Ownership Heterogeneity and Corporate Innovation Output: A Study on Family Blockholders and Activist Hedge Funds

Peer-reviewed author version

Leute, Matthias; BAMMENS, Yannick; Carree, Martin & HUYBRECHTS, Jolien (2023) Ownership Heterogeneity and Corporate Innovation Output: A Study on Family Blockholders and Activist Hedge Funds. In: Family Business Review, 36 (2) , p. 254 -280.

DOI: 10.1177/08944865231168918
Handle: http://hdl.handle.net/1942/40239

Ownership Heterogeneity and Corporate Innovation Output: A Study on Family Blockholders and Activist Hedge Funds

Matthias Leute[a], Yannick Bammens[b], Martin Carree[a], Jolien Huybrechts[a]

[a] *Maastricht University, School of Business and Economics, The Netherlands*

[b] *Hasselt University, Faculty of Business Economics, Belgium*

Published as: Leute M., Bammens Y., Carree M. & Huybrechts J. (2023). "Ownership Heterogeneity and Corporate Innovation Output: A Study on Family Blockholders and Activist Hedge Funds", **Family Business Review**, vol. 36(2), pp. 254–280: https://journals.sagepub.com/doi/abs/10.1177/08944865231168918.

Abstract: This study examines the interplay between two influential yet opposing shareholder types – family blockholders and hedge funds – in relation to corporate innovation output. Using panel data on U.S. publicly traded firms listed in the S&P 1500, we find that family blockholders have a negative effect on radical innovation output in the form of citation-weighted patents, and that this negative effect is intensified in the presence of activist hedge funds. Our study advances insight into the implications of ownership heterogeneity for innovation output choices in family-influenced firms.

Keywords: family ownership; institutional ownership; hedge funds; innovation; behavioral agency model.

INTRODUCTION

Over the past decades, corporate ownership structures have become increasingly heterogeneous with multiple influential shareholder types often coexisting within firms (Connelly et al., 2010a, 2010b; Hoskisson et al., 2013). While several studies have investigated the effect of individual shareholder types – such as family owners – on strategic choices and performance (e.g., Gomez-Mejia et al., 2011; Carney et al., 2015), the topic of ownership heterogeneity received scant attention and constitutes an important research area (Connelly et al., 2010a; Cirillo et al., 2019). This is particularly true for the impact of ownership heterogeneity on corporate innovation. As highlighted by Wright (2017), the question how ownership configurations affect the extent and nature of innovation deserves more research attention since "ownership differences can influence the goals, time horizons, and governance mechanisms relating to innovation", with a manifest need for "research to explore (…) the *interaction* between ownership types" (p. 74, emphasis added). How different shareholder types interact within heterogeneous ownership structures in shaping innovation dynamics warrants more conceptual and empirical research.

Concerning family-influenced firms[1], some prior work suggests that the presence of other significant shareholders indeed influences corporate processes and outcomes (e.g., Sacristán-Navarro et al., 2011, 2015), with mainly private equity receiving heightened interest in recent years (e.g., Croce & Marti, 2016; Cirillo et al., 2019; Michel et al., 2020; Neckebrouck et al., 2021). Among this limited set of studies on the role of other major owners in family firms, however, very few have investigated innovation aspects. Pioneering work by Gomez-Mejia et al. (2014) and Cirillo et al. (2019) suggests that mutual and pension funds, as well as private equity funds, help mitigate the negative effect of family ownership on R&D investments as an innovation input choice. Yet, beyond that very little is known about the association between ownership heterogeneity and innovation in a family firm setting. We advance this line of inquiry by examining the effect of the interplay between family blockholders and activist hedge funds on radical innovation outputs.

The combination of family blockholders and strategic or activist hedge funds is particularly intriguing to study for two main reasons. First, they are quite opposite in terms of strategic objectives and tactics. Family blockholders are generally undiversified long-term owners with conservative preferences (Munari et al., 2010), whereas hedge funds are diversified short-term investors who often employ aggressive investment tactics (Klein & Zur, 2011). Second, research suggests that both types of shareholders are highly influential in determining the strategic direction of a company (Gomez-Mejia et al., 2011; Brav et al., 2018). Thus, the

[1] We employ the term family-influenced firm to refer to firms in which family ties play a key role in both ownership and board membership (i.e., active family ownership; Gomez-Mejia et al., 2014, 2019). This active involvement of the owning-family (vs. mere passive ownership) is relevant for this study as we wish to examine its interplay with other activist investors and how it shapes firm-level strategic choices on innovation.

coexistence of family blockholders and hedge funds within a single firm's ownership structure presents a theoretically compelling setting to investigate the influence of ownership heterogeneity on corporate innovation.

Regarding the strategic implications of ownership heterogeneity, our study centers on the innovation output choice.[2] Next to addressing the research gap on ownership heterogeneity (cf. Wright, 2017; Cirillo et al., 2019), we aim to shed further light on another gap in the family firm innovation field by examining such innovation output choices. Contrary to research on R&D investments as an innovation input choice, which has produced rather consistent results, prior work on how family influence shapes a firm’s innovation output is fraught with mixed findings (e.g., Block et al., 2013; Matzler et al., 2015; Duran et al., 2016; Chirico et al., 2020), leading scholars to call for more research on contingencies and boundary conditions. We frame the presence of strategic hedge funds in a family firm’s ownership structure as one such potentially significant contingency variable affecting innovation output choices.

Our study’s research question thus reads as follows: within a heterogenous ownership structure consisting of family blockholders and strategic hedge funds with seemingly opposing risk and temporal preferences, what is the effect of the interplay between both shareholder types on the firm’s innovation output choice? As previously mentioned, earlier studies on the link between ownership heterogeneity and corporate innovation in family firms have examined the presence of shareholders such as mutual, pension, and private equity funds, which have very different profiles than those of hedge funds[3], and these studies focused on innovation inputs

[2] We frame radical innovation as an output choice, reflecting the nature of innovation outputs being targeted with a given R&D budget. It can be noted that innovation output is not only determined by strategic choices but also by firm-level capabilities. In our argumentation, we will focus on the strategic choice element since we are interested in exploring ownership-induced variance in radical innovation outcomes – where ownership configurations likely affect strategic choices more strongly and directly than capabilities (with possible indirect implications for capabilities often running via strategic choices), especially among large publicly listed corporations where resource constraints should be less influential.

[3] Hedge funds typically have a high-risk and short-term investment profile. Compared to mutual and pension funds which are more heavily regulated, hedge funds tend to embark on riskier strategies, including leverage and short selling, to achieve higher returns over shorter time periods. Compared to private equity firms which usually invest in companies that are not publicly listed or take them private, hedge funds can build up and exit investments more quickly as shares are publicly traded, allowing for a shortened time horizon.

rather than outputs (Gomez-Mejia et al., 2014; Cirillo et al., 2019). While those studies found that these external investors mitigate the negative effect of family ownership on R&D spending, we develop and test the novel idea that hedge fund activism may actually exacerbate the negative family effect on radical innovation outputs.

To study this research question, we employ a mixed gamble lens. An increasing number of family business scholars adopted a mixed gamble lens (e.g., Gomez-Mejia et al., 2014; Kotlar et al., 2018), for which they refer to the behavioral agency model (BAM; Wiseman & Gomez-Mejia, 1998; Martin et al., 2013) as underlying theoretic anchor. BAM itself is a fusion of prospect theory with agency theory. As we study the combined effect of family ownership and hedge funds, we will integrate prospect theory with insights from multiple agency theory since the latter pays explicit attention to the presence of multiple influential principals with diverging identities, preferences, and time horizons (Hoskisson et al., 2002, 2013; Allcock & Filatotchev, 2010; Filatotchev et al., 2011). Moreover, one of our goals is to develop a better understanding of the mechanisms driving the effect of family ownership and hedge funds on radical innovation output. To this end, we integrate insights from the prospect theoretic myopic loss aversion model, which to date were largely overlooked in BAM, namely on the role of the aggregation of mixed gamble returns in mental accounting (Benartzi & Thaler, 1995). We test our ideas using panel data on ownership and citation-weighted patents from S&P 1500 companies.

Our study makes several contributions. First, we advance knowledge on ownership heterogeneity in family-influenced firms. It is surprising that this topic received so little attention to date given that institutional investors now dominate equity markets in most developed economies (Hoskisson et al., 2002; Connelly et al., 2010b; Fernando et al., 2014). With regard to hedge funds, their activism has been praised in recent literature as an effective sanctioning mechanism for corporate inefficiencies – such as suboptimal innovation strategies – that fail to maximize shareholder value (Gilson & Gordon, 2013; Brav et al., 2018). To the best of our knowledge, we are the first to examine the interplay of family blockholders and activist hedge funds in relation to corporate innovation. We show that in the context of family-influenced firms, hedge fund activism does not represent an effective governance mechanism but instead aggravates the negative effect of family ownership on radical innovation output. This complements work by Gomez-Mejia et al. (2014) and Cirillo et al. (2019) which painted a more positive picture about the role of influential external investors. We thus reveal that when investigating the implications of ownership heterogeneity in family-influenced firms, the type of institutional investor (in our case, hedge funds) and the type of innovation choice (in our case, the innovation output choice) under consideration matter greatly.

Second, we provide deeper insight into the relationship between family ownership and corporate innovation output (Calabrò et al., 2019; Hu & Hughes, 2020). By describing the underlying mechanisms of cross-sectional and temporal aggregation in the assessment of high-risk, high-mean mixed gambles (Thaler et al., 1997; Bammens et al., 2022), we clarify why among publicly traded firms the drawbacks of family ownership likely dominate potential benefits in relation to radical innovation outputs – i.e., innovations with significant economic and technological value for society (Block et al., 2013). Importantly, we reveal how these innovation output choices are affected by the presence of activist hedge funds who have a bearing on the aggregation rules used by family blockholders.

Third, in relation to theory development, we enrich the BAM perspective on family firms by integrating insights from the prospect theoretic myopic loss aversion model (Benartzi & Thaler, 1995, 1999) with multiple agency theory (Arthurs et al., 2008; Filatotchev et al., 2011; Hoskisson et al., 2013). Specifically, we explain how socioemotional considerations shape the aggregation rules adopted by family blockholders when evaluating mixed gambles dealing with radical innovation outputs, and we clarify how these aggregation rules are influenced by the presence of other influential investors with diverging interests. Combining insights from the myopic loss aversion model with multiple agency theory constitutes a valuable advancement of the BAM-based mixed gamble lens on family firm decision-making.

THEORY AND HYPOTHESES

Innovation Output Choices as Mixed Gambles

The corporate innovation process involves multiple stages and strategic choices (Röd, 2016). Many family business studies have examined the decision on the amount of money to invest in innovation (innovation input choice; e.g., Chrisman & Patel, 2012; Gomez-Mejia et al., 2014; Brinkerink & Bammens, 2018; Bammens et al., 2022), but a less understood choice concerns the nature of the innovation outputs being targeted with the invested money (Calabrò et al., 2019). Family business research on innovation output is gaining momentum (e.g., Duran et al., 2016; Carney et al., 2019; Hu & Hughes, 2020), but remains characterized by inconclusive findings. Specifically, while some prior work suggests a positive association between family influence and patented innovation output (Tsao & Lien, 2013; Matzler et al., 2015; Duran et al., 2016)[4], others point to a negative association (Block et al., 2013; Cucculelli et al., 2016; Decker & Günther, 2017) or a nonlinear association (Chirico et al., 2020). Such mixed findings indicate that the institutional setting and other internal and external contingencies play a critical role (cf. Memili et al., 2015; Röd, 2016; Decker & Günther, 2017; Leppäaho & Ritala, 2022), and that the innovation output choice by family firms warrants further inquiry.

Targeted innovation output types vary considerably in their risk and return profile; here, the literature broadly distinguishes between incremental or routine innovations with relatively low risks and potential returns versus radical or breakthrough innovations which are more explorative in nature and involve higher risks and returns (Alexander & Van Knippenberg, 2014; Patel & Chrisman, 2014; Nieto et al., 2015; Hu & Hughes, 2020). As explained by Block and colleagues, "[r]outine innovation that often is not very risky is far less likely to constitute the type of pioneering discovery that leads to new and influential patents" (p. 183), whereas

[4] Four out of six innovation output measures that Duran and colleagues (2016) used are patent-based. Noteworthy is also the finding by Soluk and colleagues (2021) who observed a positive association between family influence and digital business model innovation (BMI), thereby revealing that "the pessimistic view of discontinuous or radical innovation in family-influenced firms (…) does not apply to digital BMI" (p. 889); however, their measure of digital BMI is not patent-based.

radical innovations have greater economic and technological importance as reflected in patent citations (Block et al., 2013). When accounting for the level of R&D spending, a firm's realized radical innovation output will thus reflect its strategic inclination toward pursuing radical innovations in lieu of more modest and less risky routine innovations.

