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Family enterprise and technological innovation

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ABSTRACT

Family enterprises in China have significant impact on China's social and economic development. Yet did technological innovation in Chinese family enterprise play a role on this impact? We examine the role that technology innovation played in the rise in importance of Chinese family businesses. We analyze the impact of family enterprises on companies' technological innovation through both family ownership and family management involvement. We further scrutinize how Chinese family-owned business internationalization strategies affected their technological innovation activities. The authors show that family ownership without family management involvement has a negative relations with companies' technical innovation. We further demonstrate that family ownerships with family management involvement have a positive relations with enterprises' technical innovation. Our study provides some effective measures to increase the investment in firms' technical innovation and minimize the disadvantages of family business. The research result has practical significance in the governance of family enterprises.

1. Introduction

China has proposed to optimize their nation's economic structure through firm-based innovation (Ahlstrom et al., 2018). Family enterprises can play an important role in this process. These family enterprises, through the use of new business models, as well as technological (Linton and Walsh, 2004; Groen and Walsh, 2013) and social innovation (Chavez et al., 2017; Marinakis et al., 2017; Gary et al., 2020), have the potential to realize new economic growth and market vitality (Babu et al., 2020) throughout the world. Scholars have contributed to the field by showing the impact that family enterprise ownership has on technology innovation in an enterprise (Decker and Günther, 2017). However, there is a gap in the literature on how the world's second leading economy's family businesses embrace technological innovation. Liang et al. (2013) was one of the first to discuss how family effects innovation in China by using agency theory and the resources perspective of the firm while focusing on family board member action. They showed that family board membership strengthened R&D investment and innovation performance, but family members involved in management weakened this relationship. Yet is this relationship really that simple. Chinese family enterprises now account for more than 40% of all A-share listed companies in China since 2010 (Chinese family business report, 2011). Further, Chinese family enterprises are important because these businesses employ 36% of non-governmental employees (Chinese family business report, 2011). Moreover, Chinese Family businesses are responsible for 15% of China's GDP (Chinese family business report, 2011). Family business in China means family involvement in the management and here we seek to understand that dynamic better.

Family enterprises have crucial impacts on China's national economy (Chinese family business report, 2011). Family businesses provides financial capital, social capital and human capital for the progress of national economy and make great contributions to social stability (Cucculelli, 2012). The unique 'familial' (Herrero, 2018) atmosphere in a family enterprise brings benefits to family business development. They reduced transaction costs (Xiang et al., 2019; Williamson, 2010) through strong cohesion and low management cost (Evert et al., 2016). However, this also presents hurdles to family business, such as unclear property rights. Some family enterprises do not overcome these hurdles and do not achieve long-term growth (Westhead et al., 2001) or can lead to firm failure (Liu, 2017). One way family firms have succeeded is through constant business transformation based on technical innovation enabled by family based "patient capital" as is the case with Corning and Motorola in the US (Walsh and Linton, 2011; Morone, 1993) and in China (Yang et al. 2019). The study examines the impact of family involvement on the family enterprises' technical innovation.

Family business as a field of research has made tremendous strides in

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recent years. There is a unique parent – offspring emotional component to family business that many authors have investigated (e Cunha et al., 2021). Scholars have written about the role of family trust and commitment in single family business (Mahto et al., 2020; Eddleston and Morgan, 2014) and trust in multiple family businesses. They find it is critical to family business success and longevity. Authors focusing on the China perspective find that trust is central to the innovation dynamic (Man-zhi, 2002). Similarly, the succession issue plague family businesses and have spurred an exceptional stream of scholarly efforts both globally (Hauck and Prügl, 2015) where they state that "socioemotional factors have both dark and bright sides in the context of innovation" and specifically on China (Xiangqian, 2007) where the author states that the "son carrying on a father industry" is the fittest mode for the family business in China.

We close these gaps in the literature and contribute to the field by analyzing family business technology innovation strategies. We do so by examining three independent variables in the technological innovation context; family ownership, family management involvement, and family enterprises internationalization strategy. Our dependent variable is family business investment strategies. We do so through an empirical analysis of Chinese A listed family firms. Our results show that family ownership alone is not enough to promote effective technology innovation strategies. However, we show that this changes when family ownership is augmented by active family management where successful technological innovation strategies often occur. Finally, we show that aggressive internationalization strategies can overcome lack of family involvement in management of family businesses and drive family businesses to successful technological innovation practice.

Our study offers proof of effective measures that increase effectiveness of family firms' technological innovation strategies. We also show how internationalization strategies help minimize the disadvantages of family business. These measures can be used by family enterprises to adapt to market variations and to continue operating with the advantages brought by technological innovation. Our findings show that family firms can use these strategies to bridge the difficult process of family business generational transfer (succession) (Porfírio et al., 2020) and remain competitive.

