED	11.0002** (2.26)	13.5624** (2.39)	0.4631 (0.66)	2.5568** (2.20)	0.2093** (2.06)	0.3173* (1.86)
Adj. R ²	0.1728	0.1047	0.0663	0.1257	0.1571	0.0911
N	2674	2674	2674	2674	1742	1742

Note: This table replicates the analysis in Table 2 using the full sample of dual-class and high-antitakeover-protection single-class firms (Panel A) and the patenting subsample (Panel B). We add variables for the original founder involvement in the firm as a top executive or board member as well as the interaction between this indicator variable and WEDGE. All variables are defined in the Appendix. We report *t*-statistics based on robust (Huber–White) standard errors in parentheses.

p* < 0.10; *p* < 0.05; ****p* < 0.01.

For robustness, we replicate these tests in several ways. First, we use the dual-class-only sample and find similar results, which are reported in Online Appendix Table IA.2. Second, we repeat the tests from Table 10 replacing FOUNDER_INVOLVED with two alternative specifications capturing either (1) the presence of a founder on the board or (2) the presence of a top executive founder. Results for both types of founder involvement are consistent. The results of these regressions are available in Online Appendix Tables IA.3 and IA.4.

6.2 | Inventor executives

We next examine the importance of an individual effect to leverage disproportionate control for enhanced innovation by using an extreme proxy for managerial innovative risk taking—the filing of a patent directly by an executive of the firm. Islam and Zein (2020) find that one in five US high-technology firms are led by CEOs who are also inventors. By law, to be listed as an inventor on a patent application, an individual must have contributed an

TABLE 11 Disproportionate control and inventor executives

Variable	Top EXEC_DUMMY	Top EXEC_PATENTS	Top EXEC_CITATIONS
<i>Panel A: Patenting sample</i>			
WEDGE	0.0960*** (3.67)	0.5528*** (2.77)	4.5502** (2.28)
Adj. R^2	0.0301	0.0714	0.0317
N	2671	2671	2671
<i>Panel B: Patenting sample: By firm age</i>			
<i>Firm age 4-10 years</i>			
WEDGE	0.1783*** (2.99)	1.1561** (2.12)	11.8428* (1.85)
Adj. R^2	0.0879	0.1474	0.0702
N	442	442	442
<i>Firm age 11+ years</i>			
WEDGE	0.0341 (1.40)	0.1751* (1.77)	0.8573** (2.25)
Adj. R^2	0.0227	0.1053	0.0649
N	2132	2132	2132

Note: This table presents a regression analysis of the patenting dual-class and high-antitakeover single-class sample. In each model, the main variable of interest is the wedge between insider voting and cash-flow rights. We also control for the number of state antitakeover statutes, Herfindahl index, return on assets (ROA), capital expenditures to assets, R&D to assets, log of sales, log of firm age, cash to assets, percentage of tangible assets, and sales growth, as well as industry (Fama & French, 1997) and year controls. All variables are defined in the Appendix. We report t-statistics based on robust (Huber–White) standard errors in parentheses.

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

original idea and must have personally expended considerable time on the patent.¹² Patent filings reflect significant personal innovative risk taking because a patent that fails would not only represent a setback for the firm but also a failure of one's own personal research agenda and reputation. The ability and willingness of a manager to take such extreme innovative risk taking suggests unique individual characteristics that could benefit from disproportionate insider control.

We use three proxies for inventor executives: (1) dummy variable if any top executive, including the CEO, chairman, or president, is listed as an inventor on a patent filing in that year (EXEC_DUMMY); (2) number of patents filed by top executives in that year (EXEC_PATENTS); and (3) number of adjusted citations of those patents with a top executive listed as an inventor (EXEC_CITATIONS). We use the subsample of patenting dual-class and high-antitakeover-protection single-class firms to compare firms that issue patents where executives are inventors to firms that issue patents without executive participation.