We aim to model ownership-induced variance in companies' innovation output choice, determining the extent to which radical innovations are pursued with a given R&D budget. This choice concerning the type of innovation output to target with their R&D investments crucially reflects a firm's risk and temporal preferences (Block et al., 2013; Patel & Chrisman, 2014; Bammens et al., 2022). Specifically, this strategic choice on the pursuit of radical innovation outputs can be framed as a *high-risk, high-mean* mixed gamble: high-risk because many radical innovation projects tend to fail, and high-mean because on average (when aggregating across a sufficient number of such projects) returns tend to be substantial (Tversky & Kahneman, 1992; Benartzi & Thaler, 1995; Bromiley, 2010). Hence, if decision-makers find high-risk, high-mean gambles more attractive, we expect a stronger emphasis on the pursuit of radical innovation outcomes with a given R&D budget (Block et al., 2013).

The notion of mixed gambles hails from prospect theory. A key feature of prospect theory is the asymmetry in the experience of losses versus gains; individuals tend to dislike losses from gambles much more than they like equally sized gains (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). This loss aversion, where losses weigh more heavily than gains, has a profound negative effect on the pursuit of projects with high-risk, high-mean returns (Benartzi & Thaler, 1995; Bammens et al., 2022). Grounded in prospect theory, the myopic loss aversion model clarifies how the negative impact of loss aversion on the pursuit of high-risk, high-mean mixed gambles (in our case, radical innovation projects) is curtailed as more cross-sectional or temporal *aggregation* occurs in decision-makers' mental accounting (Benartzi & Thaler, 1995, 1999; Thaler et al., 1997). When multiple high-risk, high-mean gambles are aggregated at the same time or over time, then prospective losses incurred in one gamble can be compensated in other gambles, or "distributions of these gambles are more favorable due to statistical aggregation, which offsets the negative effect of loss aversion" (Bammens et al., 2022, p. 1499).

Cross-sectional aggregation in mental accounting takes place when multiple gambles are considered at the same time (Thaler et al., 1997). Many investors on the stock market reduce their risk position by having a large portfolio of different stocks instead of one large equity position in a single company, evaluating their securities as portfolios rather than one at a time. Cross-sectional aggregation of high-risk, high-mean bets reduces the likelihood of experiencing a sizeable loss, thereby curbing the negative effect of loss aversion in the mixed gamble calculus (Benartzi & Thaler, 1999). Temporal aggregation takes place when there is a series of prospective gambles spread out over time (as is the case when considering current and future innovation projects), and the investor only assesses the overall outcome at the end – i.e., uses a long evaluation period – without intermediate gamble outcome evaluations (Benartzi & Thaler, 1995). Akin to cross-sectional aggregation, when decision-makers operate under extended time horizons with longer gamble evaluation periods, losses incurred in initial gambles can be made up for by gains in later gambles (Thaler et al., 1997; Bammens et al., 2022). By implication, the pursuit of radical innovation outcomes – as high-risk, high-mean gambles – represents a less attractive strategic option when cross-sectional or temporal aggregation is limited.

Family Blockholders and Innovation Gamble Aggregation

We know from prior conceptual and empirical research that family ownership is associated with socioemotional considerations in decision-making (Gomez-Mejia et al., 2011; Brinkerink & Bammens, 2018). Here we see potential benefits and drawbacks of actively involved family owners in relation to the pursuit of high-risk, high-mean radical innovations gambles.

On the one hand, an important part of families' socioemotional wealth concerns their desire to maintain a substantial degree of *family control* over corporate affairs (Gomez-Mejia et al., 2007; König et al., 2013). This harms their capacity for cross-sectional aggregation of prospective gamble returns (Thaler et al., 1997). Indeed, keeping a major ownership stake (particularly in publicly traded firms) requires that the family concentrates a significant portion of its wealth in that particular firm (Duran et al., 2016). As a result, family blockholders hold relatively undiversified portfolios (Munari et al., 2010; Patel & Chrisman, 2014), and are not able to aggregate prospective returns from high-risk, high-mean radical innovation gambles across a portfolio of firms to the same extent as other investors. In comparison, institutional investors hold stock in hundreds or even thousands of firms (Porter, 1992), which allows for sizeable cross-sectional aggregation of firm-specific risky gambles; for these diversified investors, their equity stake in any particular firm is unlikely to have an overriding influence on their gamble calculus as is the case with family blockholders.

On the other hand, family blockholders typically have a longer time window than other investors, in large part because of their socioemotional desire to continue the *family dynasty* by passing on their stake to future family generations (Le Breton-Miller & Miller, 2006; Lumpkin & Brigham, 2011; König et al., 2013). Family-influenced firms operating under a lengthened time horizon can, in principle, employ extended evaluation periods when assessing prospective gamble returns (Chrisman & Patel, 2012; Bammens et al., 2022). This implies that they can aggregate a longer series of high-risk, high-mean gambles (i.e., radical innovation projects) into more favorable long-term distributions, which increases the attractiveness of playing such gambles (Benartzi & Thaler, 1999). That is, instead of evaluating radical innovation projects in isolation one at a time, family blockholders could consider, in aggregated form, the prospective returns from multiple radical innovation projects spread out over time. Their transgenerational time horizon may thus, in principle, lead to greater temporal aggregation of prospective returns with corresponding benefits in the pursuit of radical innovation outcomes.

We expect that family-based disadvantages in cross-sectional aggregation (due to family control concerns) outweigh temporal aggregation advantages (due to family dynasty concerns) because of two main reasons. First, although families’ dynastic outlook can make them more long-term minded (König et al., 2013), the associated temporal aggregation benefits may be restricted in relation to radical innovation due to dynastic families' inherent conservative nature. As such, family dynasty also has a dark side which may partly suppress temporal aggregation benefits. Since dynastic family owners are concerned with preserving the family legacy across generations, the "worst-case scenario" – in which accumulated failed radical innovation projects would threaten the survival of the business – may be salient in their gamble calculus.[5] In the words of Bammens and colleagues (2022, p. 1504), "when the realization of (…) losses from failed innovation projects would cause a family firm to default on its credit obligations and to file for bankruptcy, families with [transgenerational intentions] experience a substantially larger SEW loss since bankruptcy also erases the possibility of a desired dynastic transfer". The above-discussed temporal aggregation benefit, anchored in family dynasty, may thus be rather limited. This aligns with the idea that family influence is generally negatively associated with the pursuit of discontinuous technologies and radical innovations (e.g., König et al., 2013; Patel & Chrisman, 2014; Nieto et al., 2015).

Second, we claim that family-based benefits in temporal aggregation are even less likely to materialize in our setting – namely that of publicly traded corporations – compared to the setting of, for instance, privately-held firms (cf. Miller et al., 2008; Le Breton-Miller et al., 2011). While family blockholders in publicly traded firms tend to hold their stock for a long time (often across generations), their gamble evaluation period – i.e., the time over which they actually aggregate prospective gamble returns (Benartzi & Thaler, 1995) – will be restricted by external pressures for short-term performance from transient investors, market analysts, and reporting requirements. Many publicly listed corporations operate under a logic of short-termism (Graves & Waddock, 1990; Jacobs, 1991; Porter, 1992; Bushee, 1998) and this severely lowers (though not necessarily fully erases) family-influenced firms' ability to act in

[5] We thank the *FBR* associate editor for suggesting this worst-case scenario argument. While a threat of bankruptcy involves a true worst-case scenario, the need to attract additional external financing to compensate for financial losses may constitute a sufficient deterrent for many dynastic business families.

line with their inherently longer transgenerational time horizon through greater temporal aggregation.[6]

In sum, we drew on the prospect theoretic myopic loss aversion model (Benartzi & Thaler, 1995) to uncover two key mechanisms – cross-sectional aggregation and temporal aggregation (also referred to as "broad framing"; Bammens et al., 2022) in mental accounting – that help explain choices on radical innovation gambles. We argue that family-based benefits in temporal aggregation are probably rather modest, and that family blockholders' drawbacks in cross-sectional aggregation likely prevail. This results in our first baseline hypothesis, which can be read as a replication of prior work sampling similar firms (Block et al., 2013):

Hypothesis 1: Accounting for R&D spending, the presence of family blockholders in a publicly listed firm's ownership structure is negatively associated with radical innovation output.

The Moderating Effect of Hedge Fund Activism

Strategic (activist) hedge funds represent, just like family blockholders, a shareholder type with substantial influence, yet with very different preferences in relation to diversification and time horizon. According to Brav (2009), the most common hedge fund tactics are concerned with realizing efficiency gains, reducing excess cash, increasing leverage and shareholder payouts, selling business units, and imposing changes in corporate governance. While there appears to be consensus on the relationship between hedge fund activism and performance increases, the

[6] Relatedly, prior research on innovation output in family firms is fraught with inconsistent findings and consideration of the institutional governance setting may partly account for some of these inconsistencies. Indeed, earlier work sampling publicly listed firms observed a negative effect of family influence on patented innovation output (e.g., Block et al., 2013), whereas others sampling (also) private firms found the opposite (e.g., see Duran et al., 2016 with their table C2 revealing that the positive effect is mainly driven by private family firms). Some work suggests that the story is even more nuanced than this; not all stock markets are subject to similar pressures for short-termism and family firms listed on, for instance, a European stock exchange may be better able to act in line with their long-term horizon than their counterparts in the U.S. where stock markets are notoriously short-term oriented (cf. Matzler et al., 2015 observing a positive effect of family influence on patented innovation output using a sample of German listed firms). The aforesaid does not account for all observed inconsistencies in this literature (cf. Decker & Günther, 2017).

impact of hedge funds on corporate innovation is less conclusive. Challenging public opinion and critical voices among scholars (Klein & Zur, 2009, 2011), most empirical research suggests a positive association between the involvement of hedge funds and more radical (patent-based) innovation output measures due to improvements in innovation efficiency (cf. Wang & Zhao, 2015; Brav et al., 2018).

Brav and colleagues (2018) discuss several efficiency-enhancing mechanisms through which target firms may experience higher innovation outputs after hedge fund activism. For instance, by selling inefficient business units (that do not belong to a firm's core competency; Brav, 2009), target firms can refocus on their core competencies, leading to efficiency gains in innovation output. Also, post-intervention, target firms hire and fire a significantly higher number of innovators compared to their matched peers; after "redeployment", retained and new innovators tend to exhibit a higher efficiency in both patents filed and citations received as "personnel are matched or re-matched to work environments where they can be more productive" (Brav et al., 2018, p. 239). Furthermore, post-intervention, CEOs' share ownership increases and more directors are added to the board, "showing that general improvement in management and governance makes firms more innovative" (p. 239). Yet, the significant goal incongruence between hedge funds and family blockholders, in terms of diversification and time horizon, gives us reason to believe that hedge fund activism will interact with family blockholder involvement in shaping the focal firm's radical innovation choices.

Compared to family blockholders, hedge funds hold much more diversified portfolios and employ shorter investment horizons (Klein & Zur, 2011; Berrone et al., 2012). The associated differences in strategic preferences create an agency setting with high potential for *principal-principal* conflicts. When analyzing conflicts among principals, multiple agency theory (Hoskisson et al., 2013) offers a useful theoretic lens. Multiple agency theory pays explicit attention to ownership heterogeneity and the involvement of multiple (large) principals with diverging identities, preferences, and time horizons (Hoskisson et al., 2002, 2013; Allcock &

Filatotchev, 2010; Filatotchev et al., 2011). As pointed out by Hoskisson and colleagues (2013), some principals can even hold a dual identity in the sense that next to being a shareholder of the focal firm, they serve as agents to other principals beyond the focal situation; and "[t]his dual identity creates an implicit tension for the actor and can generate conflicting interests" (p. 9). Hedge fund managers, for instance, serve as principals in the focal firm, but as agents to their clients who invested in the fund. This dual identity can create goal incongruence between hedge fund managers, who aggressively seek to maximize short-term returns for their clients (Klein & Zur, 2011), and other shareholders of the firm such as family blockholders. Anchored in multiple agency theory, we propose that when hedge funds intervene in family-influenced firms, their divergent preferences cause the interaction of family ownership and hedge fund activism in relation to radical innovation outcomes to be negative.

Multiple agency theory offers a useful general framework for analyzing principal-principal conflicts (Hoskisson et al., 2013), but it does not detail the specific conflicts and interactions between our focal principals, hedge funds and family blockholders, regarding the firm's radical innovation output. To flesh out these behavioral micro-processes, and their implications for innovation output choices, we complement multiple agency theory with the earlier described prospect theoretic insights on temporal and cross-sectional aggregation (Thaler et al, 1997). As such, multiple agency theory can be viewed as overarching framework for studying ownership heterogeneity issues, and the prospect theoretic myopic loss aversion model as a behavioral theoretic "plug-in" to work out the particular principal-principal dynamics under consideration. Based on this myopic loss aversion model (Benatrzi & Thaler, 1995), we previously clarified how greater aggregation of prospective gamble returns increases the attractiveness of pursuing more radical high-risk, high-mean innovation projects.

