KEEPING IT IN THE FAMILY: DOES ULTIMATE FIRM CONTROL, TECHNOLOGICAL INTENSITY AND THE FINANCING CONSTRAINTS MATTER FOR FIRMS' R&D SMOOTHING STRATEGY?

Dr. Androniki Triantafylli
Associate Professor in Accounting
Alba Graduate Business School
The American College of Greece
E-mail: atriantafylli@alba.acg.edu

Ms. Zeenat Murtaza
PhD student
School of Business and Management, Queen Mary University of London
Email: p.vijayakumar@qmul.ac.uk

Abstract

This research examines the effect of ultimate firm control on dampening the volatilities in R&D investments. Using data of French publicly listed firms, we use the ultimate individual or family controlling shareholder data of firms exercising direct or indirect control (through other firms or through wedges which is usually achieved through voting rights agreements or through dual class shares). Based on this interaction between the family and the business that strongly affect the decision of managing and deploying available resources, we explore the relation (if any) exists between the ultimate family control and R&D smoothing using cash holdings and how this effect differs from the widely held firms. This analysis centres on the family-controlled firms' incentives for risk aversion in the presence of financing constraints while exhibiting a comparatively higher potential for maintain a smooth path of R&D investments when sufficiently higher cash reserves are available. Consistent with the loss-aversion framework and the resource-based viewpoint, we estimated the dynamic panel data model using two-step system GMM and find that the family-controlled firms potentially devote less cash holdings to smoothen the flow of R&D investments compared to the non-family firms. However, they prefer to invest more cash in R&D when they are less financially constrained. Furthermore, we hypothesize that the varying intensities of ultimate firm control and the financing constraints have a potentially different impact on family-firms' R&D smoothing strategy using cash reserves compared to non-family firms. The results support this hypothesis and also lend credence to the notion that technologically intensive non-family firms and technological intensive family-controlled firms with low control intensity undergo higher R&D smoothing using cash reserves compared to high control intensity family-firms in the presence of financing constraints.

Keywords

Ultimate firm control; Innovation; R&D smoothing; Cash holdings; Family control; Financing constraints.

Introduction

This research investigates whether the family-controlled firms use cash reserves to smoothen the flow of R&D investments such that the objective of firms' sustainable growth is ensured. Often studied at the firm level, the research scholars in corporate finance literature claim that the investments in innovation are inherently important to a firm to achieve competitiveness, survivability, and growth in today's dynamic and competitive business environment (Carnes & Ireland, 2013; Brown & Petersen, 2011; Kellermanns & Eddleston, 2006). In this respect, some research studies also evidenced a sharp rise in the R&D investments of publicly listed firms during the last few decades (He & Wintoki, 2016; Brown & Petersen, 2011). Yet, regardless of this growing significance of R&D, these claims have only recently started to gain an increased scholarly attention among the family business scholars (Chrisman & Patel, 2012; Gomez-Mejia et al., 2014). Indeed, the family business literature identifies that family firms are distinct organizational structures with unique characteristics that greatly affect their choices of engaging in and managing their R&D investments (Duran et.al., 2016). That is, on one hand, the research findings may exhibit that the family firms are significant yet traditional forms of organizations that are risk averse and resistant to invest in innovation due to undiversified wealth (Block, 2012; Chrisman & Patel, 2012). An alternative perspective also exists that holds the family businesses to be relatively more flourishing, and growth focused with long-term investment horizons since they are intended to be transferred to the succeeding generations (Ayyagari, et.al., 2011; Anderson, et. al., 2003; Anderson & Reeb, 2003). Hence, this viewpoint, on the other hand, may find support for the family firms' higher investments in innovation as it may help these firms preserve their dynasty and superior performance in the long run.

Certainly, the burgeoning nature of family business literature yielded fruitful insights into the family firms' R&D investments, much of the existing work on family firms evolved as a conflicting portrayal of family businesses. That is, whether the family firms are conservative or paragons of innovation; risk takers or the bastions of the family firms' socioeconomic wealth. Besides this inconclusiveness about the family ownership effects on the firms' R&D investments, the literature on family firms also lacks important evidence on the significance of R&D smoothing for the family firms' financial policies. However, as Brown & Petersen (2011) and others (e.g. He & Wintoki, 2016; Mikkelson & Partch, 2003) exhibit, R&D investments are an integral part of the cash holding decisions for a vast majority of publicly traded firms. So considering this research gap in the family business literature, this study makes an important argument for the effect of family control in maintaining a stable flow of R&D investments given their preferences for liquidity management. In other words, it examines the impact that the family firms' controlling power and their preference for cash reserves can have in buffering the flow of R&D from financing constraints. This conceptualization of family firms' R&D investments and their liquidity management policies helps answer: "is it that the family firms' cash reserves have a role to play in smoothing the flow of R&D investments?". Thus, this research tests the strategic consequences of family firms cash levels to offer new insights into the value of liquidity across family-controlled firms and helps deepen an understanding into the unexplored implications of family firms' R&D investments for their cash holding policies.

The contribution of this report to the existing family business literature is threefold: First, to the best of knowledge at hand, the prior research in family business literature mainly emphasized the role of family ownership in determining family firms' R&D investments (e.g. Block, 2012; Duran et.al., 2016; Sciascia et.al., 2015) or the influence of family ownership on family firms' cash levels (e.g. Anderson & Hammadi, 2016; Liu et.al., 2015). This study, however, will take a comparatively different perspective by identifying the R&D smoothing perspective of liquidity management across the family-controlled firms which is a growing yet an unaddressed concern in the family business literature. The significance of this untapped research area of R&D smoothing across family businesses is mainly because of their widespread global occurrence[1], their distinctive characteristics and their varying risk behaviours that greatly shape their strategic decision making. In this regard, numerous studies unsurprisingly attributed the divergences across family businesses to the diversities in family leadership, ownership, their preferences for socioeconomic and financial goals and the firms' legal framework (Amore et al., 2017; Chua et al., 2018; Miller & Miller, 2020). So, using a sample data of French publicly listed family-controlled firms from 1997 to 2021, this study helps conceptualize the ultimate firm control (rather than the ownership merely in terms of the shareholding% of individual or family investor) variable in an R&D smoothing model to assess whether the controlling families in family businesses decide to use their cash reserves for R&D investments in order to escape the risk of survival. Or, whether they retain those cash reserves as failed R&D investments are likely pose an immediate risk to the family firms' financial and non-financial gains. Correspondingly, this study also intends to unravel the financing constraints and technological intensity in explaining the effect of cash levels on the family-controlled firms' R&D investments as both the family firms and R&D investments are frequently associated with financing constraints. Thus, while the family-controlled firms avoid the issuance of equity in the fear of losing firm control and the dilution of ownership stakes, this research evaluates the impact of financing restrictions on the utilization of cash holdings. Lastly, on account of the positive association between the family firms' ownership concentration and the firms' cash levels, this study also attempts to assess whether the different intensities of control help determine any differences in the utilization of family-firms' cash levels for a continuous and smooth flow of R&D over time that may resultantly help seek and encourage innovation across a large business sector of family-controlled firms.

[1] Aminadav & Papaioannou (2020) reported approx. 46% firms around the globe to be held by individuals and families. Likewise, Anderson and Reeb (2003) evidenced U.S. family firms to outperform the non-family firms by 6.65% in terms of ROA while 10% in terms of Tobin's q value. Villalonga & Amit (2009), likewise, documented support for the 12% Tobin's q of family-owned firms relative to a 2% value for non-family firms.

Second, the choice of using the sample data of French publicly listed family-controlled firms will add up to the existing literature as family firms constitute a widespread occurrence in the Western European countries[2] (Amore et.al., 2017; Anderson & Reeb, 2003) and particularly among those countries that follow the French civil law legal system. This finding was also recognised by Aminadav & Papaioannou (2020) since they emphasize the French civil law countries to capture 25-30% higher share of controlled firms than the common-law countries. And that these controlled-entities were found to be even more deeply rooted in French market as France is assumed to be the cradle of French civil-law legal system. Reportedly, the recent literature also showed that the French market constitute a sizeable market of unique listed firms (i.e. more than double the size of firms belonging to other Western European French civil law countries) and among them appr. 30% firms were family controlled. This shows that the French firms will not only contribute to a larger sample size for the proposed study but also offer a perfect coverage of family-firms. Moreover, the market capitalization of family firms has also been shown to exceed the market value of all publicly listed French firms by 75%. In a similar manner, the family firms in French market also illustrated comparatively longer business lifecycles. This finding was validated by Carnes & Ireland (2013), Franks et. al., (2012) & Miller et. al. (2007) who exhibited that the ownership structures of families are highly concentrated in European market, particularly in France, and that these firms usually get inherited onto their next generations as they grow older. In view of this, the historic data revealed that the firms in European market are expected to remain family-controlled throughout their life. This characteristic of family firms in France helps gather a sizeable sample data for GMM estimation. However, if we compare this likelihood with common law countries, the findings revealed that over time the probability of a family firm to remain a family firm reduces in common-law countries like UK wherein this likelihood is significantly lower than the French firms (Franks et. al., 2012). Additional evidence from EY Family Business Index[3] revealed that more than half of the most innovative large European firms are controlled by families. So, because the EY Family Business Index also reported a vast majority of all the family businesses listed on the index to be Europe based with a significant proportion from the French market, this study assumes the French publicly listed firms to be a suitable sample to study R&D smoothing across family firms.

Accompanying this international evidence on the lifecycle of family ownership, the legal origin of French family firms has also been reported to present some important implications for the institutional and the regulatory characteristics of capital markets. In this context, prior literature widely demonstrated that the differences in legal origins are significantly important as firms from diverse legal origins have varying dependence on the different sources of finance available for the firm growth. For instance, Doucet & Requejo (2022) recently reported that the firms operating in a civil law environment are more dependent on their cash flows for the growth of firm. Likewise, their findings also suggested the beneficial effects of family control to be more pronounced in countries where the external lenders are more protected by the firms' institutional environment. Also, different legal origins have also been found to differently impact the shareholders' rights protection mechanisms (Djankov et. al., 2003). Some legal scholars, in this connection, like Roe (2006) have also attempted to emphasize the linkage between an interventionist state and the civil law. Their findings revealed that in civil law countries like France, the state or government has strict control over the product, labour, and capital markets. Furthermore, a comparative review of civil law countries like France and common law regulatory system like UK suggested that the dispute resolution in common law countries involve vigorous law implementation whereas in civil law economies, there is an increasing inclination towards policy implementation over the market. (La Porta, et.al., 2006). These differences in regulatory environments likely impact the firm's governance mechanisms, shareholders rights protection (Donelli et.al., 2013), the strategic decision making (Lins et.al., 2013), and the disclosure rules (Xu, 2021).

[2] Western European countries include Austria, Belgium, Cyprus, Denmark, Faroe Islands, Finland, France, Germany, Gibraltar, Greece, Iceland, Ireland, Isle of Man, Italy, Jersey, Liechtenstein, Luxembourg, Monaco, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland & UK. Source: Aminadav & Papaioannou (2020).

[3] https://familybusinessindex.com/

Other salient features of French market include their strict disclosure requirement of voting rights. This characteristic is of particular importance for the proposed study as the classification of family firms in this research is based on the voting rights control of shareholders[4]. Likewise, the French market is also interesting and distinctive for its double voting rights privilege that is given by the French law to the shareholders of the firm. This right is notably significant as it serves as an important mechanism to help shareholders enhance their control rights over the firm. According to this, a double right of voting can be assigned to fully paid-up shares if they have been registered in the name of same shareholder for a continuous period of at least two years. So, for the proposed analysis, the double voting rights of shareholders will be taken into account as this, from a research perspective, may help accurately determine the status of a firm as family controlled (shares with different voting rights or shareholders in a mutual voting rights agreement may help some firms qualify the voting rights threshold which resultantly widens the family firm's data). Likewise, from the shareholders perspective, the accordance of double voting rights may lead the various shareholders to deviate their interests from personal to the common interests of the firm; thereby influencing the firms' decisions to incentivize firm survival and growth in the long run.

To formally examine this family firms' R&D smoothing with cash levels and to answer the proposed research questions, it is also imperative to develop an in-depth understanding on the family businesses and their associated dynamics. This is primarily because of the rapidly emerging family business literature that establish a wide-ranging and a continuously evolving defining criterion for the identification of firms as family controlled. These advancements in family firms' defining criteria may though have been shown to inform the readers of the continuous revisions in family business classification. However, there is no consensus on an exact definition of family firms, and it may even seem challenging in future as some definitions are broader in scope while others are comparatively restrictive. To resolve this paradox, Anderson et. al. (2003), however, made an effort to rationalize the expanding characterization of family firms which suggested the developments in defining criteria to correspond to a wide range of components like ownership, management, governance, ultimate control etc. that help distinguish these firms from the non-family ones. So in light of this rationale, the proposed research hinges on a definition (Aminadav & Papaioannou, 2020) that helps characterize family firms on the basis of voting rights rather than merely classifying them on the basis of ownership stakes. We purposely choose this definition of family firms to study the control effects of family members on the firms' decision making through their voting rights which is comparatively more appealing than ownership stakes to study family members control[5]. Their classification characterizes a firm as family controlled if the firm's ultimate control is in the hands of an individual shareholder or a group of related shareholders or family members that are controlled by same ultimate owner. Further, this definition specifies a minimum threshold of voting rights for a firm to be classed as family controlled such that the direct voting rights of the ultimate family owner exceed the absolute 20% voting-rights threshold criteria. This classification using voting rights threshold is purposely chosen as the voting rights control is not only a commonly accepted definition in the family business literature (e.g. Villalonga & Amit, 2006; Sraer & Thesmar, 2007; Faccio & Lang, 2002) but also a better predictor and a pure control for shareholders to exercise their decision-making power (Aminadav & Papaioannou, 2020; Faccio, et. al., 2011). Besides, looking at voting rights is conceptually more meaningful as voting rights serve as a measure of control rights; an important channel through which the shareholders can exert a significant impact on the firm policy, firm value, and hostile takeover possibilities (Schmid et.al., 2014, Chua et.al., 1999; Stulz, 1988). Shleifer & Vishny (2012) also highlighted that the large shareholders exercise their governing power using voting rights to dictate the decisions of the firm. So for this reason, this research study uses a definition of family firms that helps analyse how the firms decisions are shaped by family members.

[4] The French Commercial code mandates all beneficial owners, who either acquire or sell the company's capital or voting rights of 5% or in excess of it, to declare their rights simultaneously to the company and to the French regulatory body "*Autorité des Marchés Financiers*" (AMF) within the five business days of crossing the thresholds; the non-compliance of which may entail some serious consequences and penalties for the shareholders like suspension from exercise of voting rights power for 2 years under constitutional provision.

[5] Influential studies on family businesses like Villalonga & Amit (2006), Kellermanns & Eddleston (2006), Faccio & Lang (2002) and Lins & Servaes (2002) also used voting rights for family firms classification.

With regards to methodology, this quantitative study employs changes in cash holdings and the family ownership variable in the dynamic R&D specification to examine the family firms' cash utilization for R&D smoothing. In line with Brown & Petersen (2011) approach, the R&D regression also includes some financial measures like cash flows, debt issues, market to book ratio, sales growth and stock issues that serves to control the various determinants of R&D at the firm level. Moreover, this study also follows prior research in estimating R&D regression with a generalised method of moments (GMM) approach that helps address the potential endogeneity issues in the proposed model. The future directions of this research will consider studying the impact of other governance variables and their distinctive roles in influencing family firms' cash management for smoothing the flow of R&D investments. That is, the prospective chapters will analyse how the board structures and the effectiveness of board monitoring and advisory roles through measures like board background knowledge & skills, board term duration, board attendance, board member affiliations and board cultural and gender diversity influence this relationship of R&D smoothing with cash levels. The analysis of these possible research questions makes France an interesting context as French firms are observed to practice various control enhancing mechanisms like double voting rights together with an option of a unitary (comprises of board of directors) and a two-tier board formula which may yield varying implications for the R&D smoothing decisions of French family firms.

1. Literature Review

2.1 Definition of Family-Firms Ownership & Control structures

A prominent stream of research on family firms demonstrated a wide-ranging and a continuously evolving defining criterion that helps characterize a firm as family controlled. For instance, Allen & Panian (1982) define a family firm as an organization where the members of a descendent group and their affine hold or control at least 5 percent of the voting shares and represent as a director on the board (Miller et. al., 2007). In 1988, Holderness & Sheehan viewed a family firm as a concern owned by an individual shareholder or an entity who retains at least 50.1 percent of the firm's stock while Morck, et.al. (1988) accounted a firm as family owned if the founding family member is amongst the top two officers. Denis & Denis (1994) deemed an organization as a family firm if either its founders serve as an officer or two or more of its family members act as the directors or officers of the firm. McConaughy et al. (1998), however, reckoned a family firm as any company that is run by a founder or the member of the founding family.

La Porta et al. (1999) regarded family firms as those entities who are controlled by ultimate shareholders and who's direct and indirect voting rights exceed 20 percent. Likewise, Lansberg (1999) characterize a typical family business as an organization that is controlled and often managed by multiple family members while Ang, et.al. (2000) describe a family firm as the one where a single-family controlling more than 50% of the firm's shares. Claessens et al. (2002) elucidated these firms as entities that are held by a group of people who are connected either by blood or by marriage and who have large ownership stakes in the firm. Faccio & Lang (2002), however, distinguished family-firms on the basis of ultimate ownership such that either the family or an individual or an unlisted company on any stock exchange is the ultimate owner and that they possess either the cash flow rights or the control rights in excess of 20 percent.

In another study, Cronqvist & Nilsson (2003) designated family firms as organizations who are owned by founder families that may involve either a single person or group of individuals having close ties but do not belong to the same family. Similarly, Anderson & Reeb (2004) identify those firms as family-controlled organizations where the founding family holds fractional equity ownership and/or where the family members serve as the directors on the board (Miller et. al., 2007). Barontini & Caprio (2005), on the other hand, explained these firms as those comprising of a largest shareholder who hold at least 10 percent of the ownership rights and either the largest shareholder or the family controlling it hold more than 51 percent of the direct voting rights or they control more than double the second largest shareholder's direct voting rights (Miller et. al., 2007). Similarly, Barth, et.al. (2005) specified family firms as businesses in which the founding family or the founder owns at least 33 percent of the firm's shares.

Luo & Chung (2005) used the term family firm for those entities that are created by an entrepreneur and where the key leader has an inner circle of either the immediate family members or the people with prior social relationships like business partners, classmates, colleagues, distant relatives, friends, and in-laws (Miller et. al., 2007). Fahlenbrach (2009), however, categorized a firm as family owned if its CEO is either the founder or the co-founder of the firm. Another definition outlines family firms as businesses in which the largest controlling shareholder is either a family, an individual or an unlisted firm holding at least 10% of the firm's voting rights (Maury, 2006). Villalonga & Amit (2006), on the other hand, segregated family firms based on the founder or a family member who acts either as an officer or director of the firm or the one who owns more than 5 percent of the firm's equity. Subsequently, Perez-Gonzalez (2006) highlighted family firms as later generational businesses among two or more individuals who are connected by a blood relationship or those where the founder serves as a director, a shareholder or the chief executive of the company and they hold at least 5 percent ownership in the firm (Bebchuk, et.al., 2009).

Furthering these studies, Huang et. al. (2015) provided a comprehensive categorization for family-firms as organizations where the founding family members are either among the top executives or directors or shareholders holding significant equity stakes in the firm. Besides, their classification of family firms also mentioned the differences between the founder firms and the scion firms wherein the founding family firms were observed to contain an active involvement of founding family members in the business while scion firms encompassed family members other than the founders to be actively engaged in the business. Comparably, the study of Le Breton-Miller & Miller (2008) also demonstrated a distinction between the "lone founder businesses" wherein no family member of the firm's founder participates in the business (e.g. Microsoft), and the "family founder businesses" such as Comcast that comprise of founder and other family members serving as managers or owners of the firm.

More recently, Aminadav & Papaioannou (2020) categorized family control in a way that a shareholder or group of shareholders are controlled by an identical ultimate owner such that their direct voting rights exceed the absolute 20% voting-rights threshold criteria. However, in cases where the shareholders belong to the same family, the voting rights of all those shareholders are aggregated to determine the cumulative voting rights of the same family. Although, these developments in family firms' definitions delineated the frequent evolution with scholars constantly offering updates on what constitutes a family firm, no formal consensus has been made to date on an exact definition of family firms.

For proposed research, the study will consider a recent definition of family firms as employed by Aminadav & Papaioannou (2020); the justification of which is shared in the previous section.

2.2 Unique Characteristics of Family Firms:

Family firms represent some of the world's most innovative and the widely occurred businesses among the privately held and the publicly traded firms in the world (Duran et.al., 2016; Villalonga & Amit, 2006; La Porta et.al., 1999). Moreover, these organizational structures are modelled universal and prominent form of corporate control for their various distinguishing traits that certainly help differentiate them from the non-family or the widely held entities (Burkart et.al., 2003). Amongst their numerous characteristics, one of the most unique features of family firms relates to the concentrated ownership and the voting rights of family members that unquestionably gives them the authority to significantly impact and shape the firm's financial and investment decisions (Bunkanwanicha, et.al., 2013; Anderson & Reeb, 2003; Shleifer & Vishny, 1997). Moreover, these firms also differ from non-family firms in their governance and succession patterns.

A comprehensive investigation on family-firms revealed that the various explanations on family firms and their distinguishing traits have their roots embedded not only in theory but also in practice. These clarifications further guided the researchers to recognise these firms as a unique and a heterogeneous class of large shareholders who not only have a strong voice in the firm's decision making but also have powerful

motives (e.g. long-term orientation, transferring business to the succeeding generations etc.) to run the family business (Anderson, et. al., 2003). Due to this complex interplay between the family and the family business, these firms possess some distinctive traits. For instance,

i. Concentrated Ownership & Control Rights

One of the most striking and unique feature of family firms is the concentrated ownership and the voting rights of family members and their jurisdiction to frequently hold governance and leadership positions that help controlling families exert a significant impact in shaping the firm's financial decisions (Shleifer & Vishny 1997; Bunkanwanicha, et. al., 2013). As an illustration, Jiang et.al. (2020) highlighted that those family firms where the family members hold board chairs decide to invest more in R&D compared to family firms where the family members do not occupy family chairs. This difference in R&D intensity is primarily because of the reason that holding board chairs gives family owners the direct control rights over the firm which reduces their eventual concerns towards the potential losses to their socioemotional wealth. Likewise, family firms also differ in their debt maturity and leverage ratios from the non-family businesses (Chen et.al., 2014) while the ownership concentration of families has been shown to have a positive association with the cash holdings of the firm (Anderson & Hammadi, 2016).

ii. Family Members' Consideration for Economic & Non-economic goals

Another important characteristic of family firm is their considerations for the economic and non-economic goals (Anderson & Reeb, 2003; Leenders & Waarts, 2003; Miller & Le Breton-Miller, 2006). For example, on one hand, the families focus may be the financial sustainability of the firm which may serve as a central economic objective of any firm. The controlling families, on the other hand, may also be equally thoughtful and considerate about the family firm's underlying goals like the preservation of family-rule and longevity. These non-economic considerations in turn are likely to stimulate the shareholders to subordinate their personal interests to the organizational goals and bring a sense of common identity, loyalty, and commitment among them in order to pursue the overall business goals (Kim & Gao, 2013). Resultantly, these distinguished values of family firms and the strategic influences of controlling family members give rise to a unique blend of idiosyncratic business strategies that are considered to be significantly important in achieving a multitude of benefits (e.g. trustworthiness, quality networking, loyalty, and commitment).

iii. Long-term Survival & Reputation concerns

The family businesses are believed to be comparatively more concerned about the firm's long-term survival and reputation as the controlling families intend to pass their firms further onto their succeeding generations (Anderson & Reeb, 2003). In this regard, the findings of Ayyagari et. al. (2011) exhibited that family firms have a greater inclination to invest in R&D as these investments are used as a proxy for long-term orientation of a firm. This perspective also implies the significant benefits of large, concentrated shareholders in maximizing the firm value since the controlling shareholders' wealth is closely tied to the family business they control (Anderson et.al., 2012).

iv. Risk Aversion

Besides the family firms' preferences for survival in the long run, these businesses have also been shown to be risk aversive primarily because of their undiversified business nature which has been shown to create an impact on the investment preferences of concentrated shareholders. That is, due to the fact that the shareholders concentrate their wealth in the family business, the large undiversified shareholders may prefer to avoid risk and make investments in low-risk projects compared to high-risk investment opportunities with higher returns (Shleifer & Vishny, 1986). These findings were furthered by Anderson et. al. (2012) who argued that family members have a strong influence in mitigating firm-specific risks through the choice of their investments. This, henceforth, suggests that yet the controlling families of family firms are committed to long-term orientation, sustainable growth and survival of business, their

undiversified business nature however reveal potentially opposing risk aversive effects. And, because the R&D investments are highly volatile and risky in nature due to the uncertainty of their outcomes, the family firms may show reluctance to invest in them.