Our results in Table 11 indicate that WEDGE is positively associated with EXEC_DUMMY, EXEC_PATENTS, and EXEC_CITATIONS. Thus, disproportionate insider control (and not general antitakeover protection) appears to

¹²It is therefore unlikely that this proxy would be tainted by innovative employees who may be forced to put the boss's name on the patent. The danger is too great that by simply putting another name on a patent created by a lower level employee, the patent could be invalidated and subject to future litigation.

create the conditions for highly innovative executives to participate in the innovation process individually. When we additionally partition the sample into groups according to time since IPO, we find that the positive effect of all proxies is again most pronounced among firms closer to their IPO. WEDGE is positively associated with EXEC_DUMMY, EXEC_PATENTS, and EXEC_CITATIONS in the 4–10 years post-IPO group, whereas in the 11+ group we observe a positive effect only for WEDGE on EXEC_PATENTS and EXEC_CITATIONS. In unreported tests, we ensure that these results are robust to controlling for CEO age, tenure, gender, and proportion of option compensation.

7 | CONCLUSION

We examine the association between disproportionate insider control, enabled through dual-class share structures, and innovation. To this end, we break new ground and compare dual-class firms with single-class firms that feature other highly entrenching governance structures. Relative to firms with other types of antitakeover protection, we find that disproportionate insider control is positively associated with innovative output as measured by the number of patent filings, quality of patents in terms of patent citations, creativity of innovations as proxied by explorative patents, and efficiency of innovations represented by patent or citation production per unit of R&D spending. Disproportionate insider control therefore exerts positive effects on innovation beyond that reported from antitakeover protection in general. We find that these positive effects are concentrated among firms facing financial constraints and in competitive industries, and that they disappear over time. Most important, we find that disproportionate insider control promotes innovation only when innovative leaders are present—primarily founders and/or extreme forms of innovative risk takers such as inventor executives.

With these findings, our study significantly contributes to the nascent literature examining dual-class share structure effects on long-term growth and innovation. Many studies have examined the agency cost view of dual-class firms (Adams & Ferreira, 2008; Gompers et al., 2010; Masulis et al., 2009). However, the innovation view has not been satisfactorily examined (Bebchuk & Kastiel, 2017). Whereas Jordan et al. (2016) find that dual-class firms have higher sales growth and R&D intensity, and Cao et al. (2020) observe that a dual-class share structure is associated with a higher number of patent citations, it remains unclear whether these associations are due to a specific “dual-class” effect or whether they stem from the positive effect that any takeover protection in general may have on innovation. Our article is hence distinguished from prior work on dual-class firms by being the first to specifically examine the impact of disproportionate insider control relative to other alternative entrenching governance provisions. We also provide a significantly more complete picture of innovative activities at dual-class firms by examining a wide array of patent output measures (filings, citations, explorative vs. exploitative patents, and innovative efficiency measures) and investigating specific contexts that shed light on the conditions under which dual-class share structures are particularly well suited to enhance innovativeness and empower innovative leaders: financial constraints, competitive environment, and firm age.

Finally, our research identifies one necessary ingredient for the superior innovativeness of public firms with dual-class share structures: the critical role played by innovative leaders with disproportionate control. Specifically, we find that a dual-class structure promotes innovation only when a founder is involved with the firm as a top executive, board member, or both. We also provide evidence that dual-class empowers innovative leaders by finding that these insiders are more likely to personally file patents (Islam & Zein, 2020) because of their private benefits of entrepreneurial control (Aghion & Bolton, 1992).

Overall, our findings of enhanced innovative capabilities provide a bright spot among the numerous studies suggesting that disproportionate insider control is a value-destroying governance structure (Gompers et al., 2010; Masulis et al., 2009), and they add to the nascent literature suggesting a positive relation between dual-class structures and innovation. Nevertheless, the diminishing positive effects of disproportionate insider control post-IPO, as well as our findings that positive effects of disproportionate control on innovation are limited to firms where

the original founders exercise control, support the call for “sunset provisions” designed to convert dual-class shares to single class within a specific period post-IPO (Bebchuk & Kastiel, 2017; Cremers et al., 2020) or based on a trigger event such as the exit of the founders. Phasing out disproportionate ownership could avoid the predominance of value-destroying agency costs over value-enhancing innovativeness as the firm matures.