First, most hedge funds are relatively short-term oriented, seeking to obtain returns on their investments rather quickly (Klein & Zur, 2011). This implies that only limited temporal aggregation of prospective innovation gamble returns is possible for these hedge funds, who will actively try to enforce their efficiency-oriented short-term preferences on their target firms. By doing so, they further undermine any potential temporal aggregation advantage of family-influenced firms, which originates from family blockholders' inherent longer time horizon (Le Breton-Miller & Miller, 2006). While we already argued that temporal aggregation benefits of family ownership are not likely to fully materialize (especially in the setting of publicly listed corporations), we claim that this is even less the case when hedge funds are active in the family firm's ownership structure and aggressively push for short evaluation periods (Benartzi & Thaler, 1995; Klein & Zur, 2011). That is, the evaluation period used by family blockholders in their mental accounting of gamble returns, is expected to be further shortened when they have to consider, and partly accommodate, the preferences of short-term minded activist hedge funds. As per the myopic loss aversion model, shorter evaluation periods lead to fewer high-risk, high-mean gambles being aggregated over time (Thaler et al., 1997), thereby further lowering the attractiveness of pursuing such radical innovation outputs.

Second, as institutional investors, hedge funds tend to diversify their investments and thus benefit from greater cross-sectional aggregation. Yet, hedge funds' heightened cross-sectional aggregation is unlikely to mitigate the negative effect of a family blockholders' undiversified holdings on their cross-sectional (i.e., *cross-firm*) aggregation of gamble returns (Duran et al., 2016). Indeed, to uphold family control, family blockholders face limitations in the extent to which they can diversify their stockholdings (Gomez-Mejia et al., 2011; Duran et al., 2016), and the presence of an activist hedge fund does not affect this structural limitation in cross-firm aggregation from the family blockholders' perspective.[7] In contrast, to the extent that hedge funds push for efficiency-oriented actions such as divestitures of non-core business assets and units (Lerner, 1994; Brav et al., 2009; Pastor & Veronesi, 2009), they may even increase

[7] There is thus an asymmetry in how hedge fund activism is expected to affect family blockholders' temporal vs. cross-sectional aggregation. In line with the myopic loss aversion model, external pressures (e.g., from hedge funds) can lead one to adopt a gamble evaluation period in mental accounting that is shorter than one's inherent time horizon. However, it is unlikely that a hedge fund's broader portfolio would increase cross-firm gamble aggregation in the family coalition's mental accounting beyond the company shares the family itself holds.

unsystematic firm risk and limit *within-firm* cross-sectional aggregation possibilities (i.e., across different business lines) for family owners. This would harm their ability to cross-sectionally aggregate prospective returns across radical innovation projects, and thus the overall attractiveness of pursuing such projects (Thaler et al., 1997). Likewise, families' concern for reputation, tradition and identity likely leads them to oppose efficiency-oriented actions by hedge funds involving divestitures and personnel lay-offs, thereby undermining some of the innovation efficiency benefits ascribed to hedge fund activism (Brav et al., 2018).

In short, earlier we explained how active family ownership in listed corporations may have a negative impact on firm-level engagement in radical innovation due to drawbacks in cross-sectional aggregation, which are unlikely to be compensated by (limited) family-based benefits in temporal aggregation. Based on the above, we propose that this negative effect of family ownership is exacerbated in the presence of activist hedge funds who have substantially different strategic preferences, leading to severe principal-principal conflicts. Hedge funds are expected to further undermine family blockholders' (already limited) benefits in temporal aggregation and to potentially worsen their drawbacks in cross-sectional aggregation. This results in our second hypothesis on the combined effect of active family blockholders and hedge funds on the pursuit of radical high-risk, high-mean innovation projects:

Hypothesis 2: Accounting for R&D spending, the negative association between family blockholders and radical innovation output intensifies as hedge fund activism in the focal firm increases.

SAMPLE AND METHODS

The final sample used in this study covers 772 firms representing 2,601 firm-year observations, and it was obtained after merging several secondary data sources (e.g., Compustat, FactSet, GMI ratings, USPTO) covering U.S. firms listed in the S&P 1500. The covered time period is limited by the availability of the family firm variable and patent data, and ranges from 2002 to 2009. We use a time lag of 4 years to account for the time difference between our dependent and independent variables; the rationale behind this time lag is presented in the data analysis section. This designated time period covers both the beginning and recent developments in the hedge fund activism era (Zenner et al., 2010, 2015). The S&P 1500 index represents a solid basis for our research for several reasons: First, the frequency of hedge fund activism campaigns per year is limited, which may constrain the ability to make robust statistical inferences. Previous research identified between 50 (Klein & Zur, 2009) and 176 (Brav et al., 2008) hedge fund activism campaigns per year between 2003 to 2005 and 2001 to 2006, respectively. In order to identify the majority of hedge fund activism events, an index that covers 90% of the U.S. stock market capitalization appears reasonable. Second, although family firms represent the dominant organizational form globally, they are mostly small or medium in terms of size. Among public corporations, family firms make up around 10% of all firms based on the strict definition employed in this study (cf. Gomez-Mejia et al., 2014, 2019). Again, the broad focus facilitates the aggregation of a solid sample size, especially in light of the fact that we also need to identify firms that do not only qualify as a family firm but that are targeted by hedge funds, too. Third, focusing on listed U.S. firms allows for comparability with the majority of other studies on the impact of activism (cf. Brav et al., 2008; Clifford, 2008; Klein & Zur, 2009).

Accounting firm data was retrieved from Compustat and data on hedge fund activism from SharkRepellent, which is part of FactSet’s comprehensive database with a focus on corporate activism, takeover defense, and proxy-related issues. GMI Ratings provided the identification of family-influenced firms (Gomez-Mejia et al., 2014, 2019), and the necessary records on patents were retrieved from the publicly available dataset by Kogan et al. (2017).

To ensure comparability and consistency with prior literature on hedge funds, family firms and innovation, several industry sectors have been excluded from the sample (cf. Anderson et al., 2012; Matzler et al., 2015): enterprises from the financial sector (SIC 60 & 61), brokers (SIC 62), insurance firms (SIC 63 & 64), real estate firms (SIC 65), holdings and investment offices (SIC 67) as well as utilities (SIC 46, 48 & 49). In a similar vein, foreign subsidiaries were excluded as "their accounting and their regulation standards are different from other sectors, and government regulations may potentially affect firms' investment choices and equity ownership structure" (Matzler et al., 2015, p. 324). This procedure resulted in the removal of 320 firms on average.[8]

After performing all necessary data cleaning steps, which are described in more detail below, the datasets were merged, which resulted in a sample of 957 distinct firms for the time period between 2002 and 2009, of which 99 firms comply with our family firm definition. As a result of missing data points, the final model estimates are based on a sample of 772 firms, including 72 family firms, representing 2,601 firm-year observations.

Dependent Variable

In this study, patenting activity serves as a proxy for innovation output. Despite some criticism in the past, the use of this proxy has become a best practice in the literature (cf. Acharya & Subramanian, 2009; Aghion et al., 2013). Specifically, we employ a citation-weighted patent measure rather than relying on a simple patent count variable. Patents, in the traditional sense, are used to protect know how, yet patenting activity may also result from other motives such as blocking competitors or entering cross-licensing agreements. Defensive patenting or exchange motivated patenting does not adequately capture the radical nature of innovation outcomes and hence may lead to distorted results given the focus of our study(Grabowski & Vernon, 1990; Jaffe et al., 1993; Dahlin & Behrens, 2005). As these patents carry less economic and technological importance, they receive significantly fewer forward citations (Blind et al., 2009). To ensure that our measure captures strategic motives toward more radical innovation outputs,

[8] Due to regular adjustments of the companies listed in the S&P 1500, the number of firms across sectors varies slightly per year.

we combine patent stock data with the number of forward citations received per patent, which is a common practice to assess the economic and technological importance of innovations and helps alleviate the majority of shortcomings mentioned above (e.g., Harhoff et al., 1999; Katila, 2000; Brav et al., 2018).

The patent data used in our analysis was compiled by Kogan et al. (2017). The data covers patents issued by the USPTO between the year 1926 and February 2010, which extends the commonly used NBER patent citation data set (Hall et al., 2001) by covering 11 more years in the new millennium while maintaining matching accuracy. Since hedge fund activism saw its main surge from the year 2000 onwards (Zenner et al., 2015), it is reasonable to focus on this time frame to make sound inferences about the underlying principal-principal conflict between family owners and hedge funds. The citation-weighted patent metric was constructed as follows,

$$\Theta_{f,t}^{cw} = \sum_{j \epsilon P_{f,t}} \left(1 + \frac{C_j}{\overline{C}_j}\right) \div B_{ft} \qquad (1)$$

where $P_{f,t}$ is the set of patents issued to firm *f* in year *t*, C_j denotes the number of forward citations that patent *j* received and $\overline{C_j}$ the average number of forward citations received by patents granted in the same year as patent *j*. B_{ft} denotes the book assets of firm *f* in year *t* (cf. Kogan et al., 2017). Since firm size is said to have a significant positive impact on the number of filed patents, the metric is scaled by the book value of assets to avoid that variations in firm size lead to a bias in our proxy.

Independent Variable and Moderator

Family Firm. To date, there is no consensus on the operational criteria used to identify family firms (Gomez-Mejia et al., 2011). Most scholars agree, however, that the family should be the dominant coalition within the firm, with an active voice in determining the firm's vision (Chua et al., 1999), for example, by holding board positions to exercise their influence (Bammens et al., 2011). In line with the core motive of this study to investigate the effect of active ownership positions, we follow the recent work by Gomez-Mejia and colleagues (2014, 2019) and adopt the family firm categorization by Governance Metrics International (GMI), which includes the Corporate Library. GMI defines a family-controlled firm as "a company where family ties, most often going back a generation or two to the founder, *play a key role in both ownership and board membership*. Family members may not have full control of the shareholder vote (greater than 50%), but will generally hold *at least 20%*"[9] (cf. Gomez-Mejia et al., 2014, 2019). Whereas measures based on a family's ownership ratio may carry a certain advantage in gauging voting power, they do not account for the direct control family members have via board positions. GMI's definition, in contrast, precludes passive family ownership which caters to our focus on active ownership.

Moreover, in recent years, there has been an increasing effort to distinguish founder firms from true family firms, which involve family members from later generations (Le Breton-Miller, et al., 2011). The literature suggests that family and founder firms differ in their strategic objectives due to divergent socioemotional preferences and agency issues affecting firm-level corporate innovation (Block, 2013; Miller et al., 2013; Kotlar et al., 2018). As a result, founder firms are not part of our family firm measure[10]. Our family firm dummy equals 1 if a firm is identified as a family firm in more than 75% of its observations.[11]

Hedge Fund Activism. Most prior studies exploited 13D filings to identify activism events. The 1934 Security Exchange Act requires investors holding more than 5% beneficial

[9] Our dichotomous approach is consistent with numerous prior studies conducted on publicly traded firms (e.g., Gomez-Mejia et al., 2003, 2014, 2019; Cannella et al., 2015; Keasey et al., 2015; Kotlar et al., 2018). Similar to the definition employed by Gomez-Mejia and colleagues (2014, 2019) and Kotlar and colleagues (2018), we require family control to be at least 20% and an active involvement in corporate affairs (e.g., Allen & Panian, 1982; Daily & Dollinger, 1993; Gomez-Mejia et al., 2003, 2014, 2019; Kotlar et al., 2018).

[10] In the reported analyses, founder firms are part of the base category (i.e., nonfamily firms). Additional analyses reveal that, when we separate founder firms from other nonfamily firms, the effect of the founder firm dummy is nonsignificant and does not alter the hypothesized effects. Results are available upon request.

[11] This 75% threshold is used to prevent that small fluctuations around the shareholder vote threshold of 20% would lead to misidentifications of family firms as non-family firms in a given year; it also accounts for potential misidentifications by GMI Ratings in the years 2004 and 2005, for which we noticed an unusually high number of changes in family firm status based on the GMI indicator, that we could not confirm based on a manual check of the 14A filings retrieved from the Securities and Exchange Commission EDGAR database. For the years 2006-2009, the GMI-based family firm indicator again appeared much more stable.

ownership in any given public firm with the intent to influence corporate control to disclose their identity and the intention behind the investment. To date, the majority of hedge fund research in the U.S. makes use of these 13D filing dates to identify the start of an activism event (Brav et al., 2008, 2018; Clifford, 2008; Klein & Zur, 2009; Boyson & Mooradian, 2011).

However, this identification method has shortcomings since the majority of activism tools utilized by hedge funds do not require a 5% ownership. For a hedge fund, it is neither necessary nor desirable to accumulate a 5% ownership stake to exercise activism as this constitutes a major investment of capital and time. Rather, prior research reveals that informal activism is a cost- and time-effective alternative that precedes formal activism, which is only pursued if informal activism attempts fail (Bauer et al., 2015). Informal activism takes place behind closed doors by directly engaging in communication with the management and/or board or by exerting pressure through critical public letters or public media campaigns. Should these informal activism attempts fail, hedge funds may acquire additional shares to have all formal activism tools at their disposal (e.g., initiate a proxy fight to replace management and board members). Following this logic, the classical identification method (via 13D filings) fails to accurately capture the beginning of activism, leading to temporal deferrals in the data which distort panel data estimates.