2. Theoretical Framework & hypotheses development

From a theoretical viewpoint, the existing literature on family businesses developed and extended various theories to resolve the paradox of family firms' innovation. For example, the behavioural agency framework of family firms' innovation (Chrisman & Patel, 2012), a variant of agency theory, described family firms' underinvestment in research and development (R&D), however, this theory falls short to explain the significant presence of innovative family businesses throughout the globe. In contrast, the resource-based viewpoint (Barney, 2001) aimed to explain the various benefits of resource orchestration across the family businesses (Sirmon, et.al., 2011), yet it does not account for predicting the family firms' low levels of investments in innovation.

To unravel these conflicting perspectives on family firms' innovation, the theoretical and hypotheses development section of this research begins with emphasizing the unique and differentiating characteristics of family firms. In this respect, the recent academic literature established that family-firms are distinct from the non-family businesses in terms of the families' high levels of controlling rights, their increased wealth concentration in the business, their significant emphasis towards the firms' non-financial goals and their greater potential for the firms' long-term investment horizons. So, by virtue of this relatively greater concentration of wealth of controlling families in the family enterprise, the conventional agency theory assumes the family firms to be risk-averse in their strategic decision making. This theory also implies that family firms make lower financial investments in high-risk investment projects as they carry higher chances of loss/ failure and poor results which may eventually damage the collective welfare and the repute of the family (Carney et.al., 2013; Mishra & McConaughy, 1999).

Whilst illustrating the idiosyncratic and the peculiar characteristics of family businesses and their preferences for risky investments, the family business literature laid great emphasis on family firms' investments in R&D as an innovation input that constitute one of the many risky choices (e.g. internationalization) made by the firms. The findings from these studies revealed that unlike other investment projects, the family firms usually underinvest in R&D due to the unique and distinctive features of R&D investments. For instance, unlike capital (i.e. property, plant, and equipment) and financial assets, the R&D investments have been linked with critical financing challenges due to the high risks and uncertainty associated with R&D outcomes (Brown & Petersen, 2011). Likewise, the R&D projects have been found to be relatively unusual, idiosyncratic, and unique in nature (Aboody & Lev, 2000) as they usually require specific scientific expertise and intensive human capital (Hall and Lerner, 2010) for which the controlling families may need to rely on outside expertise. This resultantly makes it difficult for the family firms to raise financing from external sources as external financing may result in a loss or weakening of family control over the firm. Hence, the family firms usually find themselves at a disadvantage for making R&D investments (Munoz-Bullon & Sanchez-Bueno, 2011).

In line with the family firms reluctance or limited accessibility to external funding sources, the family businesses are also likely to cut down their R&D expenses in case of a temporary finance shock which may resultantly leads to the loss of skilled workers and important proprietary information. This evidence thus gathers support for the higher risks associated with R&D investments in shape of greater adjustment costs (He & Wintoki, 2016). To summarize these assumptions of behavioural agency model, it can hence be inferred that the relatively conservative financial policies of family firms (low debt levels and high liquidity) and the inherently risky and uncertain nature of R&D investments makes families less inclined towards allocating their limited financial resources to the innovation projects (De Massis et al., 2013; Block, 2012; Chrisman & Patel, 2012; Munari et al., 2010).

An extension to this framework later integrates the behavioural agency model with the prospect theory (Kahneman and Tversky, 1979) which helps develop an in-depth understanding into the

socioeconomic wealth perspective (SEW) of family firms (Gomez-Mejia et al., 2007). In line with the SEW framework, the decision makers across family firms have been described to have varying risk preferences and behaviours which may likely be dependent on some reference point or on the context of decision being faced. So by virtue of this, the family firms' decision makers are assumed to be relatively more motivated and concerned to preserve the socioeconomic wealth of the family that resultantly makes them more risk averse. In other words, the family firms' decision makers are likely to be more considerate for the firms' non-financial aspects to meet the affective needs of the family (e.g. family's identity, the continuation of family influence and the preservation of family dynasty over generation) which makes the family owners more evaluative and cautious in their decisions as risky decisions are likely to not only create a negative impact on the tradition, culture, and the legacy of family firms (De Massis et al., 2016), but may also reduce family control over the firm (Gomez-Mejia et al., 2007, 2010; Berrone et al., 2012). This theory, henceforth, favours the family firms' preference for non-financial utilities like family legacy and reputation over the financial objectives when they perceive a threat to their SEW (Fang et.al., 2021; Sciascia, et.al., 2015).

Nevertheless, the literature asserts the underinvestment of family firms in R&D projects due to the risky nature of R&D, these investments on the other hand have also been recognised by literature as performance enhancing mechanisms and the crucial driver of firms' productivity and growth that eventually helps ensure the firms' superior performance, competitiveness, and long-term survival (Brown & Petersen, 2011). So on one side, there is a research stream that concludes the family firms to be risk and loss averse as they exhibit an underinvestment pattern in R&D investments, another strand of research however concludes these firms to be comparatively more innovative than the other forms of ownership structures (Ayyagari, et.al., 2011). Moreover, despite the empirical evidence on family firms' conservative, risk and loss aversive behaviours, these firms have been revealed to be the third largest economic contributor to the world by revenues (after US and China). Some research findings also documented family businesses to be superior performers than the other forms of organizational control (e.g. Anderson and Reeb, 2003). This, hence, makes family firms' R&D investment choices an open question given the rising significance of R&D investments in today's competitive environment.

To explain this outperformance of family firms, the family business scholars have presented some opposing arguments to the above stated agency theory assumptions which support the effective monitoring mechanisms across the family firms (Chrisman et al., 2004). Prior research argued that the influential role of family members in the firms' strategic decision making makes them committed to effectively monitor family firms which in turn helps reduce the asymmetric information issues and agency costs arising from the separation of ownership and management. Besides, the results revealed that the effective monitoring of family members is also likely to result in overshadowing the family firms' potential for excessive risk avoidance that may eventually poses serious challenges to the family firms (e.g. a decline in the value of family members' equity stakes etc.). In other words, the studies revealed the monitoring benefits across family firms encouraging enough to motivate the family members for making investments in R&D projects which may involve higher risks but may eventually ensure growth, competitiveness, and long-term survival of the firm in the long run. Hence, based on these findings, this study takes into consideration the family firms' long-term goal orientation perspective (aimed to survive, and grow in the long run so that they can be transferred to the succeeding generations) (Aminadav & Papaioannou, 2020) which can primarily be accomplished through investments in R&D projects.

Another explanation by Chrisman & Patel (2012) also present sufficient supportive evidence for the family firms' higher inclination towards the R&D investments. In this vein, their study holds that the family firm's strategic decision making for risky investments is also dependent on their prior performance. So, although the empirical literature assumes the family firms to underinvest in R&D projects (e.g., Kotlar et al., 2014; Chrisman & Patel, 2012; Block, 2012), these otherwise risk-aversive family firms are likely to embrace risky projects in shape of R&D investments when they underperform the industry averages. This henceforth suggests that the family firms' decision-makers are likely to develop a risk-taking behaviour in the face of inferior firm performance, which in otherwise instances may aggravate the negative effects of loss aversion and underperformance on both the economic and the non-economic wealth of the family

business. These arguments also support the long-term orientation objective of family firms and make them a favourable setting for dedicating their resources towards R&D and risk-taking (Sciascia, et.al., 2015).

Furthering this understanding of family firms R&D investments, it is also important to understand the applications of the resource-based view (RBV) model of family firms; the assumptions of which may appear to be a fruitful route for the hypotheses development of our study. This framework suggests that if a firm continuously invest in innovation projects, it creates a fence or a barrier to imitation for its competitors which may leads to a sustainable competitive advantage for the firm (Reed & DeFillippi, 1990; Eddleston et.al., 2008). Indeed, the studies considered the family firms to exhibit a greater potential of growth and success if they invest in innovation (Gudmundson et al., 2003). This, hence, infers the innovative capacity to be a crucial source that can contribute to the attainment of family firms' success, distinctiveness, and superior performance (Zahra et al., 2004). But, given the risky and uncertain nature of R&D investments, the innovation strand of corporate finance literature discussed the funding of these investments to be faced with critical financing constraints.

Berger & Udell (1990) argued that the highly uncertain nature of R&D investments and their limited collateral value makes firms finance these investments primarily through stock issuance and internal sources. In this regard, the research findings of Brown & Petersen (2011) also implied that the U.S. manufacturing firms have an increasing reliance on their cash levels for the smoothing of their R&D investments. However, their study did not take into account the use of cash reserves across family firms which greatly differ from the non-family firms both in characteristics and performance. This accelerated relationship between the cash holdings and the firms' R&D investment was also documented by He & Wintoki (2016) who evidenced the growing cash-to-assets ratio to be particularly persistent and concentrated across the U.S. R&D-intensive firms such that their cash-to-assets ratio multiplied three times approximately since 1980s compared to the less R&D focused firms that reported a stable cash-to-assets ratio over the same period. The findings from this study however also fails to account for the varying ownership and governance structures that significantly influences the firms' preference for risk taking and strategic decision making.

So, in light of these theoretical and empirical foundations, this study aims to fill the gap of R&D smoothing across family firms. It also highlights the recent findings of Anderson & Hammadi (2016) & Liu et. al. (2015) in particular who respectively emphasised the liquidity management policies of family firms across Belgium (known to have a strong control-oriented financial system) and China. Their studies manifested that the firm's cash levels are positively related to the ownership concentration. Moreover, the corporate finance literature also asserts higher cash reserves for the financially constrained firms (e.g., Faulkender & Wang, 2006; Gamba & Triantis, 2008; Bolton et.al., 2011; Malamud & Zucchi, 2019). These findings have their evolutions in the study of Keynes (1936) who illustrated the financing constraints to be interconnected with the liquidity management (Anderson and Hammadi, 2016)

Thus, based on the findings from existing studies and the theoretical framework section, it can be hypothesized that:

H1: Compared to non-family firms, the family-controlled firms become risk averse in the presence of financing constraints while they use greater cash reserves for smoothing the flow of R&D investments when they are less financially constrained.

To understand the effects of ownership and control mechanisms, Anderson and Hamadi (2016) manifested a positive relationship between the firm's cash levels and the ownership concentration. This relationship was found to be markedly influenced by controlling shareholders' high control premium due to which they find the issuance of equity a costly option for the insiders. In a similar manner, Liu et. al. (2015) studied the effects of family control on Chinese firms' cash holding policy. Their research also disclosed that the family firms with excess control rights maintain an increasingly high level of cash reserves. This exhibits that the presence of financing frictions and governance mechanisms greatly influences their liquidity management and financing decisions. The relevance of firms' ownership and

control structures to the firm's cash policies has also been significantly emphasized by Anderson et.al. (2003) who reported these firms to be undiversified in their wealth. So, because the controlling families have their wealth tied up in the firms they control, their stakes in the firms are greatly influenced in case of a liquidity shock compared to the widely held firms that are controlled by diversified shareholders (Lins, Volpin & Wagner, 2013). Also, these firms may find greater incentives to pursue their objectives of technological innovation, firm growth and survival since these firms are an asset to the controlling families that they intend to pass onto their descendants rather than merely keeping it as a wealth that they intend to consume during their lifetime (Anderson and Reeb, 2003). Thus, based on these findings from existing studies, it can be hypothesized that:

H2: With increasing control intensities, family firms' propensity to use cash reserves for smoothing the flow of R&D investments becomes more pronounced in the absence of financing frictions.

A bulk of literature in corporate finance (e.g. Myers & Majluf (1984), Opler et al. (1999), Almeida, Campello & Weisbach (2004), Bates, Kahle & Stulz (2009), Almeida et. al., 2014) extensively emphasized the first order importance of cash management for firms as liquidity management and financing frictions are interconnected issues (Keynes, 1936). This finding has also been established by Almeida et. al. (2004) who concluded a positive trend for firms facing external financing constraints as they assign the fraction of retained cash to both current and future investments. However, for unconstrained firms, their study documented a close to zero sensitivity since these firms invest at their first-best level with no considerations of future cash flows realization. Corresponding to these findings, Bates et. al. (2009) also unravelled a secular growth (i.e. a more than two-fold increase) in the cash levels of U.S. industrial firms during 1980-2006 which was observed to be consistent with the firms' rising cash-flow volatilities, declining capital expenditures and the inclining trends in research and development. This approach of corporate finance research in liquidity management has partially been driven by the ease and financial flexibility of cash reserves due to which the firms have dedicated and ready access to a committed source of funds compared to other sources like equity or debt issuance, the access to which may not be easily and immediately available when the firms need them the most. This predominance of cash holdings in corporate world consequently led Nikolov & Whited (2014) to study the effect of firm size on cash reserves. Their study concluded that small-sized firms are in charge of higher cash levels compared to large sized entities as the former are faced with greater uncertainty than the latter ones. Further studies also attributed the dispersion in cash holdings to the overall deviations in the firm's cash flow riskiness, growth opportunities and its R&D intensity. Guided by these comprehensive investigations, Fresard (2010) and Lyandres & Palazzo (2016) lately focused on the relevance of innovation to financing frictions as R&D investment, being one of the key determinants of growth, has important implications for a firm's cash holding policy. In this context, recent studies established that R&D intensive firms are comparatively more vulnerable to financing frictions and have limited access to external capital market due to the limited collateral value of R&D assets (Brown and Petersen, 2011). That is, on account of the fact that R&D spending usually causes consistent operating losses with no immediate product outcome that could be used as a collateral, the R&D centric firms are particularly faced with greater financing constraints (Malamud & Zucchi, 2019). Based on these findings, it can hence be hypothesized that:

H3: Firms with greater financial constraints use more cash for smoothing the flow of R&D investments.

H4: Compared to hi-tech non-family firms, the hi-tech family-controlled firms increase the smoothing of their R&D investments with the rise in contemporary cash holdings.

H5: Compared to high-control intensity family-firms, the low-control intensity family firms spare higher cash reserves for R&D smoothing when they are faced with greater financing constraints.

3. Methodology & Data Collection

The empirical research uses a deductive approach to investigate the impact of ultimate control, technological intensity and financing constraints on family-firms and non-family firms' use of cash for R&D smoothing. More specifically, this quantitative research employs a panel data of family-controlled and non-family-controlled firms to exploit both the cross-sectional and the time-series variations. For investigating this relationship of ultimate family control, technological intensity and the financing constraints with firms' R&D smoothing, a sample data of French publicly listed firms is used which is then further classified into family-controlled and non-family-controlled firms using definition from the recent family business literature. A detailed explanation of the measurement of family ownership and the ultimate family control, technological intensity, financing constraints and the financial variables together with the classification of ownership data into two different groups i.e., family-controlled firms and non-family-controlled firms is presented in next sections. As explained in earlier literature, R&D investments are highly dynamic and persistent in nature. So, because of this, the study uses an autoregressive distributed lag dynamic panel data model which is estimated using the system generalized method of moments (system GMM) approach to account for the endogeneity and autocorrelation issues. Details of sample data collection process, the measurement of variables used, and the model specifications is given in the next sections.

4.1 Sample Data

The data on family ownership for French firms is mainly extracted for publicly listed companies from Thomson Reuters (TR) Eikon database[6]. This database provides coverage of shareholding percentages of ultimate individual(s) and family investors for only publicly listed firms since 1997. The choice of publicly listed firms is also subject to the fact that these firms follow strict disclosure requirements as imposed by the regulatory authorities which resultantly ensured that accurate voting rights data is collected for the ultimate investors from the company's published documents. That is, based on the ultimate ownership or shareholding information as available in TR database, the voting rights data of these individual investors and families is then manually collected from annual reports and universal registration documents available on the companies' websites and info-financiere.fr[7] for the period 1997 to 2021. Besides, the Euronext Family Business Index has also been reviewed to counter verify the recent status of some of the family businesses listed on the French market[8].

For hypotheses testing, the proposed sample mainly comprises of information for both the surviving and non-surviving firms that are established, headquartered, and listed in France. However, it excludes firms operating in financial, utilities and real estate economic sectors due to their industry specific statutory capital requirements. This resultantly available sample is then segregated into two categories i.e., "***R&D firms***" (firms that report on average a positive R&D expense in the given sample period) and "***No R&D firms***" (firms with no R&D or missing R&D expense in the defined time period). While the proposed study mainly focuses on "***R&D firms***" for statistically analysing the smoothing of R&D investments with cash holdings, the "***No R&D firms***" are only utilized to enhance our understanding of the relative presence of family firms in the French market. In other words, it gives an estimate of the presence of each type of controlling authority (i.e., family-controlled vs non-family controlled based on the 20% voting rights threshold criteria of ultimate individual(s) and family investors) across the sample data and helps assess whether the family-firms outnumber the non-family firms in the French Market.

The sample of French publicly listed firms is also required to report market capitalization, a total assets value (at least $1 million) and at least four cash holding observations. This financial data and the

[6] The database collects information from the respective regulatory authorities, stock exchanges, mutual fund portfolios, share registers, corporate websites, direct company contact, third party vendors and mutual fund portfolio holdings sourced directly from global investment management firms.

[7] Info-financiere.fr website is a centralised storage mechanism for French listed companies regulated information. This website shares regulatory information about the companies produced by AMF/ Autorite Des Marches Financiers (French financial/ stock exchange regulatory body).

[8] Euronext Family Business Index is dedicated to track and highlight the performance of family businesses listed across the four Euronext exchanges i.e. Amsterdam, Paris, Lisbon & Brussels.

information about other financial variables are obtained annually for French publicly listed firms from Compustat and Worldscope databases wherein all financial figures have been reported in millions and dollars.[9]

4.1.1 Data Collection Process

The classification of French publicly listed companies into family-controlled and non-family-controlled firms is not a trivial task. It starts from Thomson Reuters Eikon database by first extracting information about all the French publicly listed companies (both active and inactive) together with their date of incorporation, the economic sector, business sector, the industry group, the industrial sector, the date the firm was established, the ISIN codes (International Securities Identification Number), and the market capitalization**.** After extracting this data for 734 publicly listed firms that are established, headquartered, and listed in France, the next step proceeds to data scrutinization to exclude firms operating in financial, utilities and real estate economic sectors due to their industry specific and statutory capital requirements (122 firms). Also, the data cleaning process excluded those firms for which the company and financial data was unavailable (46 firms) which resultantly left 566 firms in the sample.

To establish an ultimate ownership and control variable for these observations over the period 1997-2021, the shareholding rights data of ultimate individuals and families' investors is first gathered on an individual firm basis from Thomson Reuters Eikon database[10]. It is worth explaining here that the ultimate ownership of a firm refers to an individual(s), a family or an organization that resides at the top of the hierarchy tree of the firm control with no immediate shareholder other than itself. So, based on this information of shareholding percentages, the ultimate individual(s) and the family investor(s) of firms are identified that eventually helps determine the ultimate control across French firms. Besides, it is also noteworthy to mention that the data for strategic investors of firms are collected for each year so that the status of firms is accurately determined over time. That is, it reduces the probability of characterizing a firm as family-controlled throughout the sample period whilst in reality the firm may have had over time changed its status from ***'family-controlled firm'*** to ***'widely held/ non-family-controlled'***.

In accordance with this ultimate shareholdings data extracted from Thomson Reuters Eikon database, the voting rights information is then collected from the annual reports and the universal registration documents as voting rights are considered to be a more accurate measure of identifying the shareholder's control over a firm (Aminadav & Papaioannou, 2020)[11]. The company's universal registration documents are similar to the firm's annual reports as they contain details about a company, its business, financial position, earnings, future prospects, governance, and shareholding structure however these documents are mainly intended for the frequent security issuers in the capital market. Both these documents i.e., annual reports & universal registration documents are available on the company's website and info-financiere.fr.

While extracting the information about the voting rights exercised by major ultimate shareholders, one of the major challenges relates to the language barrier as some of the documents for voting rights

[9] Detailed definitions of all variables together with their respective Compustat and Worldscope data codes are provided in the appendix section.

[10] Thomson Reuters Eikon database has some limitations for ownership data extraction. ***First***, TR Eikon only has 10,000 investors display limit. Since the dataset for proposed sample contains 566 French publicly listed companies (excluding utilities, financial, real estate and those firms for which company and financial data was unavailable) over a period of 25 years with multiple individual/family investors involved in a firm, the number of observations for the dataset exceeded far beyond the available limit of 10,000 investors display. As a result, the resulting TR display screen mainly reflected information about the recent largest ultimate individual and family investors and their shareholding over the whole period instead of giving a complete picture of any change in largest ultimate investors that may have occurred over the period of 25 years i.e., 1997-2021. This may not only have resulted in loss of data for some of the firms but may also have led to an inaccurate classification of firms as family or non-family controlled if a change in ultimate controlling authority has happened over the period of time or the ultimate control rights have increased or decreased for an investor. ***Second***, the attempt to extract ultimate investors data for 25 years only gives limited results as the data likely drops observations for firms that may have missing data at any time in the defined period i.e. from 1997-2021 due to 10,000 investors display limit. To overcome these limitations of ownership data, the information on shareholdings of largest ultimate investor is collected from TR Eikon on an individual firm basis. This shareholding information is then added to the French publicly listed firms file to ensure that the ultimate investors are accurately identified in each year and that all the firms are precisely categorized as family controlled and non-family firms.

[11] Aminadav & Papaioannou (2020) used Bureau Van Dijk to collect voting rights information of family firms. However, information of around 7,000 non-listed firms was not covered in the database so they manually collected voting rights information for these firms using published reports from regulatory agencies, governmental publications etc.

details are published in French language with no option of an English language translation. To overcome this obstacle, the voting rights information has been searched with key word "***vote***" which resultantly gave results for the percentages of voting rights information primarily in a tabular format under the heading ***"% des droits de vote"*** that translates as ***"% of voting rights"*** in English language. Furthermore, the companies' published documents also presented the details of voting right coalition (if any) among the shareholders, that in case of French language published reports was presented in the same voting rights table under the heading ***"sous-total concert"*** meaning ***"sub-total concert".***

The information on firms' voting rights is also validated from Thomson Reuters Worldscope database that not only verifies the accuracy of major shareholders' shareholding and voting rights information for most of the firms but also helps populate the missing voting rights observations in case the annual reports and related documents are unavailable. A limitation of Worldscope, however, is that the database provides shareholding and voting rights information of major shareholders for only one particular year and then generalize it over the period of years instead of reporting the largest/ major shareholder's shareholding and voting rights information for each individual year. So, for this reason, the information on voting rights for French publicly listed firms is first extracted from annual reports and registration documents and later validated and checked (for missing information) from the Worldscope database. Nevertheless, after performing all these steps, there were approximately 230 firms for which there was either missing individual/ family's shareholding and voting rights data throughout the sample period, or they have insufficient shareholding data observations (minimum 4 observations). Hence, after excluding the observations of these firms, the resultant sample data consists of 336 French publicly listed firms with 5,347 firm-year observations over the period 1997-2021.