ACKNOWLEDGMENTS

We are grateful for helpful comments from two anonymous referees, Bill Elliott, Hassan Espahbody, Erasmo Giambona, Srinivisan Krishnamurthy, Ken Lehn, Assaf Eisdorfer (discussant), Jong-Min Oh (discussant), Anil Shivdasani (discussant), and seminar and conference participants at John Carroll University, the 2018 Northern Finance Association annual meeting, the 2017 Financial Management Association annual meeting, and the 2017 Southern Finance Association annual meeting. The paper is featured on the CLS Blue Sky Blog, Columbia Law School's Blog on Corporations and the Capital Markets.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Baran, L., Forst, A., & Tony Via, M. (2022). Dual-class share structure and innovation. *Journal of Financial Research*, 1–34. <https://doi.org/10.1111/jfir.12311>

APPENDIX: VARIABLE DEFINITIONS

Variable	Definition
Disproportionate control variables	
INSIDER_VOTING_RIGHTS	Insider voting rights are measured by the proportion of all board seats controlled by insiders from both the number of votes per share of each class and disproportionate board representation rights
INSIDER_CASH_FLOW_RIGHTS	Insider cash-flow rights are the percentage of shares held by insiders of each class weighted by the dividend rights per class
WEDGE	Difference between insider voting and cash-flow rights. For single-class firms, this variable is 0 by design
Innovation variables	
PATENTS CITATIONS	Total count of patent filings in year <i>t</i> filed by firm <i>u</i> scaled by assets (billions) Total forward citations in our sample period received by all patent filings by firm <i>u</i> in year <i>t</i> . We adjust for the truncation bias in citations as in Hall et al. (2001). Each patent filing raw total citation count is scaled by the average number of citation counts received for patents in that filing year. Each patent filing is also scaled by the average number of citation counts received in their patent technology class in that filing year. This amount is cumulated for firm <i>u</i> in year <i>t</i> . We scale this variable by assets (billions)

Variable	Definition
EXPLORATIVE	Explorative patents, as defined in Fitzgerald et al. (2021). Equals the total number of firm <i>i</i> 's patents granted in year <i>t</i> that are classed as explorative divided by assets of firm <i>i</i> in year <i>t</i> . Patent is flagged as explorative if at least 80% of its citations are based on new knowledge (new cite ratio $\geq 80\%$)
EXPLOITATIVE	Exploitative patents, as defined in He et al. (in press). Equals the total number of firm <i>i</i> 's patents granted in year <i>t</i> that are classed as exploitative divided by assets of firm <i>i</i> in year <i>t</i> . Patent is flagged as exploitative if it contains at least one self-citation (citing at least one patent from the same firm <i>i</i>)
R&D	Sum of research and development (R&D) expense in years $[-2, 0]$ depreciated 20% for each year before the current year using the perpetual inventory method (Hall et al., 2005; Hirshleifer et al., 2013)
ORIGINALITY	Defined as in Trajtenberg et al. (1997). Originality $= 1 - \sum_j \eta_j s_{ij}^2$, where s_{ij} denotes the percentage of citations made by patent <i>i</i> that belong to patent technology class <i>j</i> , out of η_j patent classes. This measure is then averaged for firm <i>u</i> in year <i>t</i>
GENERALITY	Defined as in Trajtenberg et al. (1997). Generality $= 1 - \sum_j \eta_j s_{ij}^2$, where s_{ij} denotes the percentage of citations received by patent <i>i</i> that belong to patent technology class <i>j</i> , out of η_j patent classes. This measure is then averaged for firm <i>u</i> in year <i>t</i>
PATENTING_FIRMS	For firm <i>u</i> in year <i>t</i> , a firm is defined as patenting if it has filed for any patents in the previous 10 years
EXEC_DUMMY	Equals 1 if a patent was filed by any top executive (defined as CEO, chairman, or president) in firm <i>u</i> in year <i>t</i>
EXEC_PATENTS	Number of patents filed by any top executive in firm <i>u</i> in year <i>t</i>
EXEC_CITATIONS	Number of adjusted citations by top executives in firm <i>u</i> in year <i>t</i> where citations are divided by the deflation factor of Hall et al. (2001)