To address these identification issues, we build on the proposition that cost-efficient informal activism generally precedes formal activism events (cf. Becht et al., 2009; Bauer et al., 2015). This approach is also in line with the study of McCahery et al. (2016) and with the findings of Becht et al., (2009) in their study on private activists, demonstrating that the majority of activism is informal in nature. Hence, it is reasonable to assume that hedge funds that frequently engaged in formal activism in their recent past (13D filings) also frequently engage in informal activism. Therefore, we classify a firm as a target if a hedge fund holds a position of any given size and has engaged in significant formal activism in the past year. Toward this end, we investigated activists listed in the *SharkWatch50* hedge fund database, which covers the 50 most active hedge funds. To account for the increased pressure on management in the focal firm by multiple activists, we calculate the number of hedge funds that have simultaneously invested in a given firm. This identification procedure resulted in the identification of 1525 hedge fund activism (HFA) events between the years 2002 to 2009.

Control Variables. Research and development (R&D) expenses are associated with increased innovation output, and hence should be controlled for (Block et al., 2013). Prior work also indicates that innovation output is dependent on the life-cycle stage of the firm (Craig & Moores, 2006) and on their size due to the availability of resources (Baysinger & Hoskisson, 1989; Chen & Hsu, 2009). We measure age by years since establishment (Lee & O'Neill, 2003) and size by sales (Chen & Hsu, 2009). Due to the skewness of R&D expenses, firm age, and firm sales, we used log-transformations for these variables (David et al., 2008). Moreover, the variables R&D expenses and sales have been winsorized at the 1% level to prevent significant outliers from driving our model estimates. In line with SEC rules, Compustat data does not include very small R&D amounts that are not material to a firm's decision-making. Because of that, about 30 percent of the R&D expenses on Compustat are missing. Since they are not missing at random, omitting these observations would introduce a bias. Hence, we follow previous studies and imputed a zero for firms with negligibly low R&D expenses (cf. Coles et al., 2006; Chang & Dasgupta, 2009; Gomez-Mejia et al., 2014).[12]

We also control for other factors such as performance and liquidity, which have been identified by prior literature to impact corporate innovation. Firm performance controls for the influence of the firm's performance on innovation-related strategic choices (Chaney & Devinney, 1992; Barker & Mueller, 2002). We proxy for this with two different measures: Tobin's Q represents a forward-looking performance measure (Anderson & Reeb, 2003) and return on assets (ROA) measures prior firm performance (Barker & Mueller, 2002). The current

[12] The inclusion of a dummy for firms with missing R&D expenses had very limited effects on the estimated results, and a robustness test where R&D spending is not winsorized is reported in Table 5.

ratio is a commonly used proxy for the liquidity of a company, which allows firms to readily seize new strategic innovation opportunities (Baysinger & Hoskisson, 1989). Lastly, we account for inter-industry differences and yearly effects by including dummies for two-digit SIC codes and for years. This is necessary since patenting strategies and activities vary not only across industries but also across years due to macro-economic developments (e.g., financial crisis).

Data Analysis

To test our hypotheses, we exploit both time-series and cross-sectional information contained in our panel dataset by estimating a random-effects model (Greene, 2012). Whereas a fixed-effects model assumes that individual effects are time-invariant variables possibly correlated with other independent and control variables, the underlying assumption of a random-effects model is that individual effects are part of the error term structure and are independently drawn from a normal distribution. Our choice for a random-effects model is also driven by the need to estimate the effect of our time-invariant family firm variable, which is at the heart of our theoretical argumentation. Hence, we adopted a random-effects model to test how family firm status affects innovation output, and how the presence of activist hedge funds moderates this relationship. The random-effects estimations are based on the following models:

$$CWP_{i,t} = \alpha_0 + \beta_1 FF_i + \beta_2 HFA_{i,t-4} + \gamma' Controls + \delta' Year_t + \theta' Industry_i + v_i + \varepsilon_{i,t} \quad (2)$$

$$CWP_{i,t} = \alpha_0 + \beta_1 FF_i + \beta_2 HFA_{i,t-4} + \beta_3 HFA_{i,t-4} \times FF_i + \gamma' Controls + \delta' Year_t + \theta' Industry_i + v_i + \varepsilon_{i,t} \quad (3)$$

where $CWP_{i,t}$ represents the citation-weighted patents for firm *i* in year *t* calculated based on formula (1). The Variable *FF*, which is time-invariant, stands for the family firm status of firm *i*. The variable *HFA* indicates the level of hedge fund activism in firm *i* lagged by t-4 periods.[13]

[13] In our analysis, we opt for a time lag of four periods to account for the time difference between hedge fund investment and the grant of a patent. First, we account for the time between the initial hedge fund investment and the exertion of influence over strategic choices. This can range from a few months in the case of informal activism

For ease of notation *Controls* summarizes the control variables for firm *i* lagged by t-4 periods. Finally, $Year_t$ and $Industry_i$ summarize the dummies for the respective year and two-digit SIC code. The usual composite error term, $v_i + \varepsilon_{i,t}$, is added.

After testing for both serial correlation and heteroscedasticity with the Breusch-Godfrey test and the Breusch-Pagan test, we estimated our model with a robust covariance matrix. Variance inflation factors (VIF) are low for all variables, with 3.7 being the highest value. This is well below the proposed threshold of 10, and hence multicollinearity should not be an issue (Kutner et al., 2005).

RESULTS

Table 1 presents the means, standard deviations, and correlations of the variables used in our model. Bold formatting indicates significance at the 5% level. Citation-weighted patents have been calculated according to formula (1). The hedge fund activism variable is a discrete variable measuring the number of highly active hedge funds in a given period. The family firm dummy equals one if a firm was identified as a family firm in at least 75% of its observations and zero otherwise. The variable R&D represents the log-transformed R&D expenditure. Age represents the number of years a firm is in existence, which was also log-transformed. The size was measured by the log-transformed and mean-centered firm sales. The two performance measures Tobin's Q and return on assets were not transformed, and neither was the current ratio.

Insert Table 1 about here
----

to more than one year in the case of formal activism since shareholders are only eligible to submit a formal proposal if they hold their stake for at least one calendar year (Loss & Seligman, 2004; Bauer et al., 2015). Next, a time lag of a few months likely occurs between the first exertion of influence and subsequent R&D activity in the target firm. Regarding the development of patentable technology, it was found that "the total lag associated with the innovation process varied between 1.17 and 2.62 years" (Goel, 1999). Thereafter, the legal patent application has to be crafted and submitted, which may take one to two months. Finally, the mean lag between a patent application at the USPTO and its grant is 28 months (Popp et al., 2004, p.15). It is important to note that this figure is skewed with a median grant lag of 23 months. Taken together, we propose a minimum lag of four years for this study. To assess the robustness of our results, we also estimate the model with a lag of five years, which yields similar results for our hypothesized effects (Table 4).

Table 2 contains the empirical results of our random-effects estimation in two model specifications. Model 1 includes all controls as well as the variables hedge fund activism and family firm status. In line with Hypothesis 1 we find that family firm status has a strong negative and significant effect (coefficient = -0.530; p = 0.003) on citation-weighted patents. We also find that hedge fund activism has a positive and significant effect (coefficient = 0.079; p<0.001) on innovation output after four years. This positive effect on innovation may appear surprising at first glance given the short-term oriented nature of hedge funds. Yet, given the high market visibility of patents and the suggested positive effect of hedge funds on innovation outputs proclaimed by previous scholars (cf. Wang & Zhao, 2015; Brav et al, 2018), our data supports the notion of achieved innovation efficiency gains. This is in line with previous empirical findings demonstrating a positive effect of hedge fund activism on innovation output proxied by patent quantity and quality (He et al., 2014; Wang & Zhao, 2015; Brav et al., 2018).

Model 2 includes the interaction term FF x HFA in addition to the variables mentioned above for Model 1. In support of Hypothesis 2, we find a strong negative and significant interaction effect (coefficient = -0.116; p = 0.003) four periods post hedge fund intervention. As illustrated in Figure 1, while hedge funds have a positive effect on the innovation output in nonfamily firms, their effort to increase innovation does not materialize among family-influenced firms. This finding suggests the presence of additional principal-principal costs post intervention.[14] Both models (Model 1 and Model 2) were also estimated with standard errors clustered over years and industries. The unreported results are very similar to the reported results and do not qualitatively affect any conclusion.

Insert Table 2 about here
----

[14] We also assessed the combined effect of HFA and HFA x FF by using a linear restricted model where $\beta_2 HFA_{i,t-4} + \beta_3 HFA_{i,t-4} \times FF_i = 0$. The estimate was insignificant (p=0.52), hence we fail to reject the null hypothesis that the effect of hedge fund activism in family firms does not differ from zero.

Insert Figure 1 about here

Adjusting for Possible Reversed Causality

Whereas Model 1 and Model 2 reveal that family firm status and hedge fund activism have a significant impact on innovation output, estimates might suffer from endogeneity due to reverse causality. This is especially true for the variable hedge fund activism since their target choice may depend on our patent-related proxy. In case our dependent variable shows persistency, this form of reverse causality will lead to an asymptotic bias of our estimates. To account for this possibility of reverse causality, we estimated Model 3 and Model 4, including the lagged dependent variable (t-4) in addition to the variables contained in Model 1 and Model 2. The inclusion of previous values of the dependent variable is characteristic of a Granger causality procedure. A mathematical demonstration of how the inclusion of a lagged dependent variable functions as a first-order correction to potential reversed causality can be found in Carree et al. (2019). As can be seen in Table 3, the lagged dependent variable has a substantial impact and is highly significant (coefficient = 0.514; $p<0.001$). When accounting for reverse causality, the coefficients presented in support of Hypothesis 1 remain similar in Model 3 (coefficient = -0.259; $p = 0.090$). Moreover, the interaction term between family firm status and hedge fund activism remains significantly negative (coefficient -0.117; $p = 0.024$), providing additional support for Hypothesis 2.

Insert Table 3 about here

Additional Robustness Checks

First, in our main analyses we relied on the binary GMI indicator for family firm status (cf. Gomez-Mejia et al., 2014, 2019). As a robustness check, we manually collected data on the voting power (as a percentage) of the owning-family for each of these family firms and respective firm-year observation. This data is based on the SEC proxy statements and complementary online sources when needed[15]. Using these family voting percentages as a continuous measure, we reran our random-effects model, which gave very similar results to those of our main analyses (see Table A1 panel a in Appendix 1)[16]. Next, recent research based on investor's reactions to traded stocks in France proposes that threshold effects of family ownership exist (Sekerci et al., 2022). As a result, we also created new family voting share dummies where, instead of the 20% threshold used in the GMI indicator, we worked with a 30%, 40%, and 50% threshold. When working with the 40% and 50% threshold, the number of family firms became too small to run reliable analyses (only 34 and 19 family firms, resp.)[17]; when working with the 30% threshold (48 family firms), results were again similar to those reported earlier using the GMI indicator (see Table A1 panel b in Appendix 1).

Second, many of the firm-year combinations in fact had no patenting activity. About half of the observations are left-censored at zero. Therefore, it could be argued that an estimation technique that takes this into account could improve upon the linear panel regression results. Using the censReg package in R we have estimated a Tobit random effects panel data model. The Tobit model can deal with (left-)censoring and results are presented in Table A2, panel a for the family firm dummy and panel b for the family ownership percentage. The results as presented for the effect of the family firm variable and for the interaction term with hedge fund activity are in line with the results as presented above using linear panel regression techniques.

---

[15] To uncover the family name (of family blockholders) we used the company home page, press reports, and/or analyst reports.

[16] There is very little variation in family voting percentages over time such that running a fixed-effects model is sensitive to outliers (the mean voting share variation of the family firms in our sample is 2.16% from one year to the next and the median only 1.51%). Considering this caveat, in unreported results (available upon request), we find that the effect of the family voting share (hyp. 1) is negative but fails to reach significance and that the interaction term (hyp. 2) is negative and significant when using a fixed-effects model.

[17] In unreported results (available upon request), we find that the effect of the family firm dummy (hyp. 1) remains negative but fails to reach significance (p-values are 0.1 and 0.09 for the 40% and 50% threshold levels respectively) and that the interaction term (hyp. 2) is negative and significant when using the 40% and 50% thresholds with few remaining family firms in the sample.

Last, we reran our analyses on a subsample of firms considering the sector's R&D intensity. Radical innovation may be less of a strategic issue in very traditional low-tech sectors, such that principal-principal conflicts in relation to radical innovation choices may be less relevant. Toward this end, we adopted the industry-based R&D ranking proposed by the OECD (2015). This classification is representative for Western economies and the sample is largely based on US and EU data. We introduced five dummy variables: high R&D intensive sectors, medium-high R&D intensive sectors, medium R&D intensive sectors, medium-low R&D intensive sectors, and low R&D intensive sectors. We then created a subsample containing only high R&D intensive sectors; this sample contained no family firms. Subsequentially, we added medium-high, medium, and medium-low R&D intensive sectors in consecutive steps to see how many family firms are present in each subsample. The respective sample sizes were as follows: 16, 23, and 66. Accordingly, we assessed that reliable estimates are only viable if low R&D intensive sectors are excluded and the other sectors are retained. When using this subsample of high to medium-low R&D intensive sectors, results are again very similar to those obtained previously (see Table A3 panel a using the GMI family firm dummy, and Table A3 panel b using the family's voting percentage in Appendix 3).