Lastly, using the voting rights data of individual investors and families, the sample follows the definition and identification procedure of Aminadav and Papaioannou (2020) to classify the firms as family-controlled: occurring if the individual shareholder of firm (or the multiple shareholders of firm are controlled by an ultimate individual investor or a family) has 20% voting rights or more than 20% and non-family controlled otherwise. So based on this voting rights threshold criteria, the voting rights of all members of a family are summed up to find out an aggregate value for the voting rights of the family. However, in cases where more than one individual/ family shareholder has voting rights in excess of 20%, the largest shareholder is classified as the controlling shareholder. Similarly, in instances where two or more shareholders are not related to each other (i.e., they are neither family members nor corporate shareholders being controlled by an ultimate owner) but have an exact same percentage of voting rights and that alone or for each shareholder exceeds 20% cut-off, the firm is classified as non-family controlled.

A brief summary of sample data collection for ownership variable is reported in Table 1.

Categories	***Number of firms***
Publicly listed firms incorporated, listed, and headquartered in France	**734**
Exclusion of Financial, utilities and real estate sector firms	(122)
Exclusion of Firms with missing/ insufficient ownership/ company & financial data	(276)
Sample data for Individuals & Families shareholding collected for proposed study	**336 (5,347 firm-year obs.)**
"No R&D" reporting firms	(132)
Resultant R&D reporting sample data (family & non-family)	**204 (3,094 firm-year obs.)**
Non-family firms R&D reporting sample	74 (940 firm-year obs.)
Family firms R&D reporting sample	130 (2,154 firm-year obs.)

4.2 Measurement of Variables

A brief description of the measurement of variables used in the study is as follows.

i. R&D Smoothing (R&D)

R&D smoothing – the dependent variable in the empirical specification – is measured as R&D investment spending. The variable is scaled by the beginning period book value of total assets (Brown & Petersen, 2011; Block, 2012). To formally examine the smoothing of R&D with cash holdings, the available sample is further split into "***R&D firms***" (firms with average positive R&D) and "***No R&D firms***" (firms with zero or missing R&D) in the given sample period. This splitting of sample based on the R&D values results in 3,094 firm-year observations of 204 ***"R&D firms"*** over the year 1997-2021 while 2,253 firm-year observations for 132 ***"No R&D firms"*** over the period 1997-2021.

ii. Ownership Concentration (Ownership)

Ownership concentration of individual and family shareholders is determined from the voting rights' percentage of the firm's largest ultimate individual or family shareholder wherein the family members are considered to be one shareholder with combined voting power (Aminadav & Papaioannou, 2020).

iii. Ultimate control (FamilyControl)

Ultimate control variable is derived from the ownership concentration variable and is categorized into two different groups i.e., family-controlled, and non-family-controlled firms. To classify firms as family-controlled and non-family controlled, a factor variable is used that indicates 1 for family-controlled firms such that the largest ultimate controlling individual(s) or family shareholder holds more than 20% of the firm's voting rights while 0 for non-family-controlled firms (Aminadav & Papaioannou, 2020; La Porta et al., 1999).

iv. Intensity of Ultimate Family-Control (Intensity)

For examining the impact of varying intensities of control rights of ultimate individual(s) and family investors, a binary variable is used to categorize family-controlled firms as low-intensity and high-intensity family-controlled firms. This classification of ultimate family control is based on the distribution of ownership data which reveals a median value of 48%. So, a dummy variable 1 is used for low intensity family-controlled firms such that the major ultimate controlling individual or family shareholders meet the threshold criteria of 20% control rights, but the control rights are less than 48%. Alternatively, a dummy variable 2 is assigned to high-intensity family-controlled firms wherein the major ultimate individual or family shareholder holds 48% or more than 48% control rights over the firm.

v. Covid Crisis (CovidCrisis)

Covid crisis is a binary variable that indicates 1 for the period of covid-19 crisis i.e., the year 2020 & 2021 while 0 otherwise.

vi. Change in Cash Holdings (ΔCashHoldings)

Cash holdings is defined as cash and marketable securities (Opler et al., 1999) To calculate the changes in cash holdings, a difference is first taken between the beginning value of cash and short-term investments and the ending value of cash and short-term investments for time-period t. This measure is then scaled by the beginning period book value of total assets.

vii. Technological Intensity (hitech)

Technological intensity is represented by a dummy variable (1 = hitech firms, 0 = non-hitech firms) to indicate if a firm belongs to one of the technology-intensive industries like pharmaceuticals, computer

and electrical equipment, electronics, telecommunications, semiconductors, information processing etc. (Chan, et.al., 1990). Generally, firms operating in these hi-tech industries invest more in R&D (Sun et.al., 2019).

viii. Financing Constraints (Firm Age, Size)

To capture the effects of financing constraints, this study uses firm age and firm size as the measures of financing constraints (Brown & Petersen, 2011). Previous studies reported that given the likelihood of a strong correlation between firm age and asymmetric information problems, firm age can be used as a proxy for financing frictions (Brown & Petersen, 2011; Brown et al., 2009). Firm age is measured as the number of years from the date of firm's establishment. For further classification of firms based on their age, an age dummy variable is used wherein a firm is classified as "young" (0 = young firm) if the average age of firm happens to be fifteen years or less than fifteen years while "mature" (1= mature firm) otherwise. Firm size, on the other hand, is measured using firm's total sales (Matzler et.al., 2015; Chen & Hsu, 2009). Similar to earlier literature that employed firm size as a proxy for gaining access to external financing, this research further split the sample into two different categories using a binary variable for size of firm. That is, a factor variable 0 is used for small-medium sized firms while 1 for large sized firms based on 70/30 split of average firm sales during the period 1997-2021. The 70/30 split is used to assign firms because of the skewed size distribution. Also, both firm size and firm age variables are log transformed due to skewness in data (Matzler et.al., 2015; David, et.al., 2008).

ix. Control Variables:

a. **Gross Cash flow.** The literature also used the contemporaneous gross cash flows as a standard measure of financing from internal equity (Block, 2012; Brown & Petersen, 2011; Brown et.al., 2009). So as a control variable, cash flow is measured as income before extraordinary items plus depreciation and amortization plus research and development expense.
b. **Stock Issues.** For capturing the effects of external equity, the study incorporates the contemporaneous and lagged values of financing raised by issuing new stock issues. Stock issues are defined as the net cash raised from stock issues which is calculated as the sale of common and preferred stock minus the purchase of common and preferred stock.
c. **Debt issues** are used to account for the effects of external financing and firms' capital structure. Debt issues are measured as the long-term debt issued minus long-term debt reduction.
d. **Market to book ratio** is used as a control for investment demand and is calculated as the market value of assets divided by the beginning period book value of total assets where market value of assets is computed as the market value of equity plus the book value of assets minus the book value of equity (Brown & Petersen, 2011).
e. **Sales Growth** – *control for investment demand*. Sales growth is used to control for firm demand and to make a distinction between the slow and fast-growing firms. To calculate sales growth, log of change in net sales is used where net sales change is measured as the difference between sales in period *t* and sales in period *t-1* (Brown & Petersen, 2011).

All the control variables are employed from earlier studies that focus on family firms (Anderson & Reeb, 2003; Block, 2012; Matzler et.al., 2015), R&D & cash holdings (Brown et. al., 2009).

Table 2 below defines and summarize the dependent, independent & control variables:

Variable	*Description*	*Source*
Dependent Variable		
R&D Investment	Research and development expense in period t divided by the book value of total assets at the beginning of period t.	Compustat
Independent Variables		
Ownership Concentration	Voting rights percentage of the firm's largest ultimate individual/ family shareholder wherein the family members are treated as one shareholder with collective voting rights.	Thomson Reuters Eikon, Worldscope & Company reports
Family Control	Dummy variable equals 1 for family firms such that the voting rights percentage of largest ultimate individual or family investors cross the 20% voting rights threshold criteria while 0 otherwise.	Thomson Reuters Eikon, Worldscope & Company reports
Intensity	Binary variable equals 1 for family firms wherein the major ultimate controlling individual or family shareholder's control rights meet the threshold criteria of 20% but are less than 40%. Alternatively, a dummy variable 2 is assigned to family firms where the major ultimate controlling shareholder holds 40% or more than 40% control rights over the firm.	Thomson Reuters Eikon, Worldscope & Company reports
Covid Crisis	Dummy variable equals 1 for the period of covid-19 crisis i.e., 1 for the year 2020 & year 2021 while 0 otherwise.	
Cash Holdings	Cash and short-term investments in period t divided by the book value of total assets at the beginning of period t.	
ΔCash-Holdings	Change in cash and short-term investments at the beginning and end of period t divided by the beginning period book value of total assets at time 't'.	Compustat
Hi-tech	Dummy variable equals 1 for hi-tech firms such that the firm belongs to one of the NAICS (North American Industry Classification System) codes for technology-intensive industries like pharmaceuticals, computer and electrical equipment, electronics, telecommunications, semiconductors, information processing, while 0 otherwise.	Thomson Reuters Eikon
Firm Age	Log of the number of years since the firm has been established.	Thomson Reuters Eikon
Firm Size	Log of total sales of the firm.	Compustat
Control Variables		
Cash Flow	Gross cash flow in period t divided by the book value of total assets at the beginning of period t, where gross cash flow is defined as (after-tax) income before extraordinary items plus depreciation and amortization plus research and development expense.	Compustat
Stock Issues	Net cash raised from stock issues in period t divided by the book value of total assets at the beginning of period t, where net cash from stock issues is equal to the sale of common and preferred stock minus the purchase of common and preferred stock.	Compustat
Debt Issues	Net new long-term debt issued in period t divided by the book value of total assets at the beginning of period t, where net new long-term debt is equal to long-term debt issued minus long-term debt reduction.	Compustat

Market to Book	Market value of assets in period t divided by the book value of total assets in period t, where market value of assets is equal to the market value of equity plus the book value of assets minus the book value of equity.	Worldscope
Sales Growth	Log change in net sales between period t and t-1.	Compustat

4.3 Methodology & Empirical Specification

Following the seminal work of Brown et. al. (2009) and Brown & Petersen (2011), this research employs a dynamic R&D regression model with ownership and financial variables to study the effects of ultimate family-control, and financing constraints on family-firms' smoothing of R&D investments using cash reserves. This dynamic R&D model is based on the quadratic adjustment costs assumptions of Euler equation that has been developed by Bond & Meghir (1994). Furthermore, this equation also considers the dynamic optimization condition of Euler structural model that helps capture the impact of current expectations of firms' future profitability on the firms' current decisions (Brown et.al., 2009; Brown & Petersen, 2011; Whited & Wu, 2006). So, after incorporating the effects of ultimate family control (FamilyControl), financing constraints and covid-19 crisis (CovidCrisis is used as a sharp exogenous shock and a financing constraint) to the Euler equation, the Euler model specification takes the following form which helps directly explore the impact of ultimate family ownership and control together with the effects of financing constraints and global crisis on firms' R&D smoothing using cash reserves; an issue not discussed in earlier literature. This, hence, leads to the following functional form of Euler model specification:

$$R\&D_{i;t} = \beta_1 R\&D_{i;t-1} + \beta_2 R\&D^2_{i;t-1} + \beta_3 FamilyControl + \beta_4 \Delta CashHoldings_{i;t} + \beta_5 (FamilyControl * \Delta CashHoldings_{i;t}) + \beta_6 \Delta CashHoldings_{i;t-1} + \beta_7 CashFlow_{i;t} + \beta_8 CashFlow_{i;t-1} + \beta_9 StockIssues_{i;t} + \beta_{10} StockIssues_{i;t-1} + \beta_{11} DebtIssues_{i;t} + \beta_{12} DebtIssues_{i;t-1} + \beta_{13} MarketBook_{i;t-1} + \beta_{14} Salesgrowth_{i;t} + \beta_{15} Firm\ Age + \beta_{16} Firm\ Size + \beta_{17} CovidCrisis + \alpha_j + d_t + \nu_{j;t}. \quad (1)$$

where $R\&D_{i;t}$ denotes the R&D spending of firm i in period t. Because R&D is highly persistent in nature, the lagged value of R&D investment is also added to the above model specification as an independent variable and therefore the expected coefficient for lag R&D is assumed to be positive. Furthermore, the quadratic term of R&D i.e. $R\&D^2_{i;t-1}$ is included to capture the quadratic adjustment costs of R&D investment and according to the quadratic adjustment costs assumption of Euler structural model, the coefficient for the quadratic term is expected to be negative. Family Control is derived from Ownership concentration variable which is determined by the percentage of voting rights held by the individuals and family shareholder(s). Based on this voting rights information, the variable ultimate control is classified into two different groups which represents the type of firm control i.e., family-controlled firms and non-family-controlled firms. The variable equals 1 for family-controlled firms such that the ultimate and major control rights are exercised by an individual(s) or family shareholder at 20% voting rights threshold criteria while 0 otherwise. The above equation excludes Ownership concentration variable to avoid the likelihood of quasi-extreme multicollinearity issue which normally arises when a variable is derived from another variable and both variables are used as predictors. Furthermore, to test the hypotheses of family-controlled firms' use of cash holdings for R&D smoothing compared to non-family firms, an interaction term for family-control and cash holdings is also included.

The financial variables include the contemporaneous and the lagged values of change in cash holdings (ΔCashHoldings), cash flows (CashFlow), stock issues (StockIssues) and debt issues (DebtIssues) over the sample period of the study. All these financial variables and R&D investment are scaled by the firms' beginning-of-period book value of total assets. The inclusion of lagged values of financial variables is also in line with earlier studies as these variables account for the costs of factors that may influence the firms' investment (Brown & Petersen, 2011; Brown et.al., 2009; Bond & Meghir, 1994). As a source of

financing R&D investments, the expected coefficient for the change in cash holdings is predicted to be negative for firms that are dependent on cash for stabilizing the volatilities in R&D investments. However, the coefficients for cash flows and stock issues are expected to share a positive relationship with R&D investments particularly across firms that are financially constrained. Meanwhile, debt issues are assumed to be a relatively insignificant source of financing for firms that are R&D intensive. To control for firms' investment demand, the model also includes Market-to-book ratio (MarketBook) and Sales growth (Salesgrowth) (Brown & Petersen, 2011). In this respect, the variable market to book ratio is measured as the market value of assets at the beginning of period 't' (or market value of assets at time 't-1') and scaled by the beginning period book value of total assets while sales growth is computed as the difference in net sales between the period 't' and 't-1'. Both these control variables are expected to lead to a positive relationship between R&D and the firms' investment opportunities.

To measure the effects of financing constraints, earlier research studies employed firm age and firm size as measures of financing constraints (e.g., Almeida et. al., 2004; Brown & Petersen, 2011; Hadlock & Pierce, 2010). Likewise, firm age is used as another metric for financing constraint which is calculated as the difference from the date of firm's establishment. Furthermore, a binary variable Covid Crisis is also included to help capture the impact of global covid-19 crisis on firms' R&D smoothing which indicates 1 for the years of global crisis (1 = 2020 & 2021) and 0 otherwise. Additionally, the model includes firm-specific effects (αj) to control for unobserved and time-invariant factors that may affect firm's R&D such as technology and industry characteristics. Similarly, time-specific effects (dt) are included to control for combined fluctuations in the demand for R&D levels. Lastly, $\nu_{j;t}$ refers to the idiosyncratic error term.

To assess this relationship, the empirical model stated above is estimated using a system generalized-method-of moments (GMM) estimation technique. This technique was developed by Arellano & Bover (1995) and Blundell & Bond (1998) for dynamic panel data models. To justify the application of this technique, it is important to understand that the above specified autoregressive distributed lag (ARDL) dynamic panel data model assumes dependent variable ($R\&D_t$) to be a function of its past values ($R\&D_{t-1}$) together with the current and lag values of other financial variables. Besides, this dynamic panel data model is also assumed to contain an unobserved and time-constant heterogeneity (α_j) which is likely to lead to some persistent differences across the cross-sectional units. Due to these probable persistent differences, the unobserved and time constant effects of error term are likely to directly correlate with the regressor terms. Moreover, the error term is likely to determine the values of both the dependent variable ($R\&D_t$) and the lags of dependent variable ($R\&D_{t-1}$). Thus, this likely direct correlation between the regressor particularly the lagged dependent variable and the error term makes the regressor term endogenous which eventually leads to biased outcomes.

To remove these unobserved effects and to address the fundamental issue of direct correlation between the regressors and the past shocks (i.e., endogeneity and serial correlation), studies (e.g., Roodman, 2009; Kripfganz, 2019) revealed the instrumental variables (IV)/ generalised methods of moments (GMM) estimation approach to be the predominant estimation technique[12]. The GMM estimation technique transforms the data which involves first-difference data transformation (i.e., one-step system GMM) and second-order data transformation (also known as two-step system GMM) to address endogeneity issues. This approach has been found to be particularly suitable for large cross-sectional units (N) and smaller time horizons (T) i.e., N>T. The system GMM approach jointly estimates the regression in differences with the regression in levels. In this respect, the lagged level values of variables are used as instruments for the regression in differences while the lagged differences are employed as instruments for the regression in levels. System GMM is also considered to be a comparatively more efficient approach than the difference GMM as difference GMM is likely to result in too many instruments which may result in biased and relatively inefficient coefficient values and standard error estimates together with the under-

[12] Alternative approaches like maximum likelihood (ML) and bias-corrected (BC) estimation techniques also addresses the biases in dynamic panel data models. However, both these approaches have some shortcomings. For instance, both the ML and BC estimators require strict exogeneity of regressors. That is, the past periods do not provide any feedback or anticipation for the future.

identification issues (Roodman, 2009). Also, Kripfganz (2019) suggested that if the dependent variable is persistent in nature, too many lagged values or the instruments of dependent variable are likely to result in weak instruments.

The literature further assumed that the consistency and efficiency of system GMM technique is dependent on the validity of two assumptions (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998). First, the instruments used in estimation model are valid and strong instruments and second, the error terms are second-order serially uncorrelated (by construction, the error term in difference is first-order serially correlated). For this purpose, Brown et.al. (2009) and Brown & Petersen (2011) made an important assumption wherein all the financial variables were assumed to be potentially endogenous in nature. And, to resolve this endogeneity concern, earlier studies reportedly use lagged levels dated t-3 and t-4 and may further extend to include lagged levels dated t-5 and t-6 for regression in differences while lagged differences dating t-2 were used as instruments for the regression in levels starting from lagged difference dated t-1[13]. This approach was also supported by Kripfganz (2019) who suggested that often 3 or 4 lags are sufficient which can be further extended till 5th or 6th lag. He further proposed that though additional lags can be used, they are likely to weaken the instruments and may result in biased coefficients, biased standard errors, and biased and unreliable specification. So, to avoid the issue of potential data loss resulting from one-step system GMM, this research study estimates all regressions with lagged dependent and independent variables using two-step system GMM approach (Ullah et al., 2018). Furthermore, for all the models, the equation in differences uses t-2 to t-5 lagged levels as both the overidentification and serial correlation were satisfied at the 5th lag while for the equation in levels, the models use lagged differences dated t-1 as instruments. To determine the validity of instruments and that the model is correctly specified, this study uses Sargan-Hansen test of overidentifying restrictions to examine the overall validity of instruments. Meanwhile, Arellano and Bond (1991) second order serial correlation test AR(2) is also performed which helps assess the absence of serial correlation of the error term.

To analyse the effect of intensity of ultimate family control on R&D smoothing, the family-firms are further grouped into 2 categories based on the intensity of ultimate control rights held by the individual and family shareholders. This gives rise to the addition of a factor variable *"Intensity"* which equals 1 for low-control intensity family-controlled firms such that the individual or family shareholder meet the threshold criteria of 20% but wherein the ultimate major shareholder's control rights are less than 48%. Alternatively, the variable equals 2 for high-control intensity family-controlled firms where the major ultimate shareholder has 48% or greater than 48% control rights over the firm while 0 for non-family firms (non-family firms are used as reference group). To test this impact of varying intensities of ultimate family control and how family-firms with low-control intensity differs in their use of cash for R&D smoothing compared to family-firms with high-control intensity (that is H2), an interaction term for Intensity and cash holdings is used which leads to the reformulation of Eq. (1) as follows:

$$R\&D_{i;t} = \beta_1 R\&D_{i;t-1} + \beta_2 R\&D^2_{i;t-1} + \beta_3 Intensity + \beta_4 \Delta CashHoldings_{i;t} + \beta_5 (Intensity * \Delta CashHoldings_{i;t}) + \beta_6 \Delta CashHoldings_{i;t-1} + \beta_7 CashFlow_{i;t} + \beta_8 CashFlow_{i;t-1} + \beta_9 StockIssues_{i;t} + \beta_{10} StockIssues_{i;t-1} + \beta_{11} DebtIssues_{i;t} + \beta_{12} DebtIssues_{i;t-1} + \beta_{13} MarketBook_{i;t-1} + \beta_{14} Salesgrowth_{i;t} + \beta_{15} Firm\ Age + \beta_{16} Firm\ Size + \beta_{17} CovidCrisis + \alpha_j + d_t + \nu_{j;t}. \quad (2)$$

For examining the effect of financing constraints on the firm's use of cash for R&D smoothing (i.e., H3), a comparative analysis is conducted for young versus mature firms and small-medium sized versus large-sized firms. Firm size has been reported by earlier studies to be significantly important for credit extension as large-sized firms are relatively more efficient in overcoming asymmetric information and insufficient collateral issues (Bernanke et al., 1996). However, smaller firms are likely to face more financing frictions due to the potential volatilities in their growth and earnings trends (Howell, 2016). So, following that approach, this research also split R&D reporting sample into large-sized and small-medium sized firm using a 70/30 percentile split of the firms' sales (Brown & Petersen, 2011). Likewise, firm age

[13] The choice of lagged levels and lagged differences as instruments is dependent on the validity of instruments, the model, and the serially uncorrelated error term.

has been found to have a close association with informational opacity that affects the creditworthiness of the firm and the asymmetric and adverse selection costs of raising capital (Hyytinen & Pajarinen, 2008). So, for this reason, the sample firms are further classified into two different age categories i.e., mature firms if their age is more than 15 years while young otherwise (Brown & Petersen, 2011). Based on this classification, the R&D reporting sample is estimated using the following specification to test H3:

$$R\&D_{i;t} = \beta_1 R\&D_{i;t-1} + \beta_2 R\&D^2_{i;t-1} + \beta_3 Intensity + \beta_4 \Delta CashHoldings_{i;t} + \beta_5 (Intensity * \Delta CashHoldings_{i;t}) + \beta_6 Age + \beta_7 (Age * \Delta CashHoldings_{i;t}) + \beta_8 Size + \beta_9 (Size * \Delta CashHoldings_{i;t}) + \beta_{10} \Delta CashHoldings_{i;t-1} + \beta_{11} CashFlow_{i;t} + \beta_{12} CashFlow_{i;t-1} + \beta_{13} StockIssues_{i;t} + \beta_{14} StockIssues_{i;t-1} + \beta_{15} DebtIssues_{i;t} + \beta_{16} DebtIssues_{i;t-1} + \beta_{17} MarketBook_{i;t-1} + \beta_{18} Salesgrowth_{i;t} + \beta_{19} CovidCrisis + \alpha_j + d_t + \nu_{j;t}. \quad (3)$$

Where Age refers 1 for mature firms while 0 otherwise. Similarly, Size represents 1 for large-sized firms and 0 otherwise.