Firm variables

STATE_ANTI	This index is a score ranging from 0 to 6 based on the number of antitakeover measures adopted by the state: (1) control share acquisition statutes, (2) fair price statutes, (3) 3-year business combination statutes, (4) 5-year business combination statutes, (5) poison pill endorsement statutes, and (6) constituency statutes (see also Bebchuk & Cohen, 2005; Cremers & Sepe, 2017)
SALES	Log of sales
ROA	Earnings before interest, taxes, depreciation, and amortization/Total assets
CAPEX	Capital expenditures/Total assets
CASH	Cash/Total assets
TANGIBLE	Tangible assets/Total assets
SALES_GROWTH	First difference of the log of sales
AGE	Log of the number of years since the firm's IPO
FINANCIAL_CONSTRAINTS	WW_INDEX: Financial constraint index from the structural model of Whited and Wu (2006) HM_INDEX: Data from Hoberg and Maksimovic (2015) using a text-based analysis of 10-K statements for language regarding delaying investment. Larger values indicate higher financial constraint EFD_INDUSTY: Measure of external versus internal finance dependent industries by Acharya and Xu (2017)
INDUSTRY_COMPETITION	HERFINDAHL: The Herfindahl index is based on Standard Industrial Classification (SIC) 3-digit firm pairwise similarity scores from firm 10K text analysis data provided on Gerard Hoberg's website (Hoberg & Phillips, 2010).

(Continues)

Variable	Definition
	The Herfindahl index is calculated as the sum of the square of the market shares (based on revenue) for firms in a given industry
	MARKET_POWER: Squared percentage of market share of all firms in the same fixed industry classification (FIC) industry (Hoberg & Phillips, 2010)
	NUM_FIRMS_INDUSTRY: Number of firms in the same FIC industry (Hoberg & Phillips, 2010)
TOP_ANTI	Indicator variable equal to 1 if the firm is single class and has a G-index score (Gompers et al., 2003) greater than 10 in firm u in year t
FOUNDER_INVOLVED	Indicator variable equal to 1 if the original founder is a top executive or a member of the board
CEO characteristics	
CEO_AGE	Log of the age of the CEO in firm u in year t
CEO_TENURE	Log of the number of years the current CEO has served in this role for firm u in year t
FEMALE_CEO	Indicator variable equal to 1 if the CEO was female in firm u in year t
CEO_INCENTIVE	Percentage of CEO long-term incentive compensation calculated as $1 - ((\text{Salary} + \text{Bonus}) / \text{Total Compensation})$
Selection model variables	
NAME	Indicator of whether at IPO the firm name contains a person's name
MEDIA	Indicator of whether the firm operated in the media industry at the time of its IPO
SALES_RANK	Percentile rank of the firm's sales in the year of its IPO relative to firms with the same IPO year
PROFIT_RANK	Percentile rank of the firm's profits in the year of its IPO relative to firms with the same IPO year
%FIRMS	Percentage of all firms in the same Core Based Statistical Area (CBSA) in the year before the firm's IPO
%SALES	Percentage of all sales in the same CBSA in the year before the firm's IPO
SALES/REGION_SALES	Percentage of the firm's sales relative to the sales of all firms in the same CBSA in the year of its IPO