DISCUSSION

Building on multiple agency theory and the prospect theoretic myopic loss aversion model (Benartzi & Thaler, 1995; Hoskisson et al., 2013), our study advances knowledge on the interrelationship between ownership heterogeneity and radical innovation output choices. Our empirical findings reveal that publicly traded firms with active family ownership, on average, put significantly less strategic emphasis on radical high-risk, high-mean innovation outcomes, which tend to be of greater technological and economic importance for society (cf. Block et al., 2013). Importantly, our findings highlight the value of considering ownership heterogeneity in this setting by demonstrating that hedge fund activism aggravates the negative effect of family ownership. Hence, our study reveals that it is not sufficient to model strategy-related outcomes based on the analysis of a single (dominant) ownership group but that the broader ownership configuration should be considered in strategic and innovation management research.

Family-influenced firms demonstrate lower radical innovation output levels as reflected in citation-weighted patents; yet, among publicly traded corporations, firms pursuing high-risk, high-mean innovation strategies would offer their investors greater potential for maximizing shareholder value since unsystematic risk can be eliminated through diversification according to modern portfolio theory (Markowitz, 1952). From this perspective, family firms' strategic innovation behavior and resulting below-average radical innovation output levels represent a form of wealth expropriation from diversified investors. Ownership structures of most publicly traded firms are dominated by influential institutional investors, who may increase monitoring and reduce private wealth expropriation (Maury & Pajuste, 2005) – and this role has also been ascribed to activist hedge funds (Brav, 2009; Brav et al., 2018). It appears, however, that more effective tools are necessary to alleviate the problems associated with family blockholders. We therefore provide nuance to the idea of institutional shareholder activism – in particular hedge fund activism – as a panacea for corporate governance problems (Briggs, 2007; Brav et al., 2008). Indeed, our study reveals that the presumptive positive effect of hedge fund activism on innovation outcomes does not materialize among family-influenced firms.

Academic Implications

Our study contributes to the literature on the effect of family ownership on corporate innovation output (e.g., Chrisman et al., 2015; Duran et al., 2016; Calabro et al., 2019). We explained how the family-based socioemotional considerations of family control and family dynasty can be tied to cross-sectional and temporal aggregation, respectively, in decision-makers' mental accounting of radical innovation gambles. We clarified how, particularly in the setting of publicly listed corporations facing short-term market pressures, family-based disadvantages in cross-sectional aggregation likely outweigh any potential temporal aggregation benefit. As such, ours is a contextualized approach which aligns with calls made by scholars like De Massis et al. (2013) who pointed out that "potential differences between small and private versus large and public family firms may provide major challenges to our ability to generate cumulative knowledge in this area" (p. 21). We also modelled hedge fund activism as a moderator in the relation between family ownership and radical innovation, which advances prior work on the heterogeneity of family firm innovation behavior (e.g., Patel & Chrisman, 2014; Memili et al., 2015; Decker & Günther, 2017). In short, by detailing aggregation decision mechanisms and considering the institutional context as well as the hitherto overlooked contingency of hedge fund activism, we advance understanding of family firms' innovation output behavior.

Our study also contributes to the research stream on ownership heterogeneity in family-influenced firms (e.g., Sacristan-Navarro et al., 2011; Fernando et al., 2014; Cirillo et al., 2019). To date, most family business studies examined the effect of family ownership in isolation, and those few studies that considered the role of other influential shareholders mainly found a positive moderation effect (e.g., Gomez-Mejia et al. 2014 and Cirillo et al. 2019 who looked at R&D intensity). Our study highlights the importance of differentiating between investor types and points to the possibility of negative interaction effects. To the best of our knowledge, we are the first to analyze the interplay between family blockholders and hedge funds in relation to firm-level innovation output. To advance our understanding of this topic, we complemented the myopic loss aversion model with insights from multiple agency theory on principal-principal conflicts (Arthurs et al., 2008; Hoskisson et al., 2013). By investigating family blockholders and hedge funds, which represent "perfect anti-poles", we were able to show that hedge fund activism is not universally positive in its effect and may aggravate the innovation weaknesses associated with family blockholders. As such, our study answers to calls for more research on strategic decision-making and innovation processes in today's changed ownership landscape (Connelly et al., 2010a; Wright, 2017).

Lastly, we enrich the behavioral agency lens on family firm decision-making, and in particular the mixed gamble approach which recently gained in popularity (e.g., Gomez-Mejia et al., 2018, 2019; Kotlar et al., 2018). Specifically, in this study we connect insights on mixed gamble aggregation rules from the prospect theoretic myopic loss aversion model (Benartzi & Thaler, 1995, 1999; Thaler et al., 1997) to ideas on principal-principal agency problems from the multiple agency model (Arthurs et al., 2008; Hoskisson et al., 2013). Thus far, mental accounting aggregation rules received little attention among family business scholars (for exceptions, see Chrisman & Patel, 2012; Bammens et al., 2022), and principal-principal problems among influential shareholders remained largely overlooked in behavioral agency studies on family firms. We clarified how family-based socioemotional considerations affect the temporal and cross-sectional aggregation of prospective innovation gamble returns in divergent ways, and how the involvement of hedge funds undercuts the aggregation rules adopted by family blockholders. By integrating myopic loss aversion and multiple agency concepts, we were able to develop a deeper understanding of innovation output choices and, in doing so, enriched the behavioral agency lens on family firm decision-making.

Practical Implications

Our results provide valuable insights for practice. We investigated ownership-induced variance in innovation output in the form of citation-weighted patents. From a societal perspective, as well as for most (diversified) investors, the pursuit of radical innovation outcomes is generally desirable given their technological and economic impact (Block et al., 2013). In view of our finding on the negative effect of family ownership on this innovation output measure, policy-makers concerned with spurring radical innovation in the business sector may consider putting limits on the power and influence of family blockholders in listed firms; for instance, the use of dual class shares by family blockholders, which is quite common, may be restricted or made contingent on innovation-relevant provisions.

Furthermore, prior work highlights that external governance in the form of hedge fund activism sanctions corporate misbehavior and renders companies more efficient and shareholder-value minded (Brav et al., 2008; Gilson & Gordon, 2013). Interestingly, our study reveals that – in the setting of corporations with active family ownership – such hedge fund activism is largely ineffective in boosting radical innovation due to the offsetting principal-principal conflicts it engenders. This implies that family firm stakeholders interested in raising innovation performance cannot rely on this external governance vehicle, and need to resort to other governance tools such as, for example, appointing influential external board members affiliated with leading innovative firms (Bammens et al., 2011; Cannella et al., 2015).

Limitations and Future Research

Our model employs several behavioral concepts and mechanisms without measuring these. These refer to family-based socioemotional considerations (family control and family dynasty) and the associated aggregation rules applied in mental accounting (cross-sectional and temporal aggregation). While family influence is commonly used as a proxy for socioemotional decision considerations when analyzing panel data on publicly traded firms (e.g., Gomez-Mejia et al., 2014, 2018; Kotlar et al., 2018), we encourage future work to include direct measures of these explanatory behavioral constructs. One promising route for these types of firms would be to perform a text analysis on documents that are disclosed across time, such as annual reports with CEO letters, to verify the relative frequency of words that correspond with particular socioemotional and aggregation mechanisms or to use more sophisticated machine learning techniques for such text analysis.

The inferences drawn from our study are based on a sample of U.S. publicly traded firms, which has an impact on the generalizability of our findings since the regulatory standards in the U.S. are favorable for hedge fund activists (Clifford, 2008). Although this was desirable to analyze the impact of ownership heterogeneity in our study, future research would benefit from studying the impact of ownership heterogeneity in other institutional contexts. A comparative study between the U.S. and the European Union, for example, would inform the debate regarding the impact of legislation. Moreover, the short-term market pressures that are so characteristic for U.S. listed firms may influence our empirical findings; indeed, firms listed on a stock exchange in another institutional setting may be less subject to short-term pressures.

In addition, our study focused on activism exercised by hedge funds, with strategic objectives and incentive structures that are quite different from those of other (institutional) investors. We provide evidence that the impact of ownership cannot be adequately modeled in isolation, and more work is needed to develop a holistic framework capable of accounting for the complex distribution of power among multiple influential shareholder types (e.g., pension funds, mutual funds, corporate investors, state ownership), which characterizes the ownership landscape in many economies. Especially for studying the impact of family ownership on radical innovation choices, it is important to have a clearer understanding of how behavioral decision mechanisms are affected by the broader ownership configuration beyond hedge funds. This promises to be a fruitful avenue for future research.

We employed a binary indicator of active family ownership and did not assess the family's involvement in the management team. The adopted operational GMI definition of family firms (which also covers board membership of family owners; cf. supra) aligns well with our prime interest in analyzing how the presence of large and active family blockholders, in combination with other active investors, shapes the innovation output choice, and various prior family business studies have used a similar binary approach (e.g., Gomez-Mejia et al., 2003, 2014, 2019; Cannella et al., 2015; Keasey et al., 2015; Kotlar et al., 2018). Our reported robustness test using family voting percentages were reassuring, but we did not measure family vote shares for those firms that were identified as non-family firms by GMI (zero values were imputed for those firms), resulting in measurement error. It would also be interesting to be able to differentiate between the role of family ownership (our main interest) and that of family management. We therefore encourage future work, with more sophisticated measures of family ownership and management, to perform such robustness and follow-up tests.

Similarly, it would be interesting to account for the business family's investment portfolio beyond the focal firm. In this piece, we argued that families typically have disadvantages in cross-sectional aggregation due to their concentrated ownership position, but potential benefits in temporal aggregation due to their long holding period and dynastic ambitions. This suggests that, in relation to radical innovation outputs, there may be an optimal balance – one in which the family can aggregate innovation gambles across a sufficiently large number of firms while maintaining adequate control and involvement in these firms to be able to pursue a meaningful dynastic agenda (i.e., without becoming a transient retail investor). This requires future research to look beyond the level of a single firm and instead to analyze the broader investment portfolio of business families.

Citation-weighted patents have become a best practice measure among scholars studying innovation output (Acharya & Subramanian, 2009; Aghion et al., 2013), yet the measure comes with limitations. Although this measure addresses many of the shortcomings of mere patent counts as a proxy for economically and technologically important innovation output, it fails to cover radical innovations that are protected by other means than patenting such as secrecy or first-mover advantage. For family firms, socioemotional considerations may affect the use of intellectual property as a protection mechanism (Chirico et al., 2020). If family firms are more inclined to protect their innovations by means of secrecy, for example, we likely underestimate their impact on radical innovation output. Thus, we believe that future research would benefit from the use of complementary measures of radical innovation output.

Lastly, we aimed to investigate variance in firm-level strategic choices (*intentions*) to pursue radical high-risk, high-mean innovations while accounting for R&D budgets; i.e., the extent to which R&D investments are targeted at radical innovation outputs with greater economic and technological importance (Block et al., 2013). This strategic choice perspective is anchored in our BAM theoretic lens, combining insights from prospect theory and multiple agency theory. However, we cannot rule out that our results partly capture differences in firms' *abilities* to attain radical innovation outputs. When controlling for R&D spending, realized radical innovation outcomes (or lack thereof) can reflect both a firm's strategic choice to pursue high-risk, high-return projects and its in-house capabilities to achieve those outcomes with the allocated budget. Past choices (e.g., on hiring particular R&D profiles) also shape current capabilities. We call for future research, for example using a resource-based or dynamic capabilities lens (Barney, 1991; Teece, 2014), to extend our study by untangling these choice versus capability processes.

REFERENCES

Acharya, V. V., & Subramanian, K. V. (2009). Bankruptcy Codes and Innovation. *Review of Financial Studies*, *22*(12), 4949-4988.

Aghion, P., Van Reenen, J., & Zingales, L. (2013). Innovation and Institutional Ownership. *American Economic Review*, *103*(1), 277-304.

Alexander, L. & Van Knippenberg, D. (2014). Teams in pursuit of radical innovation: A goal orientation perspective. *Academy of Management Review, 39*(4), 423-438.

Allcock, D., & Filatotchev, I. (2010). Executive incentive schemes in initial public offerings: The effects of multiple-agency conflicts and corporate governance. *Journal of Management*, *36*(3), 663-686.

Allen, M. P., & Panian, S. K. (1982). Power, performance, and succession in the large corporation. *Administrative Science Quarterly*, *27*(4), 538–547.

Anderson, R. C., Duru, A., & Reeb, D. M. (2012). Investment policy in family controlled firms. *Journal of Banking & Finance, 36*(6), 1744-1758.

Anderson, R. C., & Reeb, D. M. (2003). Founding-family ownership and firm performance: Evidence from the S&P 500. *The Journal of Finance, 58*(3), 1301-1328.