For investigating the effects of technological intensity, the R&D reporting sample is further classified into hi-tech & low-tech firms by applying a more restricted definition of R&D intensity. This classification helps analyse the differences between hi-tech family-controlled and hi-tech non-family-controlled firms and how these firms with different ultimate-control types and different intensities of control differ in their R&D volatility dampening strategies using cash reserves. Besides, the effects of financing constraints on firms' use of cash for R&D smoothing are also assessed across technologically intensive family-controlled and non-family firms. In this respect, a factor variable hitech is introduced to distinguish hi-tech firms from low-tech ones. As literature reported hitech firms to be generally more R&D intensive in nature (Sun et. al., 2019), hi-tech variable indicates 1 if the firm belongs to one of technology-intensive industries while 0 otherwise. This procedure though reduces the number of observations for R&D reporting firms, it helps assess the R&D smoothing strategy of hi-tech firms' sample (H4) using the above model specification (3).

Lastly, the heterogeneity of family-controlled firms is tested (H5) which may help explain the differences in the risk-taking behaviours and the strategic decisions of family firms such as the degree to which the differences in control rights of family members and the possession of resources influence the innovation goals of family firms. To exploit this heterogeneity, the sample of family-controlled R&D reporting firms' is estimated based on the intensity of ultimate family control and the financing constraints faced by these firms. Using the above model specification (3), the interaction terms test how family-controlled firms with different control intensities and varying financing constraints stabilize the volatilities in R&D investments using cash holdings.

4. Descriptive Statistics

5.1 Summary Statistics

Table 3 classifies the sample data of 5,347 firm-year observations by the type of voting rights control over the firm. In view of this, the table exhibits that a vast majority of firm-year observations i.e., 71.14% are family-controlled based on the 20% voting rights threshold criteria, while only a small percentage i.e., 28.86% of the recorded observations were found to be non-family controlled.

Table 3: Summary statistics of firm-year observations (by firm control rights)

Classification of firms' observations by voting rights control	Frequency	Percent	Cum.
Family controlled	3804	71.14	71.14
Non-family-controlled	1543	28.86	100.00
Total	**5347**	**100.00**	

Furthermore, as explained earlier in the data section, the proposed research is mainly focused on the R&D reporting firms to statistically analyse the smoothing of R&D investments with cash holdings. So, by virtue of this, the below table summarizes and segregates the available information of 5,347 firm-year

observations into four different groups based on the type of control and the R&D expense reported during the sample period i.e., from 1997 to 2021.

Table 4: Summary of "R&D" and "No R&D" expense reporting firm-year observations (by control rights)

R&D dummy	Firm type (observations) by voting rights control		
	Family-controlled	**Non-family controlled**	**Total**
R&D	2154	940	3094
No R&D	1650	603	2253
Total	**3804**	**1543**	**5347**

As reported in above table, 2,154 family-controlled firm-year observations (out of 3,804 family firm-year observations) and 940 non-family firm-year observations (out of 1,543 non-family firm-year observations) reported a positive mean R&D value during the sample period. Cumulatively, these 3,094 R&D reporting firm-year observations represent an unbalanced panel data for 204 French publicly listed firms (both family-controlled and non-family firms).

A comparative summarized view of each firm type (i.e., family-controlled & non-family controlled) in the total sample data of 5,347 firm-year observations and only "R&D expense" reporting sample data of 3,094 firm-year observations is reported in Table 5. These statistics are mainly intended to enhance our understanding on the type of firm-control (i.e., family-controlled, and non-family-controlled observations) being exercised by French publicly listed firms across the various industries and over the period of time in both the "***total***" sample observations and ***"R&D"*** reporting observations. The unbalanced panel data sample observations are reported using information from Thomson Reuters Eikon database. These data are reported for publicly listed firms that are incorporated, listed, and headquartered in France during 1997-2021. However, it excludes firms operating in financial, utilities and real estate economic sector or those that are established, listed, or headquartered outside France. Also, firms with missing cash holdings and market capitalization observations or those with a total assets value of less than $1 million are excluded from the sample. Firms under the ***'Total Sample'*** category includes all firm-year observations of family and non-family firms irrespective of their R&D expense reporting status while 'R&D expense reporting sample' only includes firms that reported on average a positive R&D value during the sample period.

Table 5: Summary of Thomson Reuters (TR) Industrial classification of firms based on voting rights control.

TR Industrial group classification of firm	Total Sample			R&D expense/ reporting sample		
	Firm type (observations) by voting rights control			Firm type (observations) by voting rights control		
	(1) Family-controlled	**(2) Non-family controlled**	**(3) Total**	**(4) Family-controlled**	**(5) Non-family controlled**	**(6) Total**
Aerospace & Defense	92	54	146	92	54	146
Automobiles & Auto Parts	94	15	109	94	15	109
Beverages	159	26	185	0	0	0
Biotechnology & Medical Research	69	123	192	62	104	166
Chemicals	127	10	137	38	10	48
Communications & Networking	17	15	32	17	15	32
Computers, Phones & Household Electronics	41	47	88	21	39	60
Construction & Engineering	107	8	115	83	4	87
Consumer Goods Conglomerates	19	5	24	19	5	24
Containers & Packaging	70	0	70	22	0	22
Diversified Retail	10	4	14	7	0	7

Electronic Equipment & Parts	22	13	35	22	13	35
Food & Drug Retailing	98	16	114	25	0	25
Food & Tobacco	135	12	147	69	4	73
Freight & Logistics Services	65	22	87	15	22	37
Healthcare	139	92	231	95	62	157
Homebuilding & Construction Supplies	135	18	153	114	18	132
Hotels & Entertainment Services	214	65	279	7	0	7
Household Goods	20	49	69	16	18	34
Integrated Hardware & Software	22	0	22	22	0	22
Leisure Products	112	18	130	112	18	130
Machinery, Tools, Heavy Vehicles, Trains & Ships	256	68	324	211	42	253
Media & Publishing	271	172	443	157	55	212
Metals & Mining	47	9	56	23	0	23
Office Equipment	20	6	26	0	6	6
Oil & Gas	13	62	75	0	32	32
Paper & Forest Products	51	0	51	26	0	26
Passenger Transportation Services	9	5	14	9	1	10
Personal & Household Products & Services	48	0	48	24	0	24
Pharmaceuticals	122	60	182	122	60	182
Professional & Commercial Services	269	95	364	151	20	171
Renewable Energy	0	12	12	0	12	12
Semiconductors & Semiconductor Equipment	12	74	86	12	74	86
Software & IT Services	532	295	827	337	224	561
Specialty Retailers	157	18	175	31	13	44
Telecommunications Services	29	4	33	29	0	29
Textiles & Apparel	201	51	252	70	0	70
Total	**3804**	**1543**	**5347**	**2154**	**940**	**3094**

This table exhibits an industrial group categorization of firm-year observations by the voting rights control. In this respect, the ***'Total sample'*** firm-year observations (Table 5: (1), (2), (3)) help understand the significant and negligible presence of each firm type across the various industries. However, the R&D expense reporting sample (Table 5: (4), (5), (6)) presents a comparison of family and non-family firms in relation to the whole sample data. Overall, both these categories revealed that the number of family-controlled firm-year observations are approximately three times the number of non-family-controlled firm-year observations. This, hence, provides support for the wide presence of family-controlled firms in the French market.

Results from ***'Total Sample'*** (Table 5: (1)) revealed that the family-controlled firm-year observations are markedly present (14%) in the "*Software & IT services*" industry (i.e., 532 firm-year observations of 3,804 family-controlled firm-year observations). But the share of this category of firms is almost non-existent in *"Passenger Transportation Services" and* "*Renewable energy*" industrial groups. Likewise, the '***R&D expense reporting'*** sample (Table 5: (4)) also implies the highest percentage (15.65%) of family-controlled firm-year observations to be in the "*Software & IT services*" industry while their presence is missing in the *"Beverages*", "*Office Equipment*", "*Oil & Gas*" and "*Renewable Energy*" industrial groups.

Contrary to family-controlled firm-year observations, the non-family-controlled observations in the '***Total Sample***' (Table 5: (2)) exhibited that the share of non-family firm-year observations is least/ non-existent in "*Containers & Packaging*", "*Integrated Hardware & Software*", *"Paper & Forest products",* "*Office Equipment*", "*Personal & Household Products & Services*" & "*Telecommunications Services*" industrial groups. However, a noteworthy presence of non-family observations can be seen in the "*Software & IT*

services" industrial group (295 firm-year observations of 1543 non-family firm-year observations i.e., 19.12% of all non-family-controlled firms). Similarly, the '***R&D expense reporting'*** sample (Table 5: (5)) demonstrate a majority of non-family observations in the "*Software & IT services*" while lowest results have been observed in "*Beverages", "Containers & Packaging*", *"Diversified Retail"*, "*Food & Drug retailing", "Hotels & Entertainment Services*", *"Integrated Hardware & Software", "Metals & Mining", "Paper & Forest products", "Personal & Household products", "Telecommunication Services" & "Textiles & Apparel".* Besides the inexistence of non-family firms in the above specified industrial groups, the data also demonstrated that a vast majority of non-family firms in "*Construction & Engineering", "Food & Tobacco", "Household Goods",* "*Media & Publishing", "Passenger Transportation Services" & "Professional & Commercial Services"* do not report an R&D figure during the sample period.

A yearly comparison of family and non-family observations in the below mentioned graphs presents a comprehensive review of the evolving patterns of family and non-family observations over 25 years.

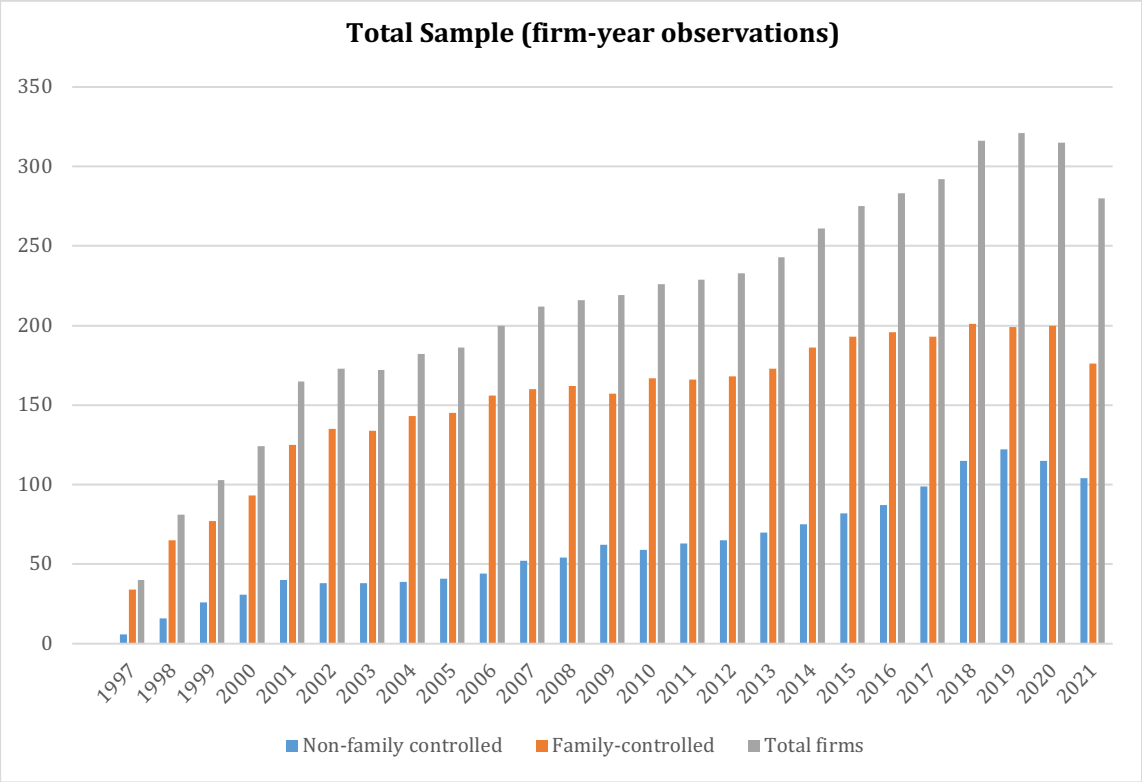

Fig A. Total sample of family-controlled & non-family-controlled firms, years. The figure plots the firm-year observations of both family-controlled and non-family controlled publicly listed firms in France for the whole sample over the period 1997-2021.

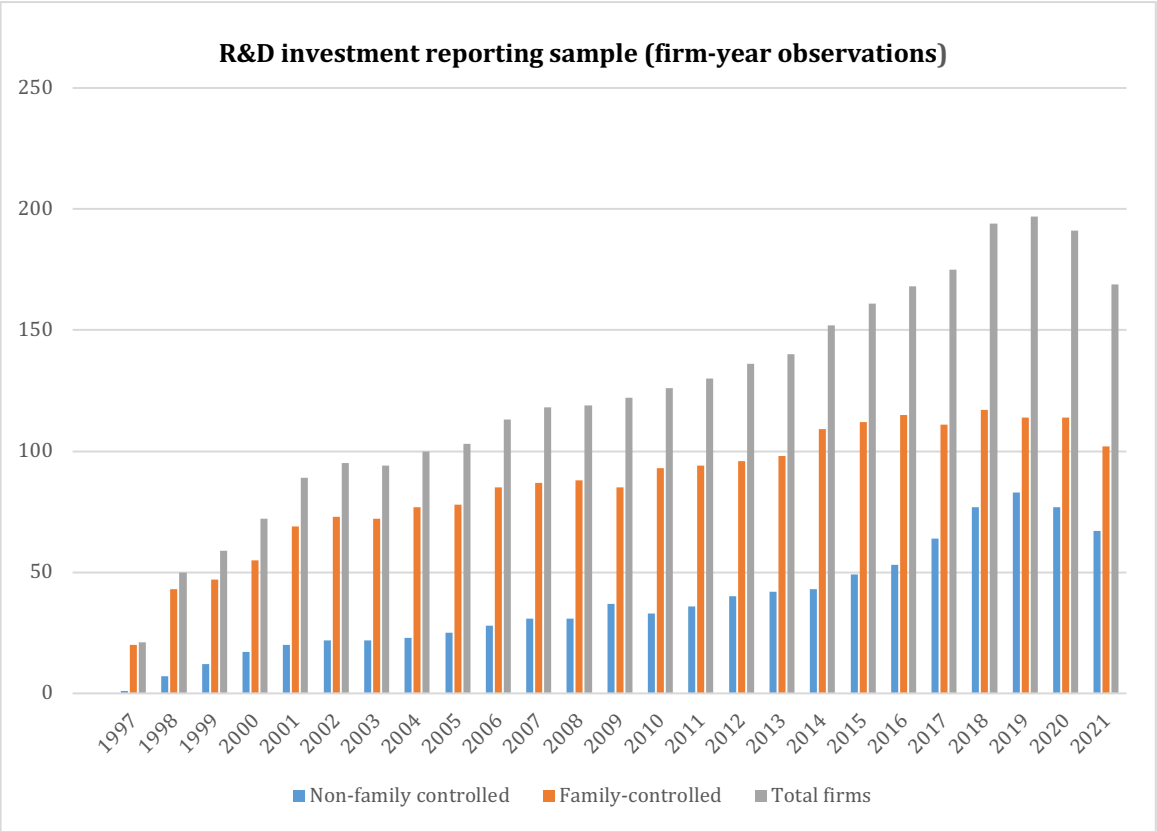

Fig B. R&D expense reporting sample of family-controlled & non-family-controlled firms, Years. The figure plots firm-year observations of R&D reporting sample of both family-controlled and non-family controlled publicly listed firms in France for the period 1997-2021.

Both graphs show that over time the percentage of both family firms and non-family firms observations increases. This growing trend is mainly because of the increasing availability of data over the sample time period. Also, the data reveal that majority of firms maintained their status as "family-controlled" and "non-family controlled" throughout the sample period. Overall, the graphs indicate that the family-controlled firm-year observations are significantly higher than the non-family ones for both the 'Total Sample' & 'R&D expense reporting sample' observations.

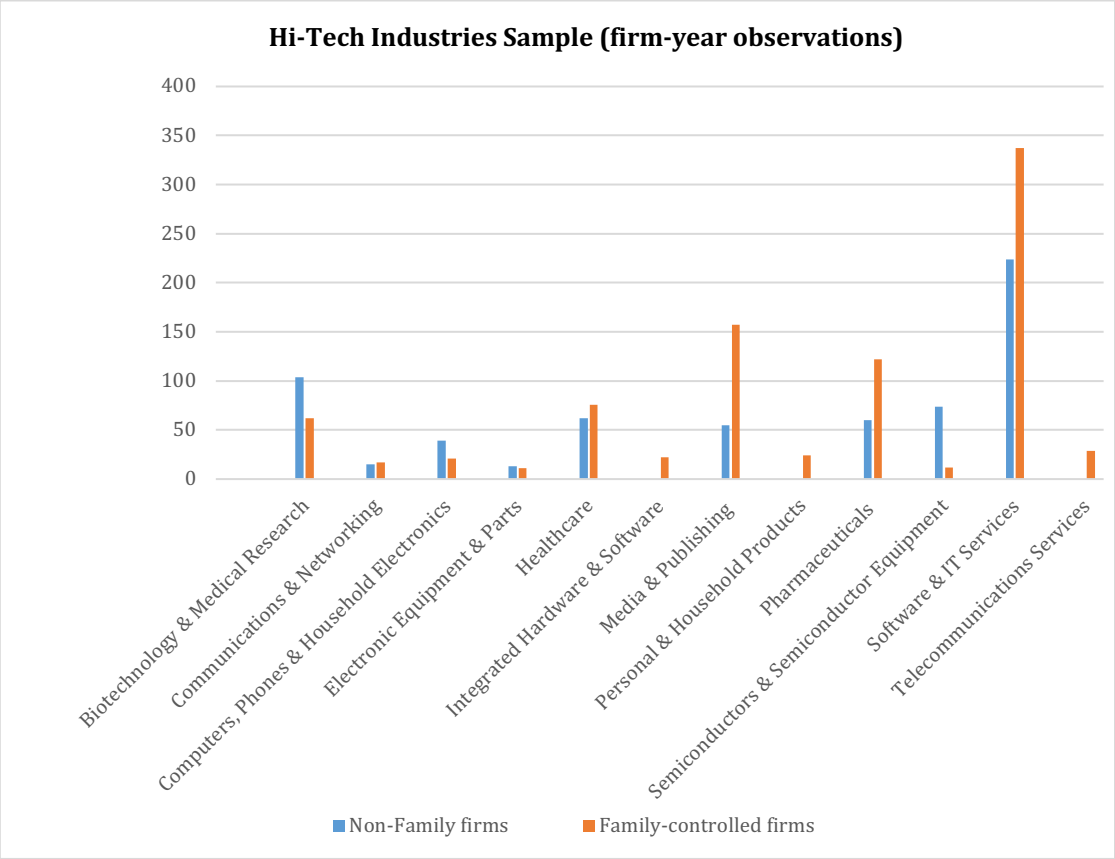

Fig. C. R&D intensive family-controlled & non-family-controlled firm-year observations, R&D intensive industries. The figure plots firm-year observations of R&D intensive family-controlled and non-family controlled publicly listed firms in France for the period 1997-2021.

Likewise, the graph above (Fig. C) compares the family and non-family firm-year observations based on their presence in technology-intensive industries. This categorization follows the classification criteria of Chan et.al. (1990) that defines hi-tech firms as R&D intensive firms belonging to technology intensive industries like pharmaceuticals, semiconductors, computer and electrical equipment, communication, information processing, electronics, medical equipment, and telecommunications. The graph exhibits a significant presence of R&D intensive family and non-family firm-years observations across ***"Software & IT services"*** industry while the least presence of family-controlled firm-year observations can be found in ***"Semiconductors & Semiconductor equipment"*** industry.

5.2 Descriptives & Univariate Analysis

Table 6 reports the descriptive statistics of '*R&D expense reporting* firms' for both the categories of control types. These figures are based on firms' annual observations wherein the financial figures in the table (i.e., R&D, cash holdings, cash flow, stock issues, debt issues and market to book) are scaled by the beginning period book value of firms' total assets. Also, this table presents a univariate t-test of the R&D reporting sample data to analyse whether significant differences occur between the reported means of family and non-family observations.

Table 6: Descriptives & Univariate analysis of R&D reporting firms.

Variable	Family-firms	Non-Family firms	Family-firms vs non-family firms (1/0) [a] (Difference)
	Mean (S.D.)	Mean (S.D.)	Test of equality of means (t-test statistics) [b]
R&D Investment	0.039 (0.109)	0.098 (0.142)	t-stat: 12.48; p = 0.000
Cash & short-term investments	0.167 (0.155)	0.265 (0.275)	t-stat: 12.57; p = 0.000
Ownership Concentration	51.83 (19.12)	9.09 (6.08)	t-stat: -8.73; p = 0.000
Cash Flow	0.105 (0.434)	0.051 (0.196)	t-stat: -3.72; p = 0.000
Stock Issues	0.035 (0.286)	0.154 (0.601)	t-stat: 7.41; p = 0.000
Debt Issues	0.001 (0.025)	0.000 (0.007)	t-stat: -0.72; p = 0.471
Market to Book	1.817 (2.298)	2.175 (2.917)	t-stat: 3.66; p = 0.000
Sales Growth	2.192 (2.471)	1.533 (2.424)	t-stat: -6.87; p = 0.000
Firm Age	40.35 (15.19)	33.47 (14.21)	t-stat: -11.82; p = 0.000
Firm size	5.572 (2.301)	4.300 (3.022)	t-stat: -12.81; p = 0.000

[a] N = 3,094 firm-year observations (family-controlled: 2154 obs.; non-family: 940 obs.)

[b] All t-tests are two-sided.

The univariate t-test values reveal important differences between the two groups of ultimate firm control. In this respect, the family-owned firms appear to make significantly lower investments in R&D than non-family firms. Surprisingly, the mean values of cash levels, stock issues, and the market to book ratio are also observed to be higher in non-family firms as compared to family firms. Yet, the mean values of ownership concentration are considerably higher in family-controlled firms than the non-family firms. For debt issuance, the p-value do not attest significant differences between family and non-family firms. But the analysis reported family firms to experience higher cash flows and higher sales growth than the non-family firms. Moreover, the family firms are also noted to be comparatively more mature and bigger in size relative to non-family ones. Overall, the t-statistics univariate analysis holds the family-firms to be a distinct group of firms with statistically significant differences in their R&D investments and cash holdings in particular.

A visual representation of the differences between R&D investments (dependent variable) and cash holdings (independent variable) for both firm types (i.e., family, and non-family firms) are plotted below:

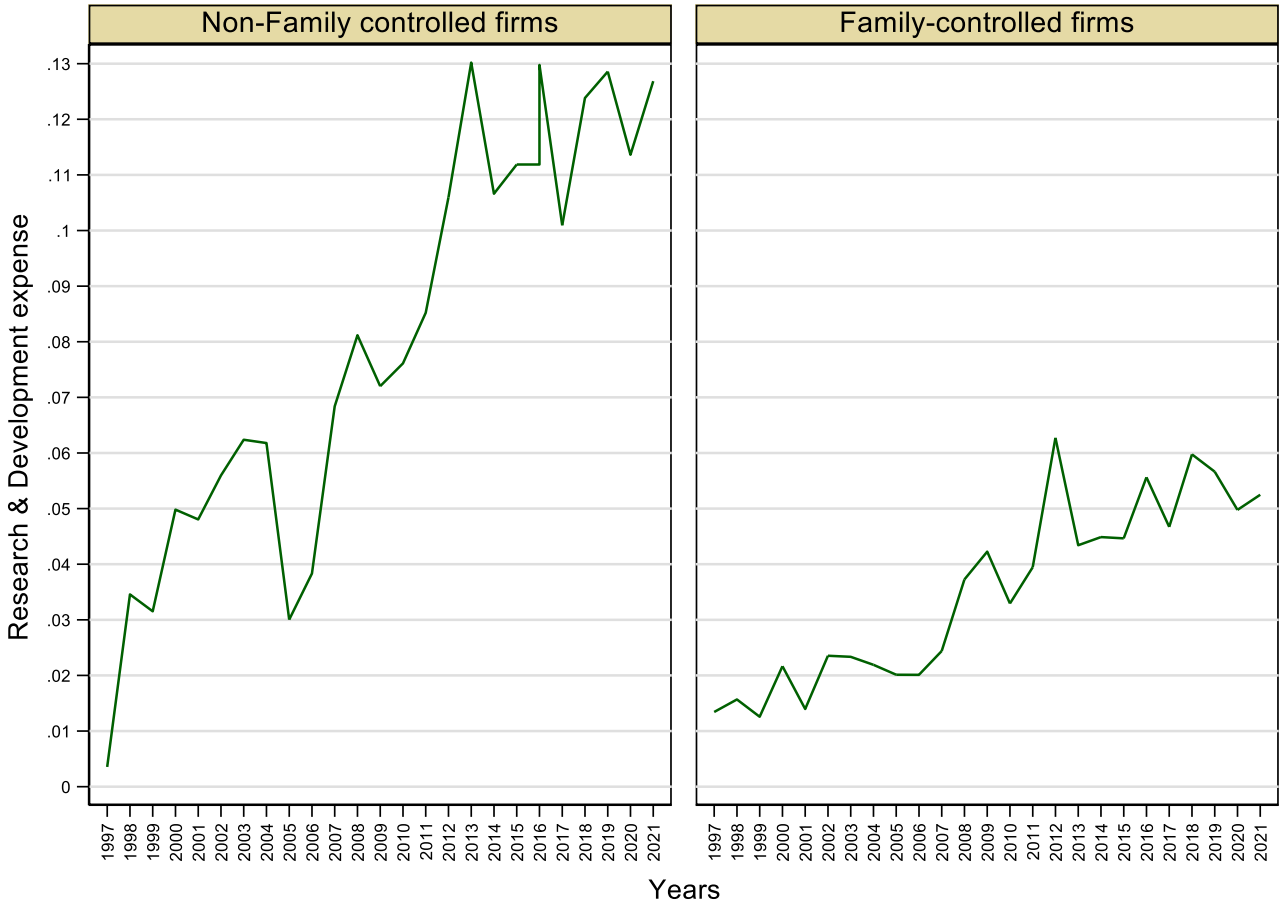

Fig D. R&D expense, years. The figure plots Research & Development (R&D) expense of 'R&D reporting' sample for non-family-controlled and family-controlled firms over the period of 25 years i.e., 1997-2021. All figures are measured in Million $ and scaled by beginning of period book value of total assets. A firm is classified as family-controlled if the voting rights percentage of largest ultimate individual/ family investors exceed the 20% voting rights threshold criteria and non-family controlled otherwise.

The graphical plots for Research and development (R&D) expense depict the trends in R&D for the French publicly listed family and non-family firms during the year 1997-2021. The plots comprise of an unbalanced panel data for 2154 family firm-year observations and 940 non-family firm-year observations. For both groups, the average R&D investment expense shows that R&D intensity has grown at a much higher pace across non-family firms than the family-firms. For family firms, the initial years exhibit an increasing trend from 1997-2000, however, this trend started to decrease somehow following the year 2002. But this pattern moved towards the recovery phase as an inclining trend can be seen in the later years starting from the year 2006-2007. In this regard, the recently published OECD reports revealed that starting from the year 2000 till 2019, the significance of R&D tax support incentives (e.g. tax credit incentives; subsidized tax rates etc.) has predominantly caused a remarkable increase in business R&D in France (OECD, 2021; Business R&D intensity in France is highest in EU region that increased by 0.16 pp compared to the OECD region average of 0.05 pp). More specifically, since 2007, the R&D expenditure has been reported to show an increase in volume across France wherein the gross domestic expenditure of the country on research and development increased by 2.0% on average each year. Similar to family firms, the

non-family firms also revealed an upward trend in intensity of R&D investments which has mainly been ascribed to the extensive financial support of French government to the business R&D i.e., nearly twice as much as the equivalent for the entire OECD area. The increasing trend in R&D during the initial years can be speculated to be the result of increasing R&D efforts in France since 1982. By virtue of these efforts, the French government provided generous tax incentives (e.g., subsidized tax rates on R&D expense) to businesses investing in R&D. In particular, OECD reported these tax benefits to have particularly increased during the last decade.

During the pandemic years i.e., following 2019, the graphs exhibit a sharp decline in the growth of R&D investments which seems to be practically the same across both groups. That is, due to the pandemic in the last few years, OECD published reports observed the positive growth in R&D to be greatly affected across both the groups. Nonetheless, the lockdowns and the unprecedented and challenging situations in the last few years may have led to a considerable decrease in R&D investments across a number of sectors, a slight rise in R&D patterns during these years may be assumed to be due to the sectors that have been positively influenced by the crisis e.g. healthcare, online retail, IT industry (OECD, 2021) that are reported to be R&D intensive industries by the existing literature (Cockburn & Henderson, 1994; Lerner, 1997).

In a similar manner, the annual plots of average cash and short-term investments (Fig E) for both family and non-family firms exhibited a sharp rise during the year 2013-2015 with a steep decline in 2019.

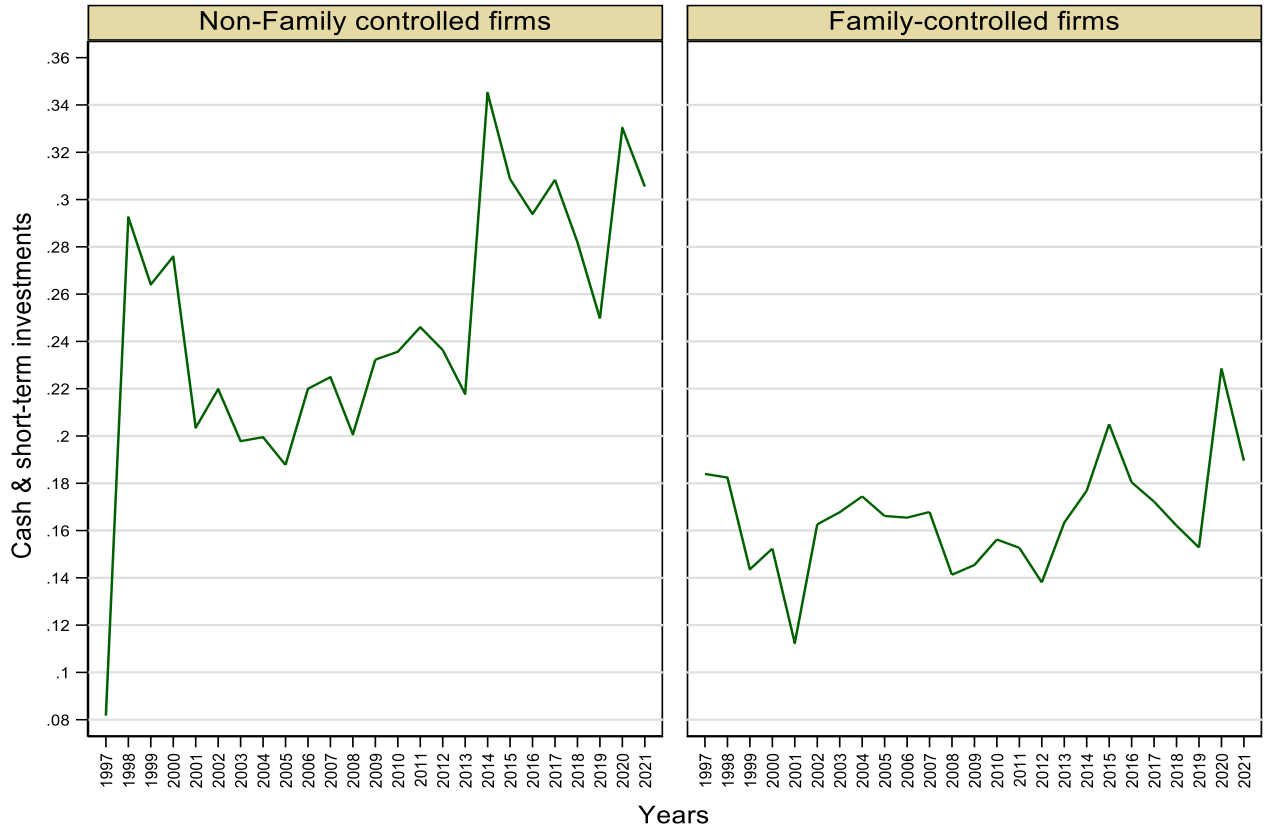

Fig E. Cash & short-term investments, years. The figure plots cash and short-term investments of 'R&D reporting' sample for non-family-controlled firms and family-controlled firms over the period of 25 years i.e.,1997-2021. All figures are measured in Million $ and scaled by beginning of period book value of total assets. A firm is classified as family-controlled if the voting rights percentage of largest ultimate individual/ family investors exceed the 20% voting rights threshold criteria and non-family-controlled firm otherwise.

The graph shows an inclining trend in liquidity levels across both the groups. For few years, a steep

decline may be observed in cash holdings particularly during the recessionary period of early 2000 and the great financial depression period of 2007-2008. Likewise, the covid-19 pandemic period also adversely affected the global economy and resulted in a drainage and sudden decline in liquidity levels during the last 3 years. But both the family and non-family firms can be seen to follow a recovery phase afterwards given the significant increase in cash holdings in the later years. To summarise, the sharp swings in cash levels during the last 5 years can be assumed to correspond to the changes in economic and political environment in France that shaped the entrepreneurial and investment climate in France. Besides, the pandemic effects on the economic and business activities may also have influenced the liquidity patterns in the last few years.

5. Regression Results & Discussion

The regression estimates for dynamic panel data model are reported using two-step system GMM as the dynamic panel data is likely to suffer from potential endogeneity issues. To address these endogeneity concerns, the literature reported two-step system GMM to be an efficient approach for addressing endogeneity issues using instrumental variables (Ullah et al., 2018). This study, thus, estimates all model specifications with two-step system GMM by making use of lagged dependent and independent variables as instruments for the regression in differences and the regression in levels model. That is, based on the theoretical motivations, the estimation models use t-2 to t-5 lagged levels as instruments for the equation in differences while for the equation in levels, the models use lagged differences dated t-1 as instruments. Besides, the results are reported using Windmeijer corrected (WC) standard errors that are considered to be more efficient and robust to heteroskedasticity and serial correlation (Kripfganz, 2019). The predicted values for GMM estimators are reported in Table 7 that help analyse the relative impact of ultimate firm ownership and control, the varying intensities of ultimate family control, technological intensity, and the financing constraints on firms' R&D investment protection using cash holdings.

For all estimations (i.e., (1), (2), (3), (4) & (5)), the coefficients for lagged R&D variable are positive and statistically significant ($p<0.01$). In this regard, it is important to mention here that the first three estimations (Model 1, Model 2, & Model 3) include a sample of all R&D reporting firms to test H1, H2 & H3; while Model 4 only refers to Hi-tech R&D reporting firms sample that helps assess whether there exist any differences between the R&D smoothing strategy of hi-tech family and hi-tech non-family firms. Model 5, however, compares the effects of financing constraints on family firms' use of cash holdings for R&D smoothing. Reportedly, the results from all estimations show the coefficient for lagged dependent variable to be consistent with the Euler equation specification and the prior literature that hold R&D investments to be highly persistent in nature (e.g., Bond & Meghir, 1994; Brown & Petersen, 2011; Alkhataybeh, 2021; Liu et.al., 2021). This outcome is also supported in light of the substantial adjustment costs associated with R&D investments. These costs, for instance, include the wage payments to the highly skilled employees or the scientists or highly skilled technology workers; the costs of hiring and training these workers; sunk costs of R&D and innovation initiatives etc. So, in case if a firm is faced with transitory finance shock and it temporarily cut-down its R&D expense, this usually entails the release of skilled workers which may result in additional hiring and training costs in the future for the firm together with the loss of important proprietary information of the firm or its dissemination to the competitors in case the R&D workers are fired (Brown & Petersen, 2011; Liu et. al., 2021). So, to protect the loss of this valuable firm-specific knowledge embedded in the human capital, the R&D focused firms usually find it more efficient to maintain a consistent flow and a smooth path of R&D investments over a longer period (Brown & Petersen, 2015; Brown & Petersen, 2011; Kang et al., 2017). This, hence, suggests that due to the magnitude of adjustment costs associated with R&D investments (Hall, 2002), the lag value of R&D investments positively influences R&D smoothing. Also, for this reason, the estimated coefficient for lagged R&D squared (i.e., the quadratic adjustment cost of R&D investments) variable is reportedly a negative or a close to 0 coefficient value in all model specifications which also aligns with the results of earlier studies (e.g., Brown et al., 2009; Brown & Petersen, 2011).

Table 7: Dynamic R&D regression with ultimate family ownership and control, financing constraints and change in cash holdings.

Dependent variable: $(R\&D)_t$	**Model (1) (R&D reporting sample)**	**Model (2) (R&D reporting sample)**	**Model (3) (R&D reporting firms)**	**Model (4) (R&D reporting Hi-Tech firms' sample)**	**Model (5) (R&D reporting family-firms sample)**
$(R\&D)_{t-1}$	0.409***	0.427***	0.475***	0.388***	0.397***
	(0.163)	(0.161)	(0.136)	(0.152)	(0.142)
$(R\&D)^2_{t-1}$	-0.104*	-0.069**	-0.067	-0.051	0.000
	(0.059)	(0.036)	(0.045)	(0.074)	(0.005)
$(\Delta CashHoldings)_t$	-0.165***	-0.137***	-0.326***	-0.243***	-0.790***
	(0.067)	(0.057)	(0.118)	(0.088)	(0.181)
Family control	-0.043				
	(0.033)				
Family control * $(\Delta CashHoldings)_t$	0.132**				
	(0.058)				
$(\Delta CashHoldings)_{t-1}$	-0.014	-0.012	-0.025	-0.087**	-0.022
	(0.097)	(0.063)	(0.054)	(0.044)	(0.052)
$(CashFlow)_t$	0.007	0.005	0.042	0.141	0.039
	(0.024)	(0.023)	(0.039)	(0.093)	(0.058)
$(CashFlow)_{t-1}$	0.173*	0.113*	0.112	-0.030	-0.005
	(0.097)	(0.061)	(0.087)	(0.042)	(0.010)
$(StockIssues)_t$	0.073**	0.057**	0.096*	0.074*	0.260***
	(0.035)	(0.029)	(0.057)	(0.041)	(0.101)
$(StockIssues)_{t-1}$	0.020	0.015	0.022	0.044**	-0.006
	(0.025)	(0.015)	(0.018)	(0.021)	(0.011)
$(DebtIssues)_t$	0.090	0.103	0.155	0.236	0.035
	(0.142)	(0.103)	(0.140)	(0.338)	(0.334)
$(DebtIssues)_{t-1}$	-0.449	-0.167	-0.369	-0.097	0.205
	(0.903)	(0.586)	(0.911)	(0.178)	(1.005)
$(MarketBook)_{t-1}$	0.003	0.003	-0.001	-0.001	0.002
	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
$(Salesgrowth)_t$	0.001	0.001	0.001	-0.001	-0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)
Firm age	-0.001	-0.001			
	(0.001)	(0.001)			
Firm Size	-0.006**	-0.004***			
	(0.003)	(0.001)			
Covid Crisis	0.010	0.006	0.011	0.009	0.009*
	(0.006)	(0.006)	(0.009)	(0.010)	(0.006)
Intensity of family control(Less than 40% voting rights)		-0.027	-0.038	-0.017	
		(0.033)	(0.054)	(0.040)	
Intensity of family control(More than 40% voting rights)		-0.044*	-0.001	-0.023	-0.010
		(0.025)	(0.045)	(0.065)	(0.016)
Intensity of family control(Less than 40% voting rights) * $(\Delta CashHoldings)_t$		0.098*	0.051	0.080	
		(0.060)	(0.135)	(0.108)	
Intensity of family control(More than 40% voting rights) * $(\Delta CashHoldings)_t$		0.129***	0.211**	0.212**	0.390***
		(0.054)	(0.105)	(0.109)	(0.140)
Mature firms			-0.085	-0.162**	-0.159
			(0.096)	(0.080)	(0.132)

Mature firms * $(\Delta CashHoldings)_t$			0.184* (0.110)	0.087 (0.066)	0.512*** (0.149)
Large-sized firms			-0.054* (0.032)	-0.088** (0.046)	-0.008 (0.008)
Large-sized firms * $(\Delta CashHoldings)_t$			-0.194 (0.284)	-0.164 (0.278)	-0.007 (0.137)
m2	0.23	0.26	0.32	0.39	0.50
J-test (p-value)	0.27	0.32	0.53	0.39	0.59
Year-effects	Yes	Yes	Yes	Yes	Yes
No. of Instruments (linear)	72	81	91	84	68
No. of observations	2829	2829	2829	1403	1983

**** p<.01, ** p<.05, * p<.1.* All models (i.e., Model 1, 2, 3, 4, 5 & 6) are estimated using two-step system GMM. The equation in differences uses t-2 to t-5 lagged levels for all the models as both the overidentification and serial correlation were satisfied at the 5th lag. For the equation in levels, the models use lagged differences dated t-1 as instruments. Also, the two-step system GMM includes both the firm fixed and time effects. Robustness tests results for within-firm serial correlation are also included in the table to indicate the absence of serial correlation. In this respect, m2 test reports results for second-order autocorrelation in the sample data which, in this case, render GMM consistent as the second order serial correlation value i.e., m2 reject the null hypothesis (p>0.10). Likewise, Sargan-Hansen J-test represents results for overidentifying restrictions. A p-value >0.10 in all six models provides confidence in the model specification and the validity of instruments.

Furthermore, the coefficient value for the change in cash holdings is also as expected i.e., a negative and statistically significant value (p<0.01) is observed in all the model estimations which implies a unit increase in cash holdings to decrease the R&D smoothing of firms. This means that in the event of an increasing or positive change in cash holdings, there will reportedly be an increase in the contemporaneous level of cash reserves which implies the maintenance of higher cash levels in time period 't' compared to 't-1'. In contrast, a negative change in cash holdings reflect the presence of greater financing frictions and the firms' increasing reliance on cash reserves. So, a higher negative coefficient value for the changes in cash holdings for non-family firms implies that compared to family-controlled firms, the financially constrained non-family firms greatly reduce their cash holdings in time period 't' and rather spare/ use those cash reserves for financing R&D investments. This, hence, suggests the existence of a negative relationship between the changes in cash holdings and R&D smoothing (Brown & Petersen, 2011). In this regard, supportive evidence has also been provided by Bolton et. al. (2011) and Gamba & Triantis (2008) who principally emphasized that given the uncertain nature of R&D outcomes and the volatilities involved in these investments, the R&D intensive firms are usually prone to concentrate more on using cash reserves. Likewise, Brown & Petersen (2011) and Lyandres & Palazzo (2016) highlighted the intrinsic difficulties associated with financing R&D driven innovations through external funds or debt. That is, given the highly intangible and the risky nature of R&D assets, the R&D focused firms are usually faced with greater financing constraints and intense competitive pressures at the investment stage. So, for these reasons, the R&D focused firms usually find cash a favourable option to make a breakthrough and to ensure their survival (Lyandres & Palazzo, 2016).

For the impact of ultimate firm control on R&D smoothing, Table 7 exhibits a negative coefficient value for the family-controlled firms. This finding also aligns with previous studies that suggested a negative association between family-ownership and risky investments (Munoz-Bullon & Sanchez-Bueno, 2011; Munari, et.al., 2010; Chen & Hsu, 2009). That is, given the distinctive firm characteristics and the risk-taking behaviour of family firms, these firms usually underinvest in innovation to protect their socioemotional wealth goals compared to the non-family firms (e.g., Duran et.al., 2016; Patel & Chrisman, 2014). To further assess the differences between family-controlled and non-family-controlled firms' use of cash for R&D smoothing, a two-way interaction term is applied between the ultimate firm control and the changes in cash holdings. The results for two-way interaction term (Model 1; Table 7) also give statistically significant outcome (p<0.05), as the main effect of the changes in cash holdings. The coefficient value for the interaction effect of changes in cash holdings and ultimate firm control reveals that the slope of change in cash holdings for family-controlled firms is -0.03 (p<0.05) while that for non-family firms is -0.17

(p<0.01). This explicitly shows that the effect of changes in cash holdings on R&D smoothing is comparatively stronger for non-family firms than the family-controlled firms in the presence of financing frictions. However, this effect is reversed for firms with less financing constraints and higher cash levels in time 't' compared to 't-1'. That is, the family-controlled firms smoothen their R&D investments more when a higher level of cash holdings are in place in contemporaneous time period 't' than 't-1' when compared with non-family firms (Hypothesis 1). To visualise these differences in R&D smoothing between the family-controlled and non-family firms, a contrast of margins graph (Fig.F) is plotted below. The graph contrasts the average marginal interactive effects of ultimate firm control and the changes in cash holdings with non-family firms as the reference group for comparison.

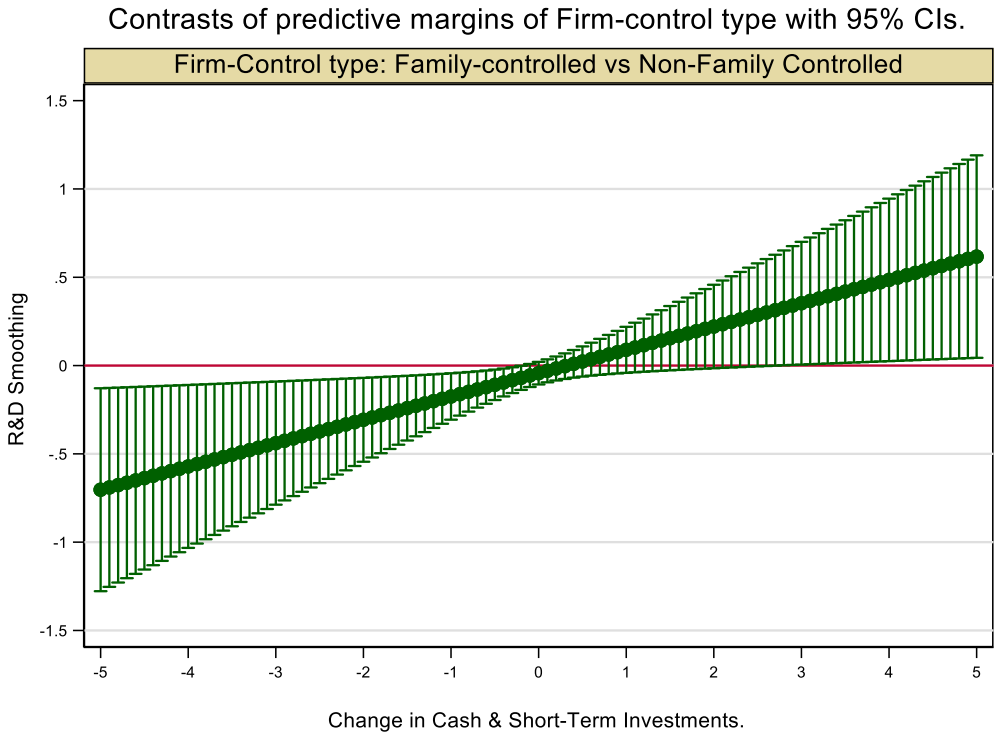

Fig. F R&D Smoothing, Change in Cash & short-term investments. The figure exhibits the average contrast of marginal effect for changes in cash and short-term investments over the ultimate firm control (non-family firms is used as reference group).