Arthurs, J. D., Hoskisson, R. E., Busenitz, L. W., & Johnson, R. A. (2008). Managerial agents watching other agents: Multiple agency conflicts regarding underpricing in IPO firms. *Academy of Management Journal*, *51*(2), 277-294.

Bammens, Y., Hünermund, P., & Andries, P. (2022). Pursuing gains or avoiding losses: The contingent effect of transgenerational intentions on innovation investments. *Journal of Management Studies*, 59(6): 1493-1530.

Bammens, Y., Voordeckers, W., & Van Gils, A. (2011). Boards of directors in family businesses: A literature review and research Agenda. *International Journal of Management Reviews*, *13*(2), 134–152.

Barker, V. L., & Mueller, G. C. (2002). CEO Characteristics and Firm R&D Spending. *Management Science*, *48*(6), 782-801.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Bauer, R., Moers, F., & Viehs, M. (2015). Who Withdraws Shareholder Proposals and Does It Matter? An Analysis of Sponsor Identity and Pay Practices. *Corporate Governance: An International Review*, *23*(6), 472-488.

Baysinger, B., & Hoskisson, R. E. (1989). Diversification Strategy and R&D Intensity in Multiproduct Firms. *Academy of Management Journal*, *32*(2), 310-332.

Becht, M., Franks, J., Mayer, C., & Rossi, S. (2009). Returns to Shareholder Activism: Evidence from a Clinical Study of the Hermes UK Focus Fund. *Review of Financial Studies*, *22*(8), 3093-3129.

Benartzi, S., & Thaler, R. (1995). Myopic loss aversion and the equity premium puzzle. *Quarterly Journal of Economics*, *110*(1), 73-92.

Benartzi, S., & Thaler, R. (1999). Risk aversion or myopia? Choices in repeated gambles and retirement investments. *Management Science*, *45*(3), 364-381.

Berrone, P., Cruz, C., & Gomez-Mejia, L (2012). Socioemotional wealth in family firms: Theoretical dimensions, assessment approaches, and agenda for future research. *Family Business Review*, *25*(3), 258-279.

Blind, K., Cremers, K., & Mueller, E. (2009). The influence of strategic patenting on companies' patent portfolios. *Research Policy*, *38*(2), 428–436.

Block, J., Miller, D., Jaskiewicz, P., & Spiegel, F. (2013). Economic and technological importance of innovations in large family and founder firms: An analysis of patent data. *Family Business Review*, *26*(2), 180-199.

Boyson, N. M., & Mooradian, R. M. (2011). Corporate governance and hedge fund activism. *Review of Derivatives Research*, *14*(2), 169-204.

Brav, A. (2009). Hedge Fund Activism: A Review. *Foundations and Trends in Finance*, *4*(3), 185–246.

Brav, A., Jiang, W., Ma, S., & Tian, X. (2018). How does hedge fund activism reshape corporate innovation? *Journal of Financial Economics*, *130*(2), 237-264.

Brav, A., Jiang, W., Partnoy, F., & Thomas, R. (2008). Hedge fund activism, corporate governance, and firm performance. *The Journal of Finance*, *63*(4), 1729-1775.

Briggs, T. W. (2007). Corporate governance and the new hedge fund activism: An empirical analysis. *Journal of Corporation Law*, *32(4)*, 681-738.

Brinkerink, J., & Bammens, Y. (2018). Family influence and R&D spending in Dutch manufacturing SMEs: The role of identity and socioemotional decision considerations. *Journal of Product Innovation Management*, *35*(4), 588-608.

Bromiley, P. (2010). Looking at prospect theory. *Strategic Management Journal*, *31*(12), 1357-1370.

Bushee, B. J. (1998). The influence of institutional investors on myopic R&D investment behavior. *Accounting Review*, *73*(3), 305-333.

Calabrò, A., Vecchiarini, M., Gast, J., Campopiano, G., De Massis, A. & Kraus, S. (2019). Innovation in family firms: A systematic literature review and guidance for future research. *International Journal of Management Reviews*, *21*(3), 317-355.

Cannella, A., Jones, C., & Withers, M. (2015). Family- versus lone-founder-controlled public corporations: Social identity theory and boards of directors. *Academy of Management Journal*, *58* (2), 436-459.

Carney, M., Van Essen, M., Gedajlovic, E. R., & Heugens, P. P. (2015). What do we know about Private Family Firms? A Meta-Analytical Review. *Entrepreneurship Theory and Practice*, *39*(3), 513-544.

Carney, M., Zhao, J., & Zhu, L. (2019). Lean innovation: Family firm succession and patenting strategy in a dynamic institutional landscape. *Journal of Family Business Strategy*, 10(4): 100247

Carree, M., Lokshin, B., & Alvarez-Alvarez, H. (2019). Technology partnership portfolios and firm innovation performance: Further evidence. *Journal of Engineering and Technology Management*, *54*, 1–11.

Chaney, P. K., & Devinney, T. M. (1992). New product innovations and stock price performance. *Journal of Business Finance & Accounting*, *19*(5), 677-695.

Chang, X., & Dasgupta, S. (2009). Target behavior and financing: How conclusive is the evidence? *The Journal of Finance*, *64*(4), 1767–1796.

Chen, H.-L., & Hsu, W.-T. (2009). Family Ownership, Board Independence, and R&D Investment. *Family Business Review, 22*(4), 347-362.

Chirico, F., Criaco, G., Baù, M., Naldi, L., Gomez-Mejia, L. R., & Kotlar, J. (2020). To patent or not to patent: That is the question. Intellectual property protection in family firms. *Entrepreneurship Theory and Practice*, *44*(2), 339-367.

Chrisman, J. J., Chua, J. H., De Massis, A., Frattini, F., & Wright, M. (2015). The Ability and Willingness Paradox in Family Firm Innovation: Family Firm Innovation Future Agenda. *Journal of Product Innovation Management*, *32*(3), 310-318.

Chrisman, J., & Patel, P. (2012). Variations in R&D investments of family and nonfamily firms: Behavioral agency and myopic loss aversion perspectives. *Academy of Management Journal, 55*(4), 976-997.

Chua, J. H., Chrisman, J. J., & Sharma, P. (1999). Defining the family business by behavior. *Entrepreneurship: Theory and Practice, 23*(4), 19–39.

Cirillo, A., Ossorio, M., & Pennacchio, L. (2019). Family ownership and R&D investment: The moderating role of banks and private equity. *Management Decision*, 57(7), 1675-1694.

Clifford, C. P. (2008). Value creation or destruction? Hedge funds as shareholder activists. *Journal of Corporate Finance*, *14*(4), 323-336.

Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics*, *79*(2), 431–468.

Connelly, B., Hoskisson, R., Tihanyi, L., & Certo, S. (2010a). Ownership as a form of corporate governance. *Journal of Management Studies*, *47*(8), 1561-1589.

Connelly, B., Tihanyi, L. Certo, S., & Hitt, M. (2010b). Marching to the beat of different drummers: The influence of institutional owners on competitive actions. *Academy of Management Journal*, *53*(4), 723-742

Craig, J. B., & Moores, K. (2006). A 10-Year longitudinal investigation of strategy, systems, and environment on innovation in family firms. *Family Business Review*, *19*(1), 1-10.

Croce, A., & Marti, J. (2016). Productivity growth in private-equity-backed family firms. *Entrepreneurship Theory and Practice*, 40(3), 657-683.

Cucculelli, M., Le Breton-Miller, I., & Miller, D. (2016). Product innovation, firm renewal and family governance. *Journal of Family Business Strategy*, 7(2), 90-104.

Dahlin, K. B., & Behrens, D. M. (2005). When is an invention really radical?: Defining and measuring technological radicalness. *Research Policy*, *34*(5), 717-737.

Daily, C. M., & Dollinger, M. J. (1993). Alternative methodologies for identifying family-versus nonfamily-managed businesses. *Journal of Small Business Management*, *31*(2), 79-90.

David, P., O'Brien, J. P., & Yoshikawa, T. (2008). The implications of debt heterogeneity for R&D investment and firm performance. *Academy of Management Journal*, *51*(1), 165-181.

Decker, C. & Günther, C. (2017). The impact of family ownership on innovation: evidence from the German machine tool industry. *Small Business Economics, 48*(1), 199–212

De Massis, A., Frattini, F., & Lichtenthaler, U. (2013). Research on technological innovation in family firms: Present debates and future directions. *Family Business Review*, *26*(1), 10-31.

Duran, P., Kammerlander, N., van Essen, M., & Zellweger, T. (2016). Doing More with Less: Innovation Input and Output in Family Firms. *Academy of Management Journal, 59*(4), 1224-1264.

Fernando, G., Schneible, R., & Suh, S. (2014). Family firms and institutional investors, *Family Business Review*, *27*(4), 328-345.

Filatotchev, I., Zhang, X., & Piesse, J. (2011). Multiple agency perspective, family control, and private information abuse in an emerging economy. *Asia Pacific Journal of Management*, *28*(1), 69-93.

Gilson, R. J., & Gordon, J. N. (2013). The agency costs of agency capitalism: Activist investors and the revaluation of governance rights. *Columbia Law Review*, *113*(4), 863-927.
Goel, R. K. (1999). *Economic models of technological change: Theory and application*. Quorum Books.
Gomez-Mejia, L., Larraza-Kintana, M., & Makri, M. (2003). The determinants of executive compensation in family-controlled public corporations. *Academy of Management Journal, 46*(2), 226–237.
Gomez-Mejia, L., Haynes, K. T., Núñez-Nickel, M., Jacobson, K. J., & Moyano-Fuentes, J. (2007). Socioemotional wealth and business risks in family-controlled firms: Evidence from Spanish olive oil mills. *Administrative Science Quarterly*, *52*(1), 106–137.
Gomez-Mejia, L., Campbell, J., Martin, G., Hoskisson, R., Makri, M., & Sirmon, D. (2014). Socioemotional wealth as a mixed gamble: Revisiting family firm R&D investments with the behavioral agency model. *Entrepreneurship Theory and Practice, 38*(6), 1351-1374.
Gomez-Mejia, L., Cruz, C., Berrone, P., & De Castro, J. (2011). The bind that ties: Socioemotional wealth preservation in family firms. *Academy of Management Annals*, *5*(1), 653-707.
Gomez-Mejia, L., Neacsu, I., & Martin, G. (2019). CEO risk-taking and socioemotional wealth: The behavioral agency model, family control, and CEO option wealth. *Journal of Management, 45*(4), 1713-1738.
Gomez-Mejia, L., Patel, P., & Zellweger, T. (2018). In the horns of the dilemma: Socioemotional wealth, financial wealth, and acquisitions in family firms. *Journal of Management, 44*(4), 1369-1397.
Grabowski, H., & Vernon, J. (1990). A new look at the returns and risks to pharmaceutical R&D. *Management Science*, *36*(7), 804-821.
Graves, S. B., & Waddock, S. A. (1990). Institutional ownership and control: Implications for long-term corporate strategy. *Academy of Management Perspectives*, *4*(1), 75-83.
Greene, W. H. (2012). *Econometric analysis* (7th ed). Boston: Prentice Hall.
Hall, B. H., Jaffe, A. B., & Trajtenberg, M. (2001). *The NBER patent citation data file: Lessons, insights and methodological tools (No. w8498)*. National Bureau of Economic Research.
Harhoff, D., Narin, F., Scherer, F. M., & Vopel, K. (1999). Citation frequency and the value of patented inventions. *Review of Economics and Statistics*, *81*(3), 511-515.
He, Z. L., Qiu, J., & Tang, T. (2014). Hedge Fund Activism and Corporate Innovation. *SSRN Electronic Journal*.
Hoskisson, R. E., Arthurs, J. D., White, R. E., & Wyatt, C. (2013). *Multiple Agency Theory*. In The Oxford handbook of corporate governance.
Hoskisson, R., Hitt, M., Johnson, R., & Grossman, W. (2002). Conflicting voices: The effects of institutional ownership heterogeneity and internal governance on corporate innovation strategies. *Academy of Management Journal*, *45*(4), 697-716.
Hu, Q., & Hughes, M. (2020). Radical innovation in family firms: a systematic analysis and research agenda. *International Journal of Entrepreneurial Behavior & Research*, 26(6), 1199-1234.
Jacobs, M. T. (1991). *Short-term America: The causes and cures of our business myopia.* Harvard Business School Press.
Jaffe, A. B., Trajtenberg, M., & Henderson, R. (1993). Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *The Quarterly Journal of Economics, 108*(3), 577-598.
Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*(2), 263-291.
Katila, R. (2000). Using patent data to measure innovation performance. *International Journal of Business Performance Management*, *2*(1-3), 180-193.
Keasey, K., Martinez, B., & Pindado, J. (2015). Young family firms: Financing decisions and the willingness to dilute control. *Journal of Corporate Finance*, *34*, 47–63.
Klein, A., & Zur, E. (2009). Entrepreneurial shareholder activism: Hedge funds and other private investors. *The Journal of Finance*, *64*(1), 187-229.

Klein, A., & Zur, E. (2011). The Impact of Hedge Fund Activism on the Target Firm's Existing Bondholders. *Review of Financial Studies, 24*(5), 1735-1771.

Kogan, L., Papanikolaou, D., Seru, A., & Stoffman, N. (2017). Technological innovation, resource allocation, and growth. *The Quarterly Journal of Economics, 132*(2), 665-712.

König, A., Kammerlander, N., & Enders, A. (2013). The family innovator's dilemma: How family influence affects the adoption of discontinuous technologies by incumbent firms. *Academy of Management Review*, 38(3), 418-441.

Kotlar, J., Signori, A., De Massis, A., & Vismara, S. (2018). Financial wealth, socioemotional wealth and IPO underpricing in family firms: A two-stage gamble model. *Academy of Management Journal, 61*(3), 1073-1099.

Kutner, M. H., Nachtsheim, C., Neter, J., & Li, W. (2005). *Applied linear statistical models* (Vol. 4). Chicago: Irwin.

Le Breton-Miller, I., & Miller, D. (2006). Why Do Some Family Businesses Out-Compete? Governance, Long-Term Orientations, and Sustainable Capability. *Entrepreneurship Theory and Practice, 30*(6), 731-746.

Le Breton-Miller, I., Miller, D., & Lester, R. (2011). Stewardship or agency? A social embeddedness reconciliation of conduct and performance in public family businesses. *Organization Science*, *22*(3), 704-721.

Lee, P. M. & O'Neill, H. M. (2003). Ownership Structures and R&D Investments of U.S. and Japanese Firms: Agency and Stewardship Perspectives. *Academy of Management Journal, 46*(2), 212-225.

Leppäaho, T., & Ritala, P. (2022). Surviving the coronavirus pandemic and beyond: Unlocking family firms' innovation potential across crises. *Journal of Family Business Strategy*, 13(1), 100440.

Lerner, J. (1994). The Importance of Patent Scope: An Empirical Analysis. *The RAND Journal of Economics*, *25*(2), 319-333.

Loss, L., & Seligman, J. (2004). *Fundamentals of securities regulation*, 5th ed. Aspen Publishers.

Lumpkin, G. & Brigham, K. (2011). Long-term orientation and intertemporal choice in family firms. *Entrepreneurship Theory and Practice*, *35*(6), 1149-1169.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance*, *7*(1), 77-91.

Martin, G., Gomez-Mejia, L., & Wiseman, R. (2013). Executive stock options as mixed gambles: Revisiting the behavioural agency model. *Academy of Management Journal, 56*(2), 451-472.

Matzler, K., Veider, V., Hautz, J., & Stadler, C. (2015). The Impact of Family Ownership, Management, and Governance on Innovation: Family Influence on Innovation. *Journal of Product Innovation Management*, *32*(3), 319-333.

Maury, B., & Pajuste, A. (2005). Multiple large shareholders and firm value. *Journal of Banking & Finance, 29*(7), 1813-1834.

McCahery, J. A., Sautner, Z., & Starks, L. T. (2016). Behind the Scenes: The Corporate Governance Preferences of Institutional Investors: Behind the Scenes. *The Journal of Finance, 71*(6), 2905-2932.

Memili, E., Fang, H. C., & Welsh, D. H. (2015). Value creation and value appropriation in innovation process in publicly-traded family firms. *Management Decision*, 53(9), 1921-1952.

Michel, A., Ahlers, O., Hack, A., & Kellermanns, F. (2020). Who is the king of the hill? On bargaining power in private equity buyouts. *Long Range Planning*, 53(2), 101859.

Miller, D., Le Breton-Miller, I., & Lester, R. H. (2013). Family firm governance, strategic conformity, and performance: Institutional vs. Strategic perspectives. *Organization Science, 24*(1), 189–209.

Miller, D., Le Breton-Miller, I., & Scholnick, B. (2008). Stewardship vs. Stagnation: An Empirical Comparison of Small Family and Non-Family Businesses. *Journal of Management Studies, 45*(1), 51–78.

Munari, F., Oriani, R., &Sobrero, M. (2010). The effects of owner identity and external governance systems on R&D investments: A study of Western European Firms. *Research Policy, 39*(8), 1093-1104.

Neckebrouck, J., Meuleman, M., & Manigart, S. (2021). Governance implications of attracting external equity investors in private family firms. *Academy of Management Perspectives*, 35(1), 25-44.

Nieto, M., Santamaria, L. & Fernandez, Z. (2015). Understanding the Innovation Behavior of Family Firms. *Journal of Small Business Management, 53*(2), 382–399.

OECD report (2015). The Impact of R&D Investment on Economic Performance: A Review of the Econometric Evidence. *OECD,* 1-45. https://one.oecd.org/document/DSTI/EAS/STP/NESTI(2015)8/en/pdf

Pástor, Ľ., & Veronesi, P. (2009). Technological Revolutions and Stock Prices. *American Economic Review*, *99*(4), 1451–1483.

Patel, P., & Chrisman, J. (2014). Risk abatement as a strategy for R&D investments in family firms. Strategic Management Journal, 35(4), 617-627.

Popp, D., Juhl, T., & Johnson, D. K. N. (2004). Time In Purgatory: Examining the Grant Lag for U.S. Patent Applications. *Topics in Economic Analysis & Policy*, *4*(1).

Porter, M. E. (1992). Capital disadvantage: America's failing capital investment system. *Harvard Business Review*, *70*(5), 65-82.

Röd, I. (2016). Disentangling the family firm's innovation process: A systematic review. *Journal of Family Business Strategy,* 7(3), 185-201.

Sacristan-Navarro, M., Cabeza-Garcia, L. & Gomez-Anson, S. (2015). The company you keep: The effect of other large shareholders in family firms. *Corporate Governance: An International Review, 23*(3), 216-233.

Sacristan-Navarro, M. Gomez-Anson, S., & Cabeza-Garcia, L. (2011). Family ownership and control, the presence of other large shareholders, and firm performance: Further evidence. *Family Business Review*, *24*(1), 71-93.

Sekerci, N., Jaballah, J., van Essen, M., & Kammerlander, N. (2022). Investors' Reactions to CSR News in Family Versus Nonfamily Firms: A Study on Signal (In)credibility. *Entrepreneurship Theory and Practice*, *46*(1), 82–116.

Soluk, J., Miroshnychenko, I., Kammerlander, N., & De Massis, A. (2021). Family influence and digital business model innovation: the enabling role of dynamic capabilities. *Entrepreneurship Theory and Practice*, 45(4), 867-905.

Teece, D. (2014). The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms. *Academy of Management Perspectives, 28*(4), 328-352.

Thaler, R., Tversky, A., Kahneman, D., & Schwartz, A. (1997). The effect of myopia and loss aversion on risk taking: An experimental test. *The Quarterly Journal of Economics*, *112*(2), 647-661.

Tsao, S., & Lien, W. (2013). Family management and internationalization: The impact on firm performance and innovation. *Management International Review*, 53, 189–213.

Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty 5,* 297–323.

Wang, Y., & Zhao, J. (2015). Hedge funds and corporate innovation. *Financial Management*, *44*(2), 353-385.

Wiseman, R. & Gomez-Mejia, L. (1998). A behavioral agency model of managerial risk taking. *Academy of Management Review, 23*(1), 133-153.

Wright, M. (2017). Innovation and ownership variety. *Innovation: Organization & Management*, 19(1), 74-79.

Zenner, M., Gosebruch, H., & Berkovitz, T. (2010). *Hedge fund activists 2.0: They are back. Creating value through pro-active strategies in response to hedge fund activism*, JP Morgan.

Zenner, M., Junek, E., Ventresca, C., & Hunker, D. (2015). *The activist revolution: Understanding and navigating a new world of heightened investor scrutiny*, JP Morgan.

TABLES AND FIGURES

Table 1. Means, Standard Deviations, and Pearson Correlation Matrix

		Mean	**STD**	A	B	C	D	E	F	G	H
Citation-weighted patents	A	1.538	2.064								
Hedge fund activism$_{t-4}$	B	0.111	0.354	**– 0.089**							
Family firm	C	0.103	0.303	**– 0.162**	– 0.004						
R&D$_{t-4}$	D	3.419	2.189	**0.775**	**– 0.103**	**– 0.098**					
Age$_{t-4}$	E	3.501	0.946	**0.108**	**– 0.093**	**0.131**	**0.134**				
Size$_{t-4}$	F	0.000	0.185	– 0.004	0.030	0.000	0.043	0.006			
Tobin's Q$_{t-4}$	G	3.807	0.342	**– 0.275**	**– 0.058**	0.006	**– 0.42**	**– 0.165**	**– 0.082**		
Current ratio$_{t-4}$	H	1.156	0.145	– 0.019	– 0.012	– 0.004	**– 0.151**	**– 0.185**	**– 0.045**	**0.561**	
Return on assets$_{t-4}$	I	39.624	107.707	**0.302**	**– 0.043**	– 0.037	**0.364**	**0.132**	**0.098**	**– 0.435**	**– 0.175**

Note: In this table, we present the means, standard deviations, and correlations. Bold formatting indicates significance at the 5% level.

Table 2. Panel Data Random Effects Estimates

	Model 1				Model 2			
	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value
Citation Weighted Patents								
Intercept	0.818	0.499	1.641	0.101	0.820	0.503	1.630	0.103
Family Firm	-0.530	0.176	-3.009	0.003 **	-0.518	0.181	-2.867	0.004 **
Hedge Fund Activism$_{t-4}$	0.079	0.014	5.557	< 0.001 ***	0.086	0.013	6.883	< 0.001 ***
Hedge Fund Activism$_{t-4}$ × Family Firm					-0.116	0.039	-2.987	0.003 **
R&D$_{t-4}$	0.438	0.024	18.116	< 0.001 ***	0.438	0.024	18.077	< 0.001 ***
Age$_{t-4}$	0.077	0.015	5.266	< 0.001 ***	0.077	0.015	5.304	< 0.001 ***
Sales$_{t-4}$	0.283	0.030	9.332	< 0.001 ***	0.283	0.031	9.279	< 0.001 ***
Tobin's Q$_{t-4}$	-0.028	0.040	-0.692	0.489	-0.028	0.039	-0.705	0.481
Return on assets$_{t-4}$	0.000	0.000	0.654	0.513	0.000	0.000	0.658	0.511
Current ratio$_{t-4}$	0.411	0.117	3.512	< 0.001 ***	0.410	0.118	3.484	< 0.001 ***
Year Dummies	Yes				Yes			
Industry Dummies (SIC Code)	Yes				Yes			
Observations	N=2601				N=2601			
Adjusted R^2	0.35				0.35			

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 3. Robustness Test: Panel Data Random Effects Estimates (Lagged DV)

	Model 3				Model 4			
	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value
Citation Weighted Patents								
Intercept	0.518	0.263	1.970	0.049 *	0.519	0.262	1.979	0.048 *
Citation Weighted Patents$_{t-4}$	0.514	0.043	12.094	< 0.001 ***	0.514	0.043	12.070	< 0.001 ***
Family Firm	-0.259	0.153	-1.697	0.090 †	-0.246	0.160	-1.536	0.125
Hedge Fund Activism$_{t-4}$	0.044	0.025	1.739	0.082 †	0.052	0.027	1.892	0.059 †
Hedge Fund Activism$_{t-4}$ × Family Firm					-0.117	0.052	-2.265	0.024 *
R&D$_{t-4}$	0.276	0.039	7.038	< 0.001 ***	0.276	0.039	7.040	< 0.001 ***
Age$_{t-4}$	-0.002	0.018	-0.140	0.889	-0.002	0.017	-0.118	0.906
Sales$_{t-4}$	0.143	0.022	6.569	< 0.001 ***	0.143	0.022	6.518	< 0.001 ***
Tobin's Q$_{t-4}$	-0.079	0.022	-3.598	< 0.001 ***	-0.080	0.022	-3.581	< 0.001 ***
Return on assets$_{t-4}$	0.000	0.000	1.337	0.181	0.000	0.000	1.340	0.180
Current ratio$_{t-4}$	0.539	0.065	8.287	< 0.001 ***	0.539	0.064	8.424	< 0.001 ***
Year Dummies	Yes				Yes			
Industry Dummies (SIC Code)	Yes				Yes			
Observations	N=2601				N=2601			
Adjusted R^2	0.69				0.69			

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 4. Robustness Test: Panel Data Random Effects Estimates (Lag 5)

	Model 5				Model 6			
	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value
Citation Weighted Patents								
Intercept	0.378	0.467	0.810	0.418	0.364	0.467	0.780	0.436
Family Firm	-0.585	0.121	-4.840	< 0.001 ***	-0.571	0.121	-4.720	< 0.001 ***
Hedge Fund Activism$_{t-5}$	0.014	0.034	0.400	0.687	0.020	0.034	0.580	0.560
Hedge Fund Activism$_{t-5}$ × Family Firm					-0.150	0.020	-7.530	< 0.001 ***
R&D$_{t-5}$	0.486	0.032	15.030	< 0.001 ***	0.486	0.032	14.970	< 0.001 ***
Age$_{t-4}$	0.068	0.012	5.890	< 0.001 ***	0.068	0.011	5.980	< 0.001 ***
Sales$_{t-5}$	0.285	0.014	19.830	< 0.001 ***	0.286	0.015	19.550	< 0.001 ***
Tobin's Q$_{t-5}$	0.001	0.125	0.010	0.991	0.002	0.124	0.020	0.988
Return on assets$_{t-5}$	0.000	0.000	1.460	0.144	0.000	0.000	1.460	0.143
Current ratio$_{t-5}$	0.526	0.106	4.960	< 0.001 ***	0.532	0.108	4.920	< 0.001 ***
Year Dummies	Yes				Yes			
Industry Dummies (SIC Code)	Yes				Yes			
Observations	N=1892				N=1892			
Adjusted R^2	0.40				0.40			