The graph shows that the use of cash holdings for R&D smoothing differs across firms exercising different types of ultimate firm control. That is, besides the negative impact of the changes in cash holdings on R&D smoothing as confirmed by earlier literature, R&D smoothing using cash holdings appears to be substantially and significantly lower for family-controlled firms compared to the non-family firms (reference group) in the presence of financing constraints. The significance of results can be confirmed from above graph as the effects for family-controlled firms are not only below the reference line but are also different from 0. So, as shown in Table 7, the smoothing of cyclical patterns in R&D investments across family-controlled firms increases at the rate of 0.03 when the firms spare an additional unit of cash in time period 't' while the smoothing of R&D investments can be observed to increase by 0.17 across non-family firms. This suggests that as the firms spare an additional unit of cash, an increasing effect can be observed with regards to the role of cash reserves in smoothing the volatilities in R&D investments. However, this effect is quantitively much smaller across family-controlled firms compared to the non-family firms when the firms are faced with financing frictions. However, this reliance and tendency of firms to smoothen the volatilities in R&D investments using cash reserves its effects and becomes more pronounced across family-controlled firms compared to non-family when sufficiently higher cash reserves are available in the contemporary time period 't'. That is, given the sufficient availability of cash reserves, the family-controlled firms appear to be more willing to use cash for R&D smoothing compared to non-family firms.

To test hypothesis 2 i.e., the effect of varying intensities of ultimate firm control on the firms' use of cash reserves for R&D smoothing, the sample data is classified into three categories based on the voting rights control of individual(s) or the family investors. In this regard, one group refers to the firms where the shareholders have less than 20% control over the firm (i.e., the non-family firms represented by dummy variable 0). The second group involves firms where the individual or family investors have greater than 20% but less than 48% voting rights control over the firm (dummy variable =1) while the third category includes family firms with ultimate control rights of individual or family investors greater than or equal to 48% (represented by dummy variable 2). This categorization shows that the main effect for the intensity of ultimate family control is a negative and significant coefficient value only for the family-controlled firms with control rights equal to or greater than 48% (-0.04). Furthermore, the two step GMM estimation presents some interesting results when the effect of the intensities of ultimate control rights was jointly assessed with the firms' use of cash holdings for R&D smoothing. In this respect, the estimate for the interaction term between the varying intensities of ultimate firm control and the changes in cash holdings revealed the average marginal effects to be a statistically significant negative coefficient value for the non-family firms (-0.137; Model 2). However, for family-controlled firms with control intensities between 20-48%, the coefficient is a marginally significant negative coefficient value of -0.039 ($p<0.10$; Model 2) while for family firms with control intensity greater than or equal to 48%, a statistically significant negative coefficient value has been observed which is comparatively much smaller in magnitude than the non-family-firms (-0.01, $p<0.01$; Model 2). This implies that as the control rights of ultimate individual or family investors increases, they become most risk averse and their tendency to smoothen R&D investments using cash is the least in the presence of financing constraints. But their reliance on cash reserves is strengthened when they are faced with less financing constraints. For low-intensity family-controlled firms, the effect of R&D smoothing using cash reserves is not significantly different from the non-family firms. This is also illustrated in the graph below (Fig. G):

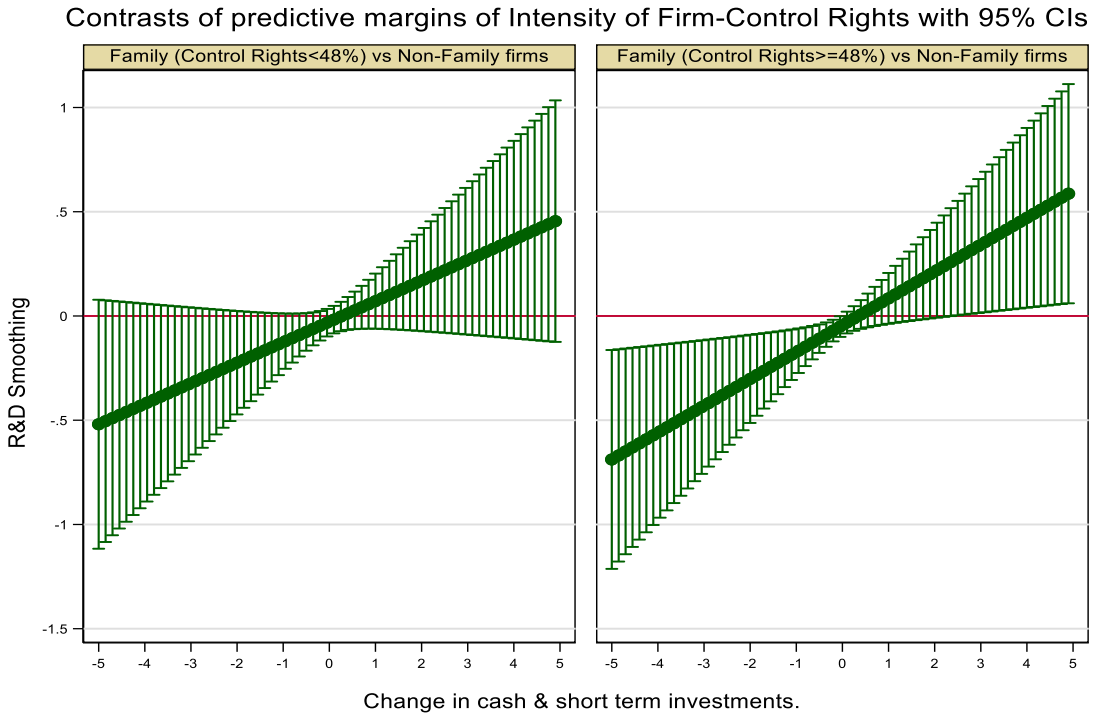

Fig.G. R&D Smoothing, Change in Cash & short-term investments. The figure exhibits the expected values of R&D Smoothing due to changes in cash and short-term investments for both family-controlled and non-family-controlled 'R&D reporting' sample.

The graph suggests that with the increasing intensity of ultimate family control, the firms' use of cash reserves for maintaining a smooth flow of R&D investments also gets strengthened when they are faced with less financing frictions. This finding contributes to the existing empirical findings on family firms' R&D investments that mainly emphasize the role of firm ownership in influencing firm's R&D investments as an innovation input (e.g., Kotlar et al., 2014; Chrisman & Patel, 2012; Block, 2012) compared to the non-family firms. This study, however, in contrast explains the financing menu of family firms for maintaining a smooth path of family firms' R&D investments. And, in this respect, the interactive effects of ultimate firm control and the changes in cash holdings support H1 that posits the unconstrained family businesses to be more inclined towards using cash reserves for promoting a smooth path of R&D investments compared to the non-family firms. Likewise, the results also support H2 that the effects of ultimate family control on firms' use of cash reserves for R&D smoothing are strikingly stronger across family-firms with high control intensity.

These results have theoretical implications for prospect theory which suggests the probability of an organization to be risk-taker in a 'loss' situation while risk-averse in a 'gain' domain (Fang et.al., 2021). In view of this, the non-family firms who invest a non-trivial amount in R&D investments preferably maintain a smooth path of R&D given the high adjustment costs of R&D investments. For family-controlled firms, this application of prospect theory however can be coupled with pecking order theory with the recognition that family firms differ from non-family firms in their way of using cash reserves for R&D smoothing. As earlier literature on family firms (e.g., Gomez-Mejia et. al., 2007) claimed that family firms often need to maintain a balance between the economic and non-economic endowments (Gomez-Mejia et al., 2014; Kotlar et al., 2014) which may make them risk averse for investing in innovation initiatives, it does not fully recognize how family firms finance and smoothen the volatilities in R&D investments compared to the non-family firms. The primary implication of our research findings is that the family-controlled firms though underinvest in R&D compared to non-family firms, they are more likely to stabilize the volatilities in R&D investments using cash reserves when they are less financially constrained. While non-family firms start out with higher R&D smoothing in the presence of financing constraints, family-firms with high control intensity catch up to non-family firms as the financing constraints are reduced and even surpass them when sufficient cash resources are available. This effect of R&D smoothing across family-controlled firms particularly those with high control intensity can also be supported for the reason that as the family maintains a significant control over the firm, the family owners exercise greater authority over the firm to shape its decisions (De Massis et al., 2020) and are less accountable for the decisions that did not work well, and also less evaluated for their choices and investment decisions (Chrisman & Patel, 2012). Hence, this perspective encourages family firms with high control intensity to smoothen the volatilities in their risky R&D investments when they have sufficiently higher cash resources available.

As the results reported the smoothing of R&D investments to differ by the type of ultimate firm control, the R&D reporting sample data is further classified on the basis of financing constraints to assess if there is an interaction between the financing constraints and the changes in cash holdings. For this purpose, the R&D reporting sample is split into young and mature firms based on the firm age and likewise small-medium and large-sized firms depending on the firms' sales. The estimated coefficients for the main effects of firm age reported a negative coefficient value. Similarly, for the joint effect of firm age and change in cash holdings (Model 3), the slope of young firms is observed to be -0.283 ($p<0.01$) while the mature firms reported an average marginal effect of -0.10 ($p<0.05$). This implies that in the presence of financing frictions, young firms spare more cash reserves for R&D smoothing. However, the mature firms comparatively do less smoothing when they are faced with greater financing constraints. These findings are also comparable to existing studies and confirm H3. That is, the combined effect of firms' age and the changes in cash holdings exhibit a greater effect of R&D smoothing using cash reserves for young firms when they are more financially constrained. So, young firms that are more R&D intensive are probable to consume more of their internal equity to smoothen R&D investments when they are faced with financing frictions compared to the mature firms. This effect is also illustrated graphically by plotting marginal graph which supports H3.

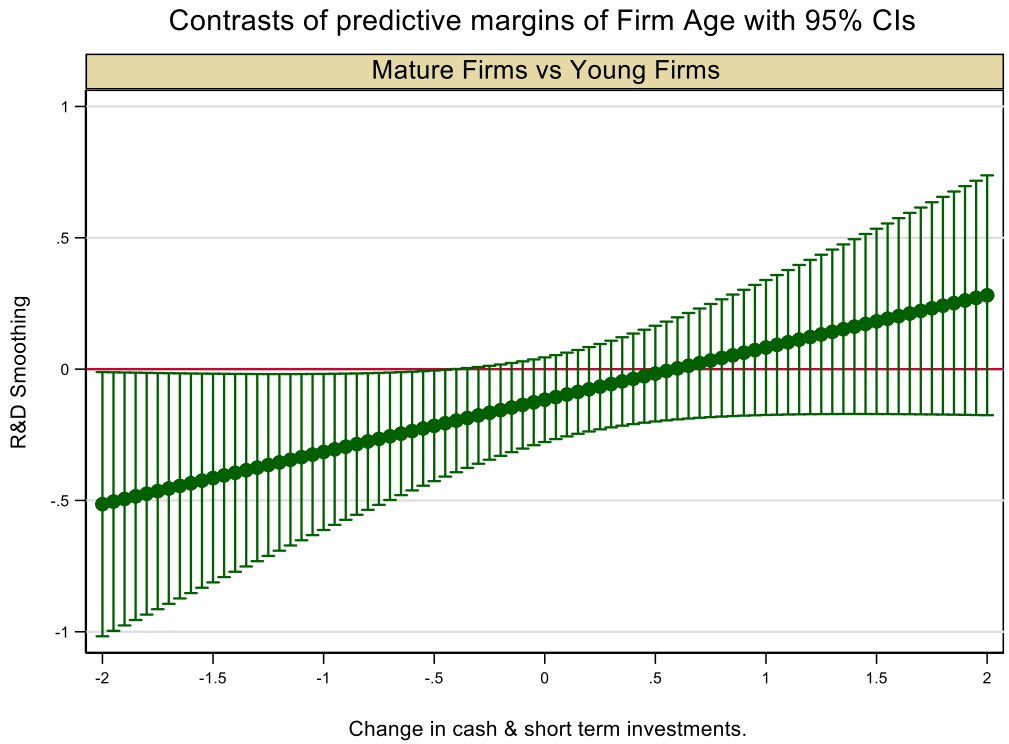

Fig. H R&D Smoothing, Change in Cash & short-term investments. The figure exhibits the average marginal effect of changes in cash and short-term investments over young and mature R&D firms.

Likewise, firm size reveals marginally significant negative coefficient value for large-sized firms. However, the results are insignificant for the interaction effects of firm size and changes in cash holdings.

To examine the dynamics of the use of cash reserves for dampening the volatilities in R&D investments across technologically intensive family-controlled and non-family firms, the sample data is further restricted to hi-tech family-controlled and hi-tech non-family firms. This categorization classifies firms as hi-tech if they belong to one of the technology-intensive industries like pharmaceuticals, computer and electrical equipment, electronics, telecommunications, semiconductors, information processing etc. (Chan, et.al., 1990). The results revealed that the average marginal effects of changes in cash holdings on R&D smoothing is -0.243 ($p<0.01$) for non-family firms. Likewise, family-firms with low-control intensity i.e., control rights <48% reported an average marginal effect of -0.271 ($p<0.01$) which is approximately very closer in magnitude to the non-family firms. Contrarily, for family-controlled firms with control rights <=48%, the average marginal effect is significantly different and lower than the marginal effects of other two categories of ultimate firm control in the presence of financing frictions.

Nevertheless, the above results display significant differences between the marginal effects of the change in cash holdings across family-controlled and non-family firms for smoothing R&D investments, an estimation is run to analyse how financing frictions differently impact the family-controlled firms with different control intensities and varying financing constraints. Overall, the results suggest that low control intensity family-controlled firms exert a quantitatively greater impact on family firms' use of cash holdings for dampening the volatilities in R&D investments when faced with financing frictions compared to family-firms with high control intensity. That is, the slope of average marginal effects for family-controlled firms with control rights less than 48% is observed to be -0.293 ($p<0.01$) while the slope of family-firms with high control intensity is reported as -0.097. Similarly, the slope of joint effect of firm age and changes in cash holdings reported an average marginal effect of -0.504 ($p<0.01$) while for mature family-firms the figure is observed as 0.008. Overall, the results supported H5 wherein the financially constrained family-controlled firms with low control intensity are observed to smoothen R&D investments more using cash

reserves compared to high-control intensity family firms. Results for the impact of varying intensities of ultimate family control on family-firms' R&D smoothing are plotted below:

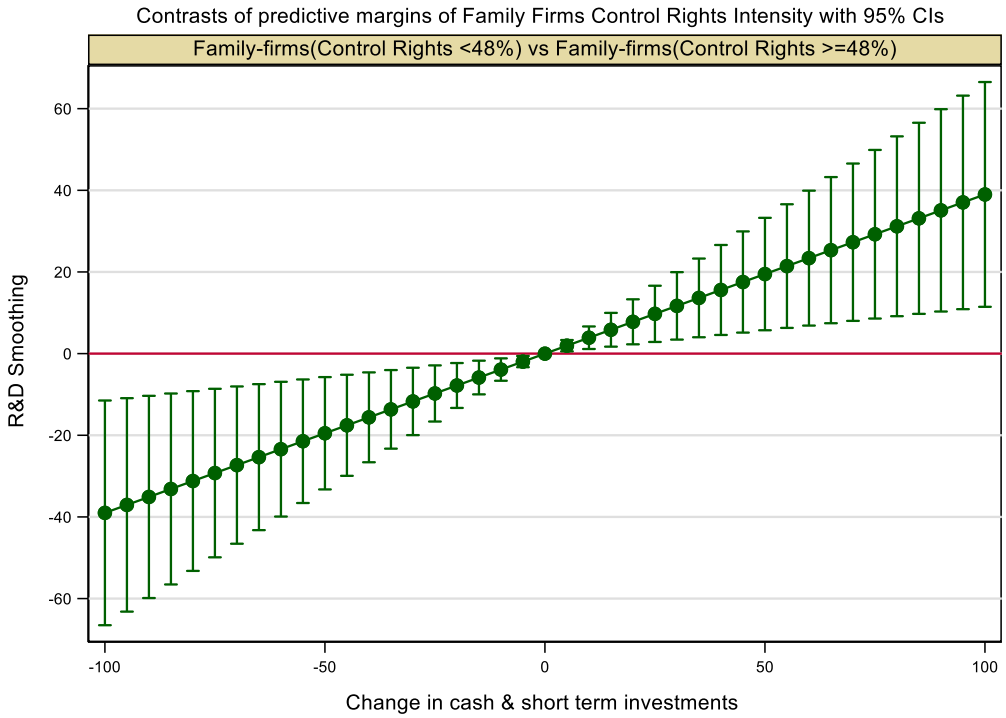

Fig.I R&D Smoothing, Change in Cash & short-term investments for Family firms. The figure exhibits the expected values of R&D Smoothing due to changes in cash and short-term investments for high control intensity and low-control intensity family-controlled firms 'R&D reporting' sample.

As a natural experiment, a dummy variable covid crisis is also used to analyse whether R&D reporting firms perceive the global covid-19 crisis as a threat to the R&D smoothing strategy or an opportunity to maintain a smooth flow of long-term value-creating investments and meet the technological demands. In this respect, Table 7 observes a marginally positive impact of covid-19 on R&D smoothing in Model 5 at 10% level (0.01; $p<0.10$). Furthermore, the lagged values of change in cash holdings are also comparable with earlier literature on R&D smoothing (e.g., Brown & Petersen, 2011) That is, the coefficient values for lagged coefficient of change in cash holdings is negative and insignificant in all the models with the exception of Model 4(Brown & Petersen, 2011). That is, the hi-tech R&D reporting firms sample exhibit a statistically significant negative coefficient value (-0.087; $p<0.05$).

Similarly, the contemporaneous coefficients for stock issues are also comparable with earlier studies as they exhibit a positive and statistically significant coefficient values in Model 1, Model 2 & Model 5 for R&D reporting firms while marginally significant in Model 3 & 4. This finding is similar to earlier studies, which suggested the importance of stock issues as an ideal source of external financing for R&D investments. However, compared to the coefficient for change in cash holdings, this coefficient is comparatively much small in magnitude. This, henceforth, suggests the significantly crucial role of cash holdings to R&D smoothing. Likewise, the lag of stock issues is a positive and statistically significant coefficient value only in Hi-tech R&D reporting sample. Unlike cash and stock issues, debt issues revealed insignificant coefficient values in all the models which is not surprising. Illustrating and supporting this finding, existing studies on R&D investments hold that R&D focused firms are in particular exposed to the potential inability to approach external capital markets. One potential cause of this limited access to external funds is mainly because of the intangible capital nature of R&D investments due to which they cannot typically be pledged as collateral for external financing issue (e.g., Falato et.al., 2022; Himmelberg & Petersen, 1994; Brown & Petersen (2011). So, because debt issuance is less likely an alternative for R&D

financing due to the intangibility of R&D assets while stock issuance is likely result in a loss of control over the firms, family firms comparably use more cash reserves for R&D smoothing. Also, R&D projects are assumed to be resource-consuming and highly uncertain investments due to which R&D firms are usually exposed to higher risks. Thus, importantly, the sample data revealed the firms' increasing reliance on cash reserves, all the model specifications established that following the preference for cash holdings, family firms consider stock issuance to be a supportive means of financing R&D investments and a way through which they can manage the financial obligations of the firm (Alkhataybeh, 2018; Brown et al., 2012). Cash flows also imply an insignificant impact however, the lag of cash flows is found to be marginally significant only in Model 1 & 2.

While analysing the impact of Market to book ratio on R&D smoothing across a sample of R&D reporting family and non-family firms, the results revealed that the coefficient is quantitively very small and insignificant coefficient value in all the models. Sales growth, another coefficient for investment demand, revealed an insignificant coefficient value for all the models, finding consistent with Brown & Petersen (2011). To summarise, the results for this study are consistent with the results of Brown & Petersen (2011) & Liu et.al. (2021) on R&D smoothing however the earlier studies did not account for the impact of ultimate firm control, the varying intensities of ultimate control rights and how these variables and technological intensities moderate R&D smoothing of firms using cash holdings. The consistency of two-step system-GMM estimates is verified using Hansen's J-test that validates the validity of instruments, and the Arellano–Bond test for detecting serial autocorrelation.

6. Conclusion

This research examines the impact of ultimate firm control and the varying intensities of ultimate control on R&D smoothing. Also, it assesses the moderating role of ultimate control, control intensity and technological intensity on family-controlled and non-family firms' use of cash holdings for R&D smoothing to emphasize its significance for the corporate financial policies. Earlier literature on family businesses mainly focused on (e.g. Anderson et.al., 2012; Block, 2012; Schmid et.al., 2014; Duran et.al., 2016) analysing the role of family ownership and family management in determining family firms' R&D investment decisions. However, this study extends the earlier literature on family firms by making use of the application of prospect theory and pecking order theory to emphasize that the family firms' choice to invest in innovation may be coupled with the availability of resources. This eventually then determines how the family firms manage a smooth path of R&D investments. Also, it aims to recognize that the way the family firms stabilize the flow of their R&D investments is different from those of the non-family firms. In this respect, the study hypothesizes that family firms tend to use more cash holdings for dampening the volatilities in R&D investments than the non-family firms when the firms are faced with less financing constraints. The study also found that this effect becomes greater as the controlling power of families and individual investors increases which means that with an increase in control over the firm, the family firms become more reliant on internal financing than the external ones in the fear of losing control over the firm. Furthermore, in the presence of financing constraints, the small-medium sized family firms revealed a greater propensity to use cash holdings as a buffer against the transitory finance shocks in R&D investments compared to the large sized family firms. Hence, this research advances the literature findings on R&D investments and innovation preferences across family and non-family firms by using an under-utilized perspective i.e., R&D smoothing. That is, rather than measuring the impact of family ownership and management on R&D, it illustrated how ultimate firm control play a role in stabilizing or maintaining a smooth flow of R&D investments using a dynamic regression model. Also, it answers how the flow of R&D smoothing varies across firms with different ultimate controlling authority and exercising different intensities of controlling power, with the availability of resources and financing constraints faced by the firms.

Additionally, following the earlier studies in innovation literature, for example, Brown & Petersen (2011) and Lyandres & Palazzo (2016) that investigated the growing and positive relationship between

cash and R&D, this study makes an additional contribution by providing important insights into the role of ultimate firm control and how it moderates the smoothing of R&D path using cash. So given the rising significance of R&D in the last few decades, this research study provides important implications for family businesses in the French market. As earlier research exhibited that R&D has grown sharply in the last few decades (Brown & Petersen, 2011; Lyandres & Palazzo, 2016), the potential gains for firms to smoothen the flow of R&D investments have also increased in the recent decades. This study, hence, provides important insights to the family business investors as to how the family businesses can dampen the underlying volatilities in the flow of R&D investments considering their financing abilities and the financing constraints. However, this research study is not without limitations. That is, although this research considered the differences among firms on the basis of ultimate firm control and particularly the heterogeneity across family firms based on their control rights, it did not tap the other rich sources of differences among family firms. For instance, within family firms, there are differences in board structures (single-tier or two-tiered), governance mechanisms (the family firms' involvement in both the management and ownership of firm), degree of professionalism and personal characteristics of family members (e.g., age, gender, experience, education etc.) that might influence the strategic decision making of family firms. Further research across family firms is thus required to compare how the various governance mechanisms and the varying traits of controlling families in family firms influence the family firms' R&D smoothing with cash holdings.

References:

Aboody, D., & Lev, B. (2000). Information asymmetry, R&D, and insider gains. *The Journal of Finance*, *55*(6), 2747-2766.

Alkhataybeh, A. (2021). Working capital and R&D smoothing: evidence from the Tel Aviv stock exchange. *Journal of Applied Economics*, *24*(1), 91-102.

Almeida, H., Campello, M., & Weisbach, M. S. (2004). The cash flow sensitivity of cash. *The journal of finance*, *59*(4), 1777-1804.

Aminadav, G., & Papaioannou, E. (2020). Corporate control around the world. *The Journal of Finance*, *75*(3), 1191-1246.

Amore, M. D., Miller, D., Le Breton-Miller, I., & Corbetta, G. (2017). For love and money: Marital leadership in family firms. *Journal of Corporate Finance*, *46*, 461-476.

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., Mansi, S. A., & Reeb, D. M. (2003). Founding family ownership and the agency cost of debt. *Journal of Financial Economics*, *68*(2), 263-285.

Anderson, R. C., & Reeb, D. M. (2004). Board composition: Balancing family influence in S&P 500 firms. *Administrative Science Quarterly*, *49*(2), 209-237.

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.

Anderson, R. W., & Hamadi, M. (2016). Cash holding and control-oriented finance. *Journal of Corporate Finance*, *41*, 410-425.

Ang, J. S., Cole, R. A., & Lin, J. W. (2000). Agency costs and ownership structure. *The Journal of Finance*, *55*(1), 81-106.

Ayyagari, M., Demirguç-Kunt, A., & Maksimovic, V. (2011). Firm innovation in emerging markets: The role of finance, governance, and competition. *Journal of Financial and Quantitative Analysis*, *46*(6), 1545-1580.

Barth, E., Gulbrandsen, T., & Schonea, P. (2005). Family ownership and productivity: The role of owner-management. *Journal of Corporate Finance*, *11*(1-2), 107-127.

Barney, J. B. (2001). Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of management*, *27*(6), 643-650.

Bebchuk, L., Cohen, A., & Ferrell, A. (2009). What matters in corporate governance?. *The Review of Financial Studies*, *22*(2), 783-827.

Berger, A. N., & Udell, G. F. (1990). Collateral, loan quality and bank risk. *Journal of Monetary Economics*, *25*(1), 21-42.

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

Block, J. H. (2012). R&D investments in family and founder firms: An agency perspective. *Journal of business venturing*, *27*(2), 248-265.

Bolton, P., Chen, H., & Wang, N. (2011). A unified theory of Tobin's q, corporate investment, financing, and risk management. *The Journal of Finance*, *66*(5), 1545-1578.

Bond, S., & Meghir, C. (1994). Dynamic investment models and the firm's financial policy. *The Review of Economic Studies*, *61*(2), 197-222.

Borisova, G., & Brown, J. R. (2013). R&D sensitivity to asset sale proceeds: New evidence on financing constraints and intangible investment. *Journal of Banking & Finance*, *37*(1), 159-173.

Brown, J. R., Fazzari, S. M., & Petersen, B. C. (2009). Financing innovation and growth: Cash flow, external equity, and the 1990s R&D boom. *The Journal of Finance*, *64*(1), 151-185.

Brown, J. R., & Petersen, B. C. (2015). Which investments do firms protect? Liquidity management and real adjustments when access to finance falls sharply. *Journal of Financial Intermediation*, *24*(4), 441-465.

Brown, J. R., & Petersen, B. C. (2011). Cash holdings and R&D smoothing. *Journal of Corporate Finance*, *17*(3), 694-709.

Bunkanwanicha, P., Fan, J. P., & Wiwattanakantang, Y. (2013). The value of marriage to family firms. *Journal of Financial and Quantitative Analysis*, *48*(2), 611-636.

Burkart, M., Panunzi, F., & Shleifer, A. (2003). Family firms. *The Journal of Finance*, *58*(5), 2167-2201.

Carnes, C. M., & Ireland, R. D. (2013). Familiness and innovation: Resource bundling as the missing link. *Entrepreneurship Theory and Practice*, *37*(6), 1399-1419.

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.

Chen, T. Y., Dasgupta, S., & Yu, Y. (2014). Transparency and financing choices of family firms. *Journal of Financial and Quantitative Analysis*, *49*(2), 381-408.

Chrisman, J. J., Chua, J. H., & Litz, R. A. (2004). Comparing the agency costs of family and non–family firms: Conceptual issues and exploratory evidence. *Entrepreneurship Theory and practice*, *28*(4), 335-354.

Chrisman, J. J., & Patel, P. C. (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., De Massis, A., & Wang, H. (2018). Reflections on family firm goals and the assessment of performance. *Journal of Family Business Strategy*, *9*(2), 107-113.

Chua, J. H., Chrisman, J. J., & Sharma, P. (1999). Defining the family business by behavior. *Entrepreneurship theory and practice*, *23*(4), 19-39.

Claessens, S., Djankov, S., Fan, J. P., & Lang, L. H. (2002). Disentangling the incentive and entrenchment effects of large shareholdings. *The Journal of Finance*, *57*(6), 2741-2771.

Cronqvist, H., & Nilsson, M. (2003). Agency costs of controlling minority shareholders. *Journal of Financial and Quantitative analysis*, *38*(4), 695-719.

De Massis, A., Frattini, F., Kotlar, J., Petruzzelli, A. M., & Wright, M. (2016). Innovation through tradition: Lessons from innovative family businesses and directions for future research. *Academy of management Perspectives*, *30*(1), 93-116.

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.

De Massis, A. V., & Rondi, E. (2020). COVID-19 and the future of family business research. *Journal of Management Studies*, *57*(8), 1727-1731.

Denis, D. J., & Denis, D. K. (1994). Majority owner-managers and organizational efficiency. *Journal of Corporate Finance*, *1*(1), 91-118.

Djankov, S., Glaeser, E., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2003). The new comparative economics. *Journal of Comparative Economics*, *31*(4), 595-619.

Donelli, M., Larrain, B., & Urzua, I. F. (2013). Ownership dynamics with large shareholders: An empirical analysis. *Journal of Financial and Quantitative Analysis*, *48*(2), 579-609.

Doucet, P., & Requejo, I. (2022). Financing constraints and growth of private family firms: Evidence from different legal origins. *Finance Research Letters*, *44*, 102034.

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.

Eddleston, K. A., Kellermanns, F. W., & Sarathy, R. (2008). Resource configuration in family firms: Linking resources, strategic planning and technological opportunities to performance. *Journal of Management Studies*, *45*(1), 26-50.

Faccio, M., & Lang, L. H. (2002). The ultimate ownership of Western European corporations. *Journal of Financial Economics*, *65*(3), 365-395.

Faccio, M., Marchica, M. T., & Mura, R. (2011). Large shareholder diversification and corporate risk-taking. *The Review of Financial Studies*, *24*(11), 3601-3641.

Falato, A., Kadyrzhanova, D., Sim, J., & Steri, R. (2022). Rising intangible capital, shrinking debt capacity, and the US corporate savings glut. *The Journal of Finance*, *77*(5), 2799-2852.

Fang, H. C., Memili, E., Chrisman, J. J., & Tang, L. (2021). Narrow-framing and risk preferences in family and non-family firms. *Journal of Management Studies*, *58*(1), 201-235.

Fahlenbrach, R. (2009). Founder-CEOs, investment decisions, and stock market performance. *Journal of Financial and Quantitative Analysis*, *44*(2), 439-466.

Faulkender, M., & Wang, R. (2006). Corporate financial policy and the value of cash. *The journal of finance*, *61*(4), 1957-1990.

Franks, J., Mayer, C., Volpin, P., & Wagner, H. F. (2012). The life cycle of family ownership: International evidence. *The Review of Financial Studies*, *25*(6), 1675-1712.

Gamba, A., & Triantis, A. (2008). The value of financial flexibility. *The Journal of Finance*, *63*(5), 2263-2296.

Gomez–Mejia, L. R., Campbell, J. T., Martin, G., Hoskisson, R. E., Makri, M., & Sirmon, D. G. (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. R., Haynes, K. T., Nunez-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.

Gudmundson, D., Tower, C. B., & Hartman, E. A. (2003). Innovation in small businesses: Culture and ownership structure do matter. *Journal of Developmental entrepreneurship*, *8*(1), 1.

Hall, B. H., & Lerner, J. (2010). The financing of R&D and innovation. In *Handbook of the Economics of Innovation* (Vol. 1, pp. 609-639). North-Holland.

He, Z., & Wintoki, M. B. (2016). The cost of innovation: R&D and high cash holdings in US firms. *Journal of Corporate Finance*, *41*, 280-303.

Himmelberg, C. P., & Petersen, B. C. (1994). R & D and internal finance: A panel study of small firms in high-tech industries. *The review of economics and statistics*, 38-51.

Holderness, C. G., & Sheehan, D. P. (1988). The role of majority shareholders in publicly held corporations: An exploratory analysis. *Journal of Financial Economics*, *20*, 317-346.

Huang, M., Li, P., Meschke, F., & Guthrie, J. P. (2015). Family firms, employee satisfaction, and corporate performance. *Journal of Corporate Finance*, *34*, 108-127.

Jiang, F., Shi, W., & Zheng, X. (2020). Board chairs and R&D investment: Evidence from Chinese family-controlled firms. *Journal of Business Research*, *112*, 109-118.

Kang, T., Baek, C., & Lee, J. D. (2017). The persistency and volatility of the firm R&D investment: Revisited from the perspective of technological capability. *Research Policy*, *46*(9), 1570-1579.

Kellermanns, F. W., & Eddleston, K. A. (2006). Corporate entrepreneurship in family firms: A family perspective. *Entrepreneurship theory and practice*, *30*(6), 809-830.

Kim, Y., & Gao, F. Y. (2013). Does family involvement increase business performance? Family-longevity goals' moderating role in Chinese family firms. *Journal of Business Research*, *66*(2), 265-274.

Kotlar, J., Fang, H., De Massis, A., & Frattini, F. (2014). Profitability goals, control goals, and the R & D investment decisions of family and nonfamily firms. *Journal of Product Innovation Management*, *31*(6), 1128-1145.

Kripfganz, S. (2019, September). Generalized method of moments estimation of linear dynamic panel data models. In *London Stata Conference* (Vol. 17).

Kripfganz, S., & Schwarz, C. (2019). Estimation of linear dynamic panel data models with time-invariant regressors. *Journal of Applied Econometrics*, *34*(4), 526-546.

La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2006). What works in securities laws?. *The Journal of Finance*, *61*(1), 1-32.

La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (1999). Corporate ownership around the world. *The Journal of Finance*, *54*(2), 471-517.

Lansberg, I. (1999). *Succeeding generations: Realizing the dream of families in business*. Harvard Business Review Press.

Le Breton-Miller, I., & Miller, D. (2008). To grow or to harvest? Governance, strategy and performance in family and lone founder firms. *Journal of Strategy and Management*.

Leenders, M., & Waarts, E. (2003). Competitiveness and Evolution of Family Businesses: The Role of Family and Business Orientation. *European Management Journal*, *21*(6), 686-697.

Lins, K. V., & Servaes, H. (2002). Is corporate diversification beneficial in emerging markets?. *Financial Management*, 5-31.

Lins, K. V., Volpin, P., & Wagner, H. F. (2013). Does family control matter? International evidence from the 2008–2009 financial crisis. *The Review of Financial Studies*, *26*(10), 2583-2619.

Liu, D., Li, Z., He, H., & Hou, W. (2021). The determinants of R&D smoothing with asset sales: Evidence from R&D-intensive firms in China. *International Review of Economics & Finance*, *75*, 76-93.

Liu, Q., Luo, T., & Tian, G. G. (2015). Family control and corporate cash holdings: Evidence from China. *Journal of Corporate Finance*, *31*, 220-245.

Lyandres, E., & Palazzo, B. (2016). Cash holdings, competition, and innovation. *Journal of Financial and Quantitative Analysis. 51*, 1823-1861.

Malamud, S., & Zucchi, F. (2019). Liquidity, innovation, and endogenous growth. *Journal of Financial Economics*, *132*(2), 519-541.

Maury, B. (2006). Family ownership and firm performance: Empirical evidence from Western European corporations. *Journal of Corporate Finance*, *12*(2), 321-341.

McConaughy, D. L., Walker, M. C., Henderson Jr, G. V., & Mishra, C. S. (1998). Founding family-controlled firms: Efficiency and value. *Review of Financial Economics*, *7*(1), 1-19.

Mikkelson, W. H., & Partch, M. M. (2003). Do persistent large cash reserves hinder performance?. *Journal of financial and quantitative analysis*, *38*(2), 275-294.

Miller, D., & Le Breton-Miller, I. (2021). Family firms: A breed of extremes?. *Entrepreneurship Theory and Practice*, *45*(4), 663-681.

Miller, D., & Le Breton-Miller, I. (2006). Family governance and firm performance: Agency, stewardship, and capabilities. *Family business review*, *19*(1), 73-87.

Miller, D., Le Breton-Miller, I., Lester, R. H., & Cannella Jr, A. A. (2007). Are family firms really superior performers?. *Journal of corporate finance*, *13*(5), 829-858.

Mishra, C. S., & McConaughy, D. L. (1999). Founding family control and capital structure: The risk of loss of control and the aversion to debt. *Entrepreneurship theory and practice*, *23*(4), 53-64.

Morck, R., Shleifer, A., & Vishny, R. W. (1988). Management ownership and market valuation: An empirical analysis. *Journal of financial economics*, *20*, 293-315.

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.

Munoz-Bullon, F., & Sanchez-Bueno, M. J. (2011). The impact of family involvement on the R&D intensity of publicly traded firms. *Family Business Review*, *24*(1), 62-70.

Opler, T., Pinkowitz, L., Stulz, R., & Williamson, R. (1999). The determinants and implications of corporate cash holdings. *Journal of Financial Economics*, *52*(1), 3-46.

Reed, R., & DeFillippi, R. J. (1990). Causal ambiguity, barriers to imitation, and sustainable competitive advantage. *Academy of management review*, *15*(1), 88-102.

Roe, M. J. (2006). Legal origins, politics, and modern stock markets. *Harvard Law Review*, 460-527.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The stata journal*, *9*(1), 86-136.

Schmid, T., Achleitner, A. K., Ampenberger, M., & Kaserer, C. (2014). Family firms and R&D behavior–New evidence from a large-scale survey. *Research Policy*, *43*(1), 233-244.

Sciascia, S., Nordqvist, M., Mazzola, P., & De Massis, A. (2015). Family ownership and R&D intensity in small-and medium-sized firms. *Journal of Product Innovation Management*, *32*(3), 349-360.

Shleifer, A., & Vishny, R. W. (1997). A survey of corporate governance. *The Journal of Finance*, *52*(2), 737-783.

Shleifer, A., & Vishny, R. W. (1986). Large shareholders and corporate control. *Journal of Political Economy*, *94*(3, Part 1), 461-488.

Sirmon, D. G., Hitt, M. A., Ireland, R. D., & Gilbert, B. A. (2011). Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects. *Journal of management*, *37*(5), 1390-1412.

Sraer, D., & Thesmar, D. (2007). Performance and behavior of family firms: Evidence from the French stock market. *Journal of the European economic Association*, *5*(4), 709-751.

Stulz, R. (1988). Managerial control of voting rights: Financing policies and the market for corporate control. *Journal of financial Economics*, *20*, 25-54.

Ullah, S., Akhtar, P., & Zaefarian, G. (2018). Dealing with endogeneity bias: The generalized method of moments (GMM) for panel data. *Industrial Marketing Management*, *71*, 69-78.

Villalonga, B., & Amit, R. (2009). How are US family firms controlled?. *The Review of Financial Studies*, *22*(8), 3047-3091.

Villalonga, B., & Amit, R. (2006). How do family ownership, control and management affect firm value?. *Journal of Financial Economics*, *80*(2), 385-417.

Xu, T. (2021). Do excess control rights benefit creditors? Evidence from dual-class firms. *Journal of Financial and Quantitative Analysis*, *56*(3), 821-852.

Zahra, S. A., Hayton, J. C., & Salvato, C. (2004). Entrepreneurship in family vs. non–family firms: A resource–based analysis of the effect of organizational culture. *Entrepreneurship theory and Practice*, *28*(4), 363-381.

APPENDIX: Variable's definition

VARIABLES DEFINITION FROM THOMSON REUTERS EIKON DATABASE	
Variables	**Definition**
1. Ultimate parent	The organization that resides at the top of a hierarchy tree, which has no Immediate Parent other than itself. Ultimate Parent is a derived relationship, based on the Immediate Parent populated.
2. Strategic Entity	Entities (incl. individuals) that do not invest for 'investment management' purposes, but rather invest in companies as strategic shareholders.
3. Individual Investor	Individual Investor include Individual wealthy investors.
4. Other Insider/Directors	Other Insider/Directors represent holdings and transactions by any entity (person, institution, trust, company, etc.) that is in a "policymaking" position, officer, director, or a beneficial owner of a company's stock.
VARIABLES DEFINITION FROM WORLDSCOPE DATABASE	
5. Major Shareholders	**Major Shareholders Stock Data, Current Item; Field 18370 All Industries:** MAJOR SHAREHOLDERS represent any individual or company that owns more than the local legal disclosure requirement of the outstanding shares of a company. The name of the individual or group along with the percent of outstanding shares held are shown in this fields. This is a free text field; shareholders are separated by a semi-colon. This field replaces historic fields 18360 18369 Major Shareholders 1 10, which restricted collection to ten shareholders. Data for this field is available prior to Jan 2014.
6. Market Capitalization	**Market Capitalization (U.S.$) Supplementary Data, Annual & Interim Item; Field 07210 All Industries:** MARKET CAPITALIZATION (U.S.$) represents the total market value of the company based on year end price and number of shares outstanding converted to U.S. dollars using the year end exchange rate. For companies with more than one type of common/ordinary share, market capitalization represents the total market value of the

	company. This item is also available at the security level for 1987 and subsequent years.
VARIABLES DEFINITION FROM COMPUSTAT DATABASE	
7. Assets - Total	**Mnemonic** **Category** **Periodicity** **Format** **Units** AT Balance Sheet Annual Number Millions This item represents the total value of assets reported on the Balance Sheet. This item is available for the Bank, Financial Services, and Industrial formats. U.S. GAAP and Canadian IFRS Definition (Canadian GAAP prior to January 1, 2011) This item represents current assets plus net property, plant, and equipment plus other noncurrent assets, including intangible assets, deferred items and investments and advances. The item is the sum of: 1. Current Assets - Total (ACT) 2. Property, Plant and Equipment (Net) - Total (PPENT) 3. Investment & Advances - Equity (IVAEQ) 4. Investment & Advances - Other (IVAO) 5. Intangible Assets - Total (INTAN) 6. Assets - Other - Total (AO) **International Definition** **Industrial Definition** Assets - Total is the sum of: 1. Assets - Other - Total (AO) 2. Current Assets - Total (ACT) 3. Property, Plant, and Equipment (Net) - Total (PPENT) 4. Intangible Assets - Total (INTAN) 5. Investments and Advances - Equity Method (IVAEQ) 6. Investments and Advances - Other (IVAO) This item excludes contingencies reported supplementary to the Balance Sheet
8. Research & Development expense	**Mnemonic** **Category** **Periodicity** **Format** **Units** XRD Income Statement Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents all costs incurred during the year that relate to the development of new products or services.

	This amount is only the company's contribution. This item includes: 1. Software expenses 2. Amortization of software costs This item excludes: 1. Customer or government-sponsored research and development (including reimbursable indirect costs) 2. Extractive industry activities, such as prospecting, acquisition of mineral rights, drilling, mining, etc. 3. Engineering expense **International Normalized Definition:** This item represents the company's total expenditure on research and development of new or improved product lines and methods of production. **Industrial Definition:** This is a supplementary Income Statement item. This item includes: 1. Amortization of software costs 2. Company- sponsored research and development 3. Software expenses 4. Capitalized R&D This item excludes: 1. Customer- or government-sponsored research and development (including reimbursable indirect costs). 2. Extractive industry activities, such as prospecting, acquisition of mineral rights, drilling, mining, etc. 3. Engineering expense (included in Cost of Goods Sold [COGS] or Selling, General, and Administrative Expense [XSGA]). 4. Inventor royalties (included in Cost of Goods Sold [COGS] or Selling, General, and Administrative Expense [XSGA]). 5. Market research and testing (included in Cost of Goods Sold [COGS] or Selling, General, and Administrative Expense [XSGA]). 6. Support expense.

9. Cash and Short-term investments	**Mnemonic** **Category** **Periodicity** **Format** **Units** CHE Balance Sheet Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP prior to January 1, 2011) This item represents cash and all securities readily transferable to cash as listed in the Current Asset section. This item is not available for banks. This item is a component of Current Assets - Total (ACT). This item is the sum of 1. Cash (CH) 2. Short-Term Investments (IVST) This item includes, but is not limited to 1. Cash in escrow, unless legally restricted, in which case it is included in Current Assets - Other 2. Good faith and clearing house deposits for brokerage firms 3. Government and other marketable securities, including stocks and bonds, listed as short-term 4. Letters of credit 5. Margin deposits on commodity futures contracts 6. Time, demand and certificates of deposit 7. The total of a bank's currency and coin, plus its reserves with the Federal Reserve Bank and balances with other banks 8. Restricted cash This item excludes 1. Money due from sale of debentures, included in Receivables - Other Current 2. Commercial paper issued by unconsolidated subsidiaries to the parent company, included in Receivables - Other Current 3. Bullion, bullion in transit, uranium in transit, etc., included in Inventories - Raw Materials This item is the sum of: 1. Cash (CH) 2. Short-Term Investments - Total (IVST) This item is not available for utilities. **International Definition** This item represents any immediately negotiable medium of exchange and funds convertible into cash within a short period of time. This item is a component of Current Assets - Total (ACT).