† $p < 0.10$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 5. Robustness Test: Panel Data Random Effects Estimates (R&D Not Winsorized)

	Model 7				Model 8			
	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value
Citation Weighted Patents								
Intercept	0.842	0.488	1.725	0.085 †	0.845	0.493	1.715	0.086 †
Family Firm	-0.569	0.163	-3.493	< 0.001 ***	-0.556	0.168	-3.315	< 0.001 ***
Hedge Fund $\text{Activism}_{t\text{-}4}$	0.079	0.014	5.607	< 0.001 ***	0.086	0.012	6.961	< 0.001 ***
Hedge Fund $\text{Activism}_{t\text{-}4}$ × Family Firm					-0.113	0.043	-2.610	0.009 **
$\text{R\&D}_{t\text{-}4}$	0.436	0.025	17.670	< 0.001 ***	0.436	0.025	17.643	< 0.001 ***
$\text{Age}_{t\text{-}4}$	0.078	0.015	5.232	< 0.001 ***	0.078	0.015	5.270	< 0.001 ***
$\text{Sales}_{t\text{-}4}$	0.282	0.029	9.642	< 0.001 ***	0.282	0.029	9.584	< 0.001 ***
Tobin's $Q_{t\text{-}4}$	-0.028	0.040	-0.691	0.489	-0.028	0.039	-0.704	0.481
Return on $\text{assets}_{t\text{-}4}$	0.000	0.000	0.809	0.418	0.000	0.000	0.813	0.416
Current $\text{ratio}_{t\text{-}4}$	0.407	0.116	3.502	< 0.001 ***	0.407	0.117	3.477	< 0.001 ***
Year Dummies	Yes				Yes			
Industry Dummies (SIC Code)	Yes				Yes			
Observations	N=2601				N=2601			
Adjusted R^2	0.35				0.35			

† p < 0.10; * p< 0.05; ** p< 0.01; *** p< 0.001

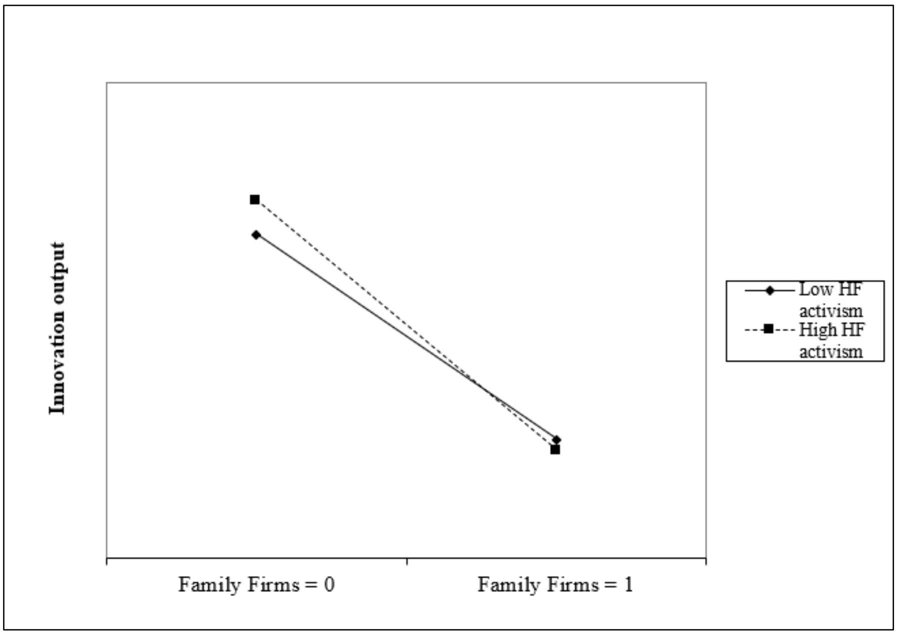

Figure 1. Interaction of Family Blockholders and Hedge Fund Activism on Innovation Output

APPENDIX 1

Table A1. Robustness Test: Panel Data Random Effects Estimates

	Panel a (family voting share %)								Panel b (30% voting share threshold)							
	Model 1				Model 2				Model 1 (Threshold 30%)				Model 2 (Threshold 30%)			
	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value
Citation Weighted Patents																
Intercept	0.832	0.493	1.687	0.092 †	0.832	0.492	1.690	0.091 †	0.856	0.488	1.753	0.080 †	0.853	0.488	1.747	0.081 †
Family Firm	-0.008	0.002	-3.714	< 0.001 ***	-0.008	0.002	-3.422	< 0.001 ***	-0.285	0.134	-2.132	0.033 *	-0.277	0.138	-2.001	0.046 *
Hedge Fund Activism$_{t-4}$	0.079	0.014	5.663	< 0.001 ***	0.085	0.014	5.966	< 0.001 ***	0.079	0.014	5.723	< 0.001 ***	0.084	0.014	5.948	< 0.001 ***
Hedge Fund Activism$_{t-4}$ × Family Firm					-0.002	0.000	-4.526	< 0.001 ***					-0.114	0.041	-2.745	0.006 **
R&D$_{t-4}$	0.438	0.024	18.115	< 0.001 ***	0.438	0.024	18.014	< 0.001 ***	0.440	0.026	17.053	< 0.001 ***	0.440	0.026	17.077	< 0.001 ***
Age$_{t-4}$	0.072	0.012	6.037	< 0.001 ***	0.072	0.012	6.142	< 0.001 ***	0.066	0.013	4.909	< 0.001 ***	0.066	0.013	5.011	< 0.001 ***
Sales$_{t-4}$	0.286	0.031	9.231	< 0.001 ***	0.285	0.031	9.278	< 0.001 ***	0.284	0.030	9.374	< 0.001 ***	0.284	0.030	9.384	< 0.001 ***
Tobin's Q$_{t-4}$	-0.032	0.040	-0.783	0.434	-0.032	0.040	-0.806	0.420	-0.033	0.036	-0.914	0.361	-0.033	0.036	-0.927	0.354
Return on assets$_{t-4}$	0.000	0.000	0.648	0.517	0.000	0.000	0.650	0.516	0.000	0.000	0.655	0.513	0.000	0.000	0.658	0.511
Current ratio$_{t-4}$	0.405	0.119	3.411	< 0.001 ***	0.406	0.119	3.400	< 0.001 ***	0.397	0.123	3.218	0.001 **	0.399	0.124	3.212	0.001 **
Year Dummies	Yes				Yes				Yes				Yes			
Industry Dummies (SIC Code)	Yes				Yes				Yes				Yes			
Observations	N=2601				N=2601				N=2601				N=2601			
Adjusted R^2	0.35				0.35				0.35				0.35			

† p < 0.10; * p< 0.05; ** p< 0.01; *** p< 0.001

APPENDIX 2

Table A2. Robustness Test: Tobit Random Effects Estimates (BHHH maximisation)

	Panel a (family firm dummy)								Panel b (family voting share %)							
	Model 1				Model 2				Model 1				Model 2			
	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value
Citation Weighted Patents																
Intercept	-2.961	1.183	-2.504	0.012 *	-3.059	0.564	-5.426	< 0.001 ***	-3.221	1.146	-2.811	0.005 **	-3.194	0.565	-5.657	< 0.001 ***
Family Firm	-0.969	0.136	-7.097	< 0.001 ***	-0.439	0.068	-6.490	< 0.001 ***	-0.021	0.003	-6.285	< 0.001 ***	-0.006	0.001	-4.525	< 0.001 ***
Hedge Fund Activism$_{t-4}$	0.171	0.088	1.935	0.053 *	0.136	0.044	3.115	0.002	0.173	0.088	1.978	0.048 *	0.131	0.044	2.986	0.003 **
Hedge Fund Activism$_{t-4}$ × Family Firm					-2.426	1.294	-1.875	0.061 †					-0.048	0.023	-2.069	0.039 *
R&D$_{t-4}$	0.711	0.017	41.852	< 0.001 ***	0.556	0.009	63.484	< 0.001 ***	0.703	0.016	43.261	< 0.001 ***	0.556	0.009	63.243	< 0.001 ***
Age$_{t-4}$	-0.100	0.048	-2.091	0.036 *	0.092	0.023	3.949	< 0.001 ***	-0.098	0.047	-2.083	0.037 *	0.088	0.023	3.854	< 0.001 ***
Sales$_{t-4}$	0.157	0.055	2.871	0.004 **	0.268	0.026	10.133	< 0.001 ***	0.175	0.051	3.429	< 0.001 ***	0.270	0.027	10.093	< 0.001 ***
Tobin's Q$_{t-4}$	0.012	0.198	0.061	0.952	-0.025	0.093	-0.269	0.788	0.016	0.193	0.085	0.932	0.013	0.092	0.146	0.884
Return on assets$_{t-4}$	0.001	0.000	1.770	0.077 †	0.000	0.000	0.606	0.545	0.001	0.000	1.802	0.072 †	0.000	0.000	0.985	0.325
Current ratio$_{t-4}$	0.655	0.266	2.465	0.014	0.783	0.130	6.049	< 0.001 ***	0.722	0.263	2.744	0.006 **	0.755	0.131	5.759	< 0.001 ***
Year Dummies	Yes				Yes				Yes				Yes			
Industry Dummies (SIC Code)	Yes				Yes				Yes				Yes			
Observations	N=2601				N=2601				N=2601				N=2601			
Left-censored	1319				1319				1319				1319			
Uncensored	1282				1282				1282				1282			
Right-censored	0				0				0				0			

† p < 0.10; * p< 0.05; ** p< 0.01; *** p< 0.001

APPENDIX 3

Table A3. Robustness Test: Panel Data Random Effects Estimates – Excluding Low R&D Intensive Industries (OECD)

	Panel a (family firm dummy)								Panel b (family voting share %)							
	Model 1				Model 2				Model 1				Model 2			
	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value	Estimate	Std. Error	t-Statistic	p-Value
Citation Weighted Patents																
Intercept	-3.358	0.671	-5.006	< 0.001 ***	-3.306	0.692	-4.778	< 0.001 ***	-2.067	0.941	-2.198	0.028 *	-2.070	0.940	-2.202	0.028 *
Family Firm	-0.101	0.009	-11.100	< 0.001 ***	-0.070	0.010	-7.223	< 0.001 ***	-0.005	0.002	-2.470	0.014 *	-0.005	0.002	-2.309	0.021 *
Hedge Fund Activism$_{t-4}$	0.021	0.020	1.036	0.300	0.045	0.019	2.370	0.018 *	0.061	0.033	1.854	0.064 †	0.065	0.032	2.044	0.041 *
Hedge Fund Activism$_{t-4}$ × Family Firm					-0.321	0.106	-3.026	0.003 **					-0.001	0.000	-3.533	< 0.001 ***
R&D$_{t-4}$	0.555	0.008	72.866	< 0.001 ***	0.555	0.007	74.371	< 0.001 ***	0.404	0.014	28.061	< 0.001 ***	0.403	0.015	27.795	< 0.001 ***
Age$_{t-4}$	0.125	0.015	8.461	< 0.001 ***	0.127	0.015	8.499	< 0.001 ***	0.140	0.046	3.045	0.002 **	0.141	0.046	3.072	0.002 **
Sales$_{t-4}$	0.366	0.040	9.238	< 0.001 ***	0.364	0.041	8.890	< 0.001 ***	0.305	0.047	6.448	< 0.001 ***	0.305	0.047	6.476	< 0.001 ***
Tobin's Q$_{t-4}$	0.024	0.077	0.309	0.757	0.023	0.079	0.292	0.770	-0.133	0.083	-1.596	0.111	-0.132	0.083	-1.596	0.111
Return on assets$_{t-4}$	0.000	0.000	0.668	0.504	0.000	0.000	0.656	0.512	0.000	0.000	0.906	0.365	0.000	0.000	0.902	0.367
Current ratio$_{t-4}$	0.913	0.086	10.605	< 0.001 ***	0.878	0.093	9.459	< 0.001 ***	0.370	0.252	1.470	0.142	0.369	0.256	1.443	0.149
Year Dummies	Yes				Yes				Yes				Yes			
Industry Dummies (SIC Code)	Yes				Yes				Yes				Yes			
Observations	N=1192				N=1192				N=1192				N=1192			
Adjusted R^2	0.66				0.66				0.30				0.30			

† p < 0.10; * p< 0.05; ** p< 0.01; *** p< 0.001