	This item is the sum of: 1. Cash (CH) 2. Short-Term Investments - Total (IVST) This item includes liquid funds when no breakout from cash and short-term investments is available.
10. Income Before Extraordinary Items	**Mnemonic** **Category** **Periodicity** **Format** **Units** IB Income Statement Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents the income of a company after all expenses, including special items, income taxes, and minority interest, but before provisions for common and/or preferred dividends. This item does not reflect discontinued operations (appearing below taxes) or extraordinary items. This item is available for banks. This item includes, when reported below taxes: 1. Amortization of intangibles 2. Equity in earnings of unconsolidated subsidiaries 3. Gain or loss on the sale of securities when they are a regular part of a company's operations 4. Shipping companies' operating differential subsidies (current and prior years) This item represents: 1. Pre-tax Income (PI) *less:* 2. Income Taxes - Total (TXT) *less:* 3. Minority Interest - Income Account (MII) This item, for banks, includes net After-Tax and after-minority interest profit or loss on securities sold or redeemed. **International Definition** **Industrial Definition** This item represents income after the deduction of all expenses, including allocations to untaxed Balance Sheet reserves (if applicable), income taxes, minority interest, and net items, but before extraordinary items and provisions for dividends. This item is the sum of: 1. Pre-tax Income (PI) 2. Net Items - Total (NIT) *less:* 3. Appropriations to Untaxed Reserves (AUTXR) 4. Income Taxes - Total (TXT)

	5. Minority Interest (Income Account) (MII)
11. Depreciation and Amortization	**Mnemonic** **Category** **Periodicity** **Format** **Units** DP Income Statement Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents non-cash charges for obsolescence of and wear and tear on property, allocation of the current portion of capitalized expenditures, and depletion charges. This item is available for banks. This item is the sum of: 1. Depreciation of Tangible Fixed Assets (DFXA) 2. Amortization of Intangibles (AM) This item includes: 1. Amortization of patents, trademarks, and other intangibles 2. Amortization of book plates 3. Amortization of capitalized leases 4. Amortization of leasehold improvements 5. Amortization of tools and dies 6. Depletion charges 7. Real estate companies' amortization of development and production expense if not part of property, plant and equipment 8. Airlines' provision for obsolescence of materials and supplies even if the associated item is a current asset 9. Extractive industries' abandonments, retirements, intangible drilling costs and dry-hole expense for companies using the full-cost method of accounting for oil assets. 10. Utilities' amortization charges to operation 11. Amortization of software costs, included in Selling, General, and Administrative Expenses This item excludes: 1. Amortization of dry-hole expense for companies using the successful-efforts method of accounting for oil assets (included in Selling, General, and Administrative Expenses). When dry-hole expense is combined with an item properly classified as depreciation (for example, dry holes and abandonments), S&P Global Market Intelligence will determine whether dry holes or abandonments constitute the greater figure and the Combined Figure data code will be placed in either Depreciation and Amortization or included in the calculation for Selling, General and Administrative Expenses. 2. Amortization of debt discount or premium, included in Interest Expense

	3. Amortization of deferred cost, included in Cost of Goods Sold 4. Amortization of deferred investment tax credits 5. Amortization of negative intangibles, included in Nonoperating Income (Expense) 6. Amortization of research and development expenses, included in Selling, General, and Administrative Expenses 7. Depreciation on discontinued operations, included in Special Items or Extraordinary Items when presented below taxes 8. Depreciation on property, plant, and equipment not used in operations 9. Depreciation and amortization of unconsolidated subsidiaries, included in Nonoperating Income (Expense) 10. Telephone industries' depreciation charged to clearing accounts, included in Selling, General, and Administrative Expenses 11. Write-downs of oil and gas properties, included in Cost of Goods Sold 12. This item is the sum of: 13. Depreciation of Fixed Assets (Tangible) (DFXA) 14. Amortization of Intangibles (AM) **International Definition** **Industrial Definition** This item represents total non-cash charges to income for the gradual, systematic reduction of the actual cost or other basic value of tangible and intangible assets over their estimated useful lives. This item is the sum of: 1. Depreciation of Tangible Fixed Assets (DFXA) 2. Amortization of Intangibles (AM) **Note:** If a company reports breakouts in footnotes, the above listed items may not sum to equal this item. This item includes: 1. Amortization of patents, trademarks, and other intangibles 2. Depletion charges 3. Depreciation of Fixed Assets (Tangible) This item excludes: 1. Amortization of deferred charges (included in Cost of Goods Sold) or Operating Expense - Other 2. Depreciation of Fixed Assets (Tangible) (DFXA) not used in operations (included in Nonoperating Income (Expense) – Other
12. Stockholders' Equity - Parent - Total	**Mnemonic** SEQ **Category** Balance Sheet **Periodicity** Annual **Format** Number **Units** Millions

	Note: Prior to SFAS 160 - Noncontrolling Interests in Consolidated Financial Statements, this item was labelled "Stockholders' Equity - Total". U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents the common and preferred shareholders' interest in the company. This item includes: 1. Capital surplus 2. Common/Ordinary Stock (Capital) 3. Nonredeemable preferred stock 4. Redeemable preferred stock 5. Retained earnings 6. Treasury Stock - Total Dollar Amount (reduces Stockholder's Equity) This item is the sum of: 1. Common/Ordinary Equity - Total (CEQ) 2. Preferred/Preference Stock (Capital) - Total (PSTK) In instances where the items CEQ and PSTK are not available, the item SEQ is collected when reported. **International Definition** **Industrial Definition** This item represents common/ordinary and preferred/preference shareholders' interest in the company and any reserves reported in the Stockholders' Equity section. This item is the sum of: 1. Capital Surplus/Share Premium Reserve (CAPS) 2. Common/Ordinary Stock (Capital) (CSTK) 3. Cumulative Translation Adjustment (TRANSA) 4. Equity Reserves - Other (ERO) 5. Participation Rights Certificates (PRC) 6. Preferred/Preference Stock (Capital) - Total (PSTK) 7. Retained Earnings (RE) 8. Revaluation Reserve (RVLRV) 9. Share Capital - Other (SCO) 10. Unappropriated Net Profit (Shareholders' Equity) (UNNP) less: 11. Treasury Stock - All Capital - Total (TSTK) This item excludes all noncontrolling interests. Note: Treasury Stock Asset (TSCA) is *not* excluded from this item.

13. Purchase of Common and Preferred Stock	**Mnemonic** **Category** **Periodicity** **Format** **Units** PRSTKC Cash Flow Annual Number Millions This item represents any use of funds which decreases common and/or preferred stock. This item includes: 1. Conversion of Class A, Class B, special stock, and others, into Common/Ordinary Stock (Capital) 2. Conversion of preferred stock into Common/Ordinary Stock (Capital) 3. Purchase of treasury stock 4. Retirement or redemption of common/ordinary stock 5. Retirement or redemption of preferred stock 6. Retirement or redemption of redeemable preferred stock This item excludes: 1. Purchase of warrants 2. Reduction in stocks of a subsidiary This item contains a Combined Figure data code when: 1. Sale of Common and Preferred Stock is reported net of purchase 2. Purchase of Common and Preferred Stock is combined with another item on a Working Capital Statement (Format Code = 1), a Cash by Source and Use of Funds Statement (Format Code = 2), or a Cash Statement by Activity (Format Code = 3) Purchase of Common and Preferred Stock is combined with another item either outside or within the Financing Activities section on a Statement of Cash Flows Format Code = 7). **International Normalized Definition** **Industrial Definition** This item represents any use of funds decreasing common/ordinary, preferred/preference, participation rights certificates, or other share capital. **Format codes 1-3, 5-7** This item is a component of Uses of Funds - Total (FUSET) on a Working Capital Statement (Format Code 1), a Cash Statement Classified by Source and Use (Format Code 2), a Net Liquid Funds/Net Funds Statement Classified by Source and Use (Format Code = 5), or a Rest of World Cash Flow Statement by Source and Use (Format Code = 11). This item is a component of Cash and Cash Equivalents - Increase (Decrease) (CHECH) on a Cash Statement Classified by Activity (Format Code 3) or a Net Liquid Funds/Net Funds Statement Classified by Source and Use (Format Code = 5). This item is a component of Financing Activities - Net Cash Flow (FINCF) on a Statement of Cash Flows (Format Code 7), a Rest of

	World Cash Flow Statement by Activity (Format Code = 10), or a U.K. (revised FRS 1) Cash Flow Statement (Format Code 12). This item includes: 1. Conversion of Class A, Class B, and special stock into common/ordinary capital 2. Conversion of preferred/preference stock and/or debt into common/ordinary capital 3. Purchase of treasury capital (in Format Codes 1 - 3, 5 - 7, and 12) 4. Retirement or redemption of common/ordinary and preferred/preference capital This item excludes: 1. Purchase of warrants 2. Reduction in capital of subsidiary company 3. Purchase of treasury shares (Format Codes 10 and 11) This item contains a Combined Figure data code when: 1. Purchase of common/ordinary and preferred/preference capital is reported net of sale 2. Sale of common/ordinary and preferred/preference capital is reported outside the Financing Activities section, or if the Balance Sheet reports reductions during the year.
14. Sale of Common and Preferred Stock	**Mnemonic** **Category** **Periodicity** **Format** Uni SSTK Cash Flow Annual Number Mill U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents funds received from issuance of common and preferred stock. This item includes: 1. Conversion of Class A, Class B, special stock, etc., into Common/Ordinary Stock (Capital) 2. Conversion of preferred stock and/or debt into Common/Ordinary Stock (Capital) 3. Exercise of stock options and/or warrants 4. Increase in capital surplus due to stock issuance 5. Related tax benefits due to issuance of common and/or preferred stock 6. Sale of Common/Ordinary Stock (Capital) 7. Sale of preferred stock 8. Sale of redeemable preferred stock 9. Sale of stock This item excludes: 1. Issuance of warrants 2. Stock of subsidiary company

	This item contains a Combined Figure data code when: Purchase of Common and Preferred Stock is reported net of sale A figure for Sale of Common and Preferred Stock is presented outside the Financing Activities section on a Statement of Cash Flows **International Normalized Definition** **Industrial Definition** This item represents funds received from the issuance of common/ordinary, preferred/preference stock, participation rights certificates, or other share capital. This item is a component of Sources of Funds - Total (FSRCT) on a Working Capital Statement (Format Code 1), a Cash Statement Classified by Source and Use (Format Code 2), or a Net Liquid Funds/Net Funds Statement Classified by Source and Use (Format Code = 5). This item is a component of Cash and Cash Equivalents - Increase (Decrease) (CHECH) on a Cash Statement Classified by Activity (Format Code 3) or a Net Liquid Funds/Net Funds Statement Classified by Activity (Format Code 6). This item is a component of Financing Activities - Net Cash (FINCF) on a Statement of Cash Flows (Format Code 7), a Rest of World Cash Flow Statement by Activity (Format Code = 10), or a U.K (revised FRS 1) Cash Flow Statement (Format Code 12). This item is a component of Source of Funds - Total (FSRCT) on a Rest of World Cash Flow Statement by Source and Use (Format Code = 11). This item includes: 1. Conversion of Class A, Class B and special stock into common/ordinary stock 2. Conversion of preferred/preference stock and/or debt into common/ordinary stock 3. Exercise of stock options and/or warrants 4. Increase in capital surplus/share premium reserve due to stock issuance 5. Related tax benefits due to stock issuance 6. Sale of common/ordinary stock 7. Sale of equity stock 8. Sale of participation rights certificates 9. Sale of preferred/preference stock 10. Sale of redeemable preferred/preference stock This item excludes: 1. Issuance of warrants 2. Stock of subsidiary company

	This item contains a Combined Figure data code when: A figure for sale of common/ordinary and preferred/preference capital is reported outside the Financing Activities section on the Statement of Cash Flows (Format Code = 7) Purchase of common/ordinary and preferred/preference capital is reported net of sale Share capital increases are not reported on the Statement of Cash Flows, but are disclosed elsewhere in the company s report
15. Long-Term Debt - Issuance	**Mnemonic** **Category** **Periodicity** **Format** **Units** DLTIS Cash Flow Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item is available for banks and industrial companies. This item includes: 1. Increase in long-term and short-term debt when combined 2. Long-term debt issued for or assumed in an acquisition 3. Proceeds from bonds, capitalized lease obligations, or note obligations 4. Reclassification of current debt to long-term debt This item excludes changes in current debt when reported separately. This item contains a Combined Figure data code when: • Long-Term Debt - Reduction is reported net of the reduction of long-term debt • Issuance of Long-Term Debt is combined with another item within the Financing Activities section on a Statement of Cash Flows (Format Code = 7) Issuance of Long-Term Debt reported outside the Financing Activities section on a Statement of Cash Flows (Format Code = 7) International Normalized Definition Industrial Definition This item represents the amount of funds generated from issuance of long-term debt. **Format Codes 1-3, 5-7** This item is a component of Sources of Funds - Total on a Working Capital Statement (Format Code = 1), a Cash Statement Classified by Source and Use (Format Code = 2), or a Net Liquid Funds/Net Funds Statement Classified by Source and Use (Format Code = 5) This item is a component of Cash and Cash Equivalents - Increase (Decrease) on a Cash Statement Classified by Activity (Format

	Code = 3) or a Net Liquid Funds/Net Funds Statement Classified by Activity (Format Code = 6). This item is a component of Financing Activities - Net Cash Flow on a Statement of Cash Flows (Format Code = 7). This item includes: 1. Changes in debt not classified into current or long-term debt (for companies reporting statement formats other than a Working Capital Statement [Format Code = 1]) 2. Long-term debt issued for or assumed in an acquisition 3. Proceeds from bonds, note obligations, capitalized lease obligations, etc. (funds generated from any long-term debt categories) 4. Reclassification of current debt to long-term debt This item excludes: 1. Changes in current debt (for companies reporting statement formats other than a Working Capital Statement (Format Code = 1) 2. Current maturities of long-term debt (when a breakout is available) (for companies reporting statement formats other than a Working Capital Statement [Format Code = 1]) This item contains a Combined Figure data code when: • Retired long-term debt is reported net of debt issued (included in Long-Term Debt - Reduction) • Different types of long-term debt are combined (and no breakout is available) (included in Source of Funds - Other or Financing Activities - Other)
16. Long-Term Debt - Reduction	**Mnemonic** **Category** **Periodicity** **Format** **Units** DLTR Cash Flow Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents a reduction in long-term debt caused by long-term debt maturing (being classified as a current maturity), payments of long-term debt and the conversion of debt to stock. This item is available for banks. **This item includes:** 1. Conversion of debt to Common/Ordinary Stock (Capital) 2. Change in debt not classified into current and long-term debt on a Cash by Source and Use of Funds Statement (Format Code = 2), a Cash Statement by Activity (Format Code = 3), or a Statement of Cash Flows (Format Code = 7) 3. Change in long-term debt combined with change in current debt

	4. Current maturities of long-term debt for companies reporting a Working Capital Statement (Format Code = 1) 5. Reclassification of long-term debt due to Chapter 11 6. Transfers or reclassifications of long-term debt to current liabilities 7. Decreases to long-term debt accounts (i.e., bonds, notes, capital leases, leaseback transactions) 8. Cash statements 9. LOC or Revolving Loan Agreement This item excludes change in current debt reported separately on a Cash by Source and Use of Funds Statement (Format Code = 2), a Cash Statement by Activity (Format Code = 3), or a Statement of Cash Flows (Format Code = 7). This item contains a Combined Figure data code when: • Issuance of Long-Term Debt is reported net of debt retired • Reduction of Long-Term Debt is reported outside the Financing Activities section for a company reporting a Statement of Cash Flows (Format Code = 7) • Reduction of Long-Term Debt is combined with another item within the Financing Activities section for a company reporting a Statement of Cash Flows (Format Code = 7) (included in Financing Activities - Other) • Reduction of Long-Term Debt is combined with another item for a company reporting a Working Capital Statement (Format Code = 1), a Cash by Source and Use of Funds Statement (Format Code = 2), or a Cash Statement by Activity (Format Code = 3) **International Normalized Definition** **Industrial Definition** This item represents a reduction in long-term debt caused by the maturity of long-term debt, payments of long-term debt, and the conversion of debt to capital stock. **Format Codes 1-3, 5-7** This item is a component of Uses of Funds - Total (FUSET) on a Working Capital Statement (Format Code = 1), a Cash Statement Classified by Source and Use (Format Code = 2), or a Net Liquid Funds/Net Funds Statement Classified by Source and Use (Format Code = 5). This item is a component of Cash and Cash Equivalents - Increase (Decrease) (CHECH) on a Cash Statement Classified by Activity (Format Code = 3) or a Net Liquid Funds/Net Funds Statement Classified by Activity (Format Code = 6). This item is a component of Financing Activities - Net Cash Flow (FINCF) on a Statement of Cash Flows (Format Code = 7). This item includes: 1. Changes in debt not classified as current and long-term debt (for companies reporting statement formats other than a Working Capital Statement [Format Code = 1])

	2. Conversion of debt to common/ordinary stock 3. Current maturities of long-term debt on a Working Capital Statement (Format Code = 1) 4. Long-term creditors (when components are not reported separately on the Flow of Funds Statements or in the notes) 5. Transfers or reclassifications of long-term debt to current liabilities This item excludes: 1. Changes in current debt (for companies reporting statement formats other than a Working Capital Statement [Format Code = 1]) 2. Current maturities of long-term debt (when a breakout is available) (for companies reporting statement formats other than a Working Capital Statement [Format Code = 1]) This item contains a Combined Figure data code when: • Long-term debt issued is reported net of debt retired (Long-Term Debt - Issuance [DLTIS]) • Different types of long-term debt are combined (and no breakout is available) (included in Uses of Funds - [FUSEO] or Financing Activities - Other [FIAO])
17. Sales/Turnover (Net)	**Mnemonic Category Periodicity Format Units** SALE Income Statement Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents gross sales, the amount of actual billings to customers for regular sales completed during the period, reduced by cash discounts, trade discounts, and returned sales and allowances for which credit is given to customers. This item is scaled in millions. For example, the 1999 annual sales for GM is 173215.000 (or 173 billion, 215 million dollars). **This item includes:** 1. Any revenue source that is expected to continue for the life of the company 2. Other operating revenue 3. Instalment sales 4. Franchise sales, when corresponding expenses are available **Special cases, by industry, include:** 1. Royalty income when considered operating income (i.e., oil companies, extractive industries, publishing companies, etc.) 2. Retail companies' sales of leased departments when corresponding costs are available and included in expenses. If costs are not available, the net figure is included in Nonoperating Income (Expense).

	3. Shipping companies' operating differential subsidies and income on reserve fund securities when shown separately 4. Finance companies' earned insurance premiums and interest income for finance companies, the sales are counted only after net losses on factored receivables purchased 5. Airline companies, net mutual aid assistance and federal subsidies 6. Cigar, cigarette, oil, rubber, and liquor companies' net sales are after deducting excise taxes 7. Income derived from equipment rental is considered part of operating revenue 8. Utilities' net sales are total current operating revenue 9. For banks, this item includes total current operating revenue and net pretax profit or loss on securities sold or redeemed. 10. Life insurance, and property and casualty companies' net sales are total income 11. Advertising companies' net sales are commissions earned, not gross billings. 12. Franchise operations' franchise and license fees 13. Leasing companies' rental or leased income 14. Hospitals' sales net of provision for contractual allowances (will sometimes include doubtful accounts) 15. Security brokers' other income 16. Engineering, Hazardous Waste, etc. (collect net revenue instead of gross revenue when the difference is due to outside subcontractor cost) **This item excludes:** 1. Nonoperating income 2. Interest income, included in Nonoperating Income (Expense) 3. Equity in earnings of unconsolidated subsidiaries, included in Nonoperating Income (Expense) 4. Other income, included in Nonoperating Income (Expense) 5. Rental income, included in Nonoperating Income (Expense) 6. Gain on sale of securities or fixed assets, included in Special Items 7. Discontinued operations, included in Special Items 8. Excise taxes, excluded from sales and also deducted from Cost of Goods Sold 9. Royalty income, included in Nonoperating Income (Expense) 10. Royalty income, net of expenses 11. Other operating income, net **International Normalized Definition** **<u>Industrial Definition</u>** This item represents gross sales reduced by cash discounts, trade discounts, returned sales, excise taxes, and value-added taxes and allowances for which credit is given to customers. **This item includes:**

	1. Advertising companies' net sales or commissions earned 2. Airline companies' net mutual aid assistance and federal subsidies 3. Any external operating revenue source expected to continue for the life of the company 4. Equipment rental income 5. Franchise fees 6. Hospitals' sales net of provision for contractual allowances 7. Leasing companies' rental or leased income 8. License fees 9. Management fees 10. Retail companies' sales of leased departments, when corresponding expenses are reported in the Income Statement and no breakout is available 11. Royalty income, when included in operating revenues 12. Shipping companies' operating differential subsidies and income on reserve fund securities (when a breakout is available) **This item excludes:** 1. Capitalized costs, included in Capitalized Costs (CAPCST) for companies using Income Statement Model Number 02 Purchases Format) 2. Effects of excise taxes and value-added taxes, when not reported on the Income Statement (included in Cost of Goods Sold [COGS] or Operating Expense [XOPRO]) 3. Equity in earnings of unconsolidated subsidiaries, included in Nonoperating Income (Expense) (NOPIO) 4. Interest income, included in Interest and Related Income (IDIT) 5. Nonoperating income, included in Nonoperating Income (Expense) (NOPIO) 6. Other operating income, included in Nonoperating Income (Expense) (NOPIO) 7. Rental income, included in Nonoperating Income (Expense) Other (NOPIO)`
18. Capital Expenditures	**Mnemonic** **Category** **Periodicity** **Format** **Units** CAPX Cash Flow Annual Number Millions U.S. GAAP and Canadian IFRS Definition (Canadian GAAP Prior to January 1, 2011) This item represents cash outflow, or the funds used for additions to the company's property, plant and equipment, excluding amounts arising from acquisitions, reported in the Statement of Cash Flows (Format Code = 7). This item is available for bank and industrial formats. This item includes: 1. Expenditures for capital leases 2. Increase in funds for construction 3. Reclassification of inventory to property, plant and equipment

	4. Increase in leaseback transactions when included in the investing section of the Statement of Cash Flows (Format Code = 7) 5. Any item included in the property, plant and equipment from the balance sheet. 6. Logging roads and timber This item excludes: 1. Capital expenditures of discontinued operations 2. Changes in property, plant and equipment resulting from foreign currency fluctuations when listed separately 3. Decrease in funds for construction presented as a use of funds 4. Property, plant and equipment of acquired companies 5. Net assets of businesses acquired 6. Decrease in funds for construction on the "Uses" side 7. Software costs unless included in property, plant and equipment on the Balance Sheet 8. Property, plant and equipment for real estate investment trust companies, which are investments, not property. Capital expenditures are usually equal to zero. 9. Deposits on property, plant and equipment This item contains a Combined Figure data code when: • Capital expenditures are reported in a section other than Investing Activities on Statement of Cash Flows (Format Code = 7) • Capital expenditures are combined with another item in the Investing Activities section on a Statement of Cash Flows (Format Code = 7) • Capital expenditures are reported net of the sale of property, plant and equipment and the resulting figure is negative. For companies reporting either a Working Capital Statement (Format Code = 1) or Cash by Source and Use of Funds (Format Code = 2), the negative figure is included in Uses of Funds - Other. For companies reporting either a Cash Statement by Activity (Format Code = 3) or a Statement of Cash Flows (Format Code = 7), the negative figure is included in Sale of Property, Plant and Equipment. Capital Expenditures are combined with another item for a company reporting a Working Capital Statement (Format Code = 1), a Cash by Source and Use of Funds Statement (Format Code = 2), or a Statement of Cash Flows (Format Code = 7) International Normalized Definition Industrial Definition This item represents cash outflow or the funds used for additions to the company's property, plant and equipment. **Format codes 1-3, 5-7** This item is a component of Uses of Funds - Total (FUSET) on a Working Capital Statement (Format Code = 1), a Cash Statement

	Classified by Source and Use (Format Code = 2), or a Net Liquid Funds/Net Funds Statement Classified by Source and Use (Format Code = 5). This item is a component of Cash and Cash Equivalents - Increase (Decrease) (CHECH) on a Cash Statement Classified by Activity (Format Code = 3) or a Net Liquid Funds/Net Funds Statement Classified by Activity (Format Code = 6). This item is a component of Investing Activities - Net Cash Flow (IVNCF) on a Statement of Cash Flows (Format Code = 7). This item includes: 1. Expenditures for capital leases 2. Increase in funds for construction 3. Reclassification of inventories/stocks to fixed assets This item excludes: 1. Capital expenditures of discontinued operations (included in Uses of Funds - Other [FUSEO] or Investing Activities - Other [IVACO]) 2. Changes in fixed assets due to foreign currency fluctuations (when reported separately) (included in Uses of Funds - Other [FUSEO] or Investing Activities - Other [IVACO]) 3. Decrease in funds for construction reported in the Uses section (included in Uses of Funds - Other [FUSEO]) 4. Fixed assets of an acquired company (included Acquisitions [AQC]) 5. Net assets of an acquired company (included in Acquisitions [AQC]) This item contains a Combined Figure data code when: • The net amount reported for capital expenditures is negative. When the company reports a Working Capital Statement (Format Code = 1) or a Cash Statement Classified by Source and Use (Format Code = 2), the negative amount is netted against Uses of Funds - Other (FUSEO). When a company reports a Cash Statement Classified by Activity (Format Code = 3), the negative amount is netted Sale of Property (SPPE) • This item is combined with another item within or outside the Investing Activities section on a Statement of Cash Flows **Format codes 10-12** This item is a component of Investing Activities - Net Cash Flow (IVNCF) on a Rest of World Cash Flow Statement by Activity (Format Code = 10). This item is a component of Use of Funds - Total (FUSET) on a Rest of World Cash Flow Statement by Source and Use (Format Code = 11).

	Purchase of Tangible Fixed Assets is a component of Capital Expenditure and Financial Investment - Net Cash Flow (CAPXFI) on a U.K. (revised FRS 1) Cash Flow Statement (Format code 12). This item includes reclassification of inventories/stocks to tangible fixed assets. This item excludes: 1. Capital expenditures or purchase of tangible assets of discontinued operations. The combined total is included in Investing Activities - Other (IVACO) or Use of Funds - Other (FUSEO) 2. Additions to tangible fixed assets or net assets of an acquired company. The combined total is included in Acquisitions (AQC) This item contains a Combined Figure data code when: • Purchases of tangible fixed assets are not reported on the Cash Flow Statement, but are disclosed elsewhere in the company's report • Sales of tangible fixed assets are reported net of purchases. The combined total is included in Sale of Fixed Assets (STFIXA)