The rest of the paper is organized in the following manner. We first provide a literature review that is followed by the research methodology where a series of hypothesis which are presented. We follow this with a full review of our tested hypothesis and findings. In our discussions and further research sections we provide a discussion of related suggestions, limitations and further research is provided.

2. Literature review

We primarily use agency theory perspective, with its focus on decision maker self-interest and rational decision making (Jensen & Meckling, 1976) to focus on our research question. Agency theory suggests cost arises due to the separation of ownership from control, different risk preferences, information asymmetry and or moral hazards and that is or focus. Agency theory has a long history in both the field of management and economics and has been extensively used by authors in family business research (Daily et al., 2003; Chrisman et al., 2010). Agency theory has been extensively used in fields like accounting (Ronen & Kashi, 1995); finance and supply chains (Elmanizar et al., 2019), economics (Wright et al., 2001), organizational behavior (Shapiro, 2005; Shi et al., 2017; Kosnik & Bittenhausen, 1992) and marketing (Dominici et al., 2017; Tate et al., 2010). Agency theory is one of the most utilized theory basis utilized in researching family businesses (Kallmuenzer, 2015).

Family businesses, on its face seems to limit the disconnect between ownership and decision making (Litz, 1997). Yet authors have used agency theory to better understand particular aspects of the behavior of actors in family firms. Specifically, McKinght and Weir (2009), although not specifically focused on family business, demonstrated that increased board ownership decreases agency costs. Other authors have found that the complexity of family issues (Nordqvist et al., 2008) proved to create an even more complex milieu of individual preferences in family firms (Chrisman et al., 2004; Corbetta & Salvato, 2004; Gomez-Mejia et al., 2001; Sharma et al., 1997; Newbert and Craig, 2017). Moreover, authors have shown that family firms, especially in the technology space (Marrone, 2017), to display the ability to utilize long term resources such as "Patient capital" more effectively as compared to their non-family business-based competitors. It's popularity and interest has attracted some detractors (Wiseman and Gomez-Mejia, 1998; Pepper and Gore, 2015; Eisenhardt, 1989) and they have proposed splintering the field into subfields like positive agency theory, behavioral agency theory and others. We agree with this finer distinction and we focus on behavioral agency theory. We also embrace the resource-based view (Barney, 1991; Wernerfelt, 1984) view of the firm as underpinnings in our investigation. Family based researchers have investigated firm succession (Cabrera-Suárez et al., 2001), family firm performance (Liu et al., 2012) and many other family firm aspects using the resource-based view of the firm.

We review the literature focuses on family involvement and enterprise's technical innovation. We do so by reviewing those authors that provided value through classical agency theory, behavioral agency theory, socioemotional wealth, competence-based view of the firm's resource-based view. We focused on authors within these literature streams that focused on family companies and their technical innovation strategies. Finally, the relationship between family involvement and enterprises' innovation is further analyzed and studied by assessing relevant literature theories of internationalization strategy.

2.1. Classical agency theory and family business

Agency theory is the most often used theoretical base utilized in family business research (Kallmuenzer, 2015) and family members often act as agents rather than stewards of famliy businessees (Chrisman et al., 2007). It has been used to understand the difference in CEO tenure (Tsai et al., 2006) and relations between family members (Van den Berghe and Carchon 203). Classical agency theory has always formed the mainstream of previous literatures (e.g., Chua et al., 2009; Morck and Yeung, 2003; Van Den Berghe and Carchon, 2003) that study the problems related to the technical innovation of family companies. Therefore, this research chooses to review the relevant literature of agency theory (e.g., Eisenhardt, 1989; Karra et al., 2006; Madison et al., 2016) to more intuitively analyze the connection between family involvement and firm's technical innovation. According to the explanation of relevant literature of agency theory, it is generally believed that classical agency problems could be considered as lying between internal family members and between family and non-family members (Kallmuenzer, 2015). The first problem mainly expounds the problems between shareholders and managers. Because managers participate more in day-to-day operations of companies than investors and have different effectiveness function from shareholders, information asymmetry and objective inconsistency would inevitably occur between them (Block, 2012). These problems could further lead to opportunistic behavior, moral hazard or risk aversion which would reduce the motivation of enterprise innovation (Lazonick, 2017). However, these problems could be effectively alleviated in family enterprises.

Family enterprises usually send family members to take part in the board or senior management of the company. Consequently, company ownership and control could be focused on the family (Zellweger, 2017). This strategy would lead to several beneficial results. Firstly, from the standpoint of managers, for the consideration of development of family, managers would correct their self-interest as agents and could obtain a more long-term development view (De Massis et al., 2016). Faced with the high risk of technological innovation failure and the damage to their reputation and remuneration, managers are more likely to give high priority to the long term development of the enterprise and adjust their risk aversion strategy. Therefore, managers in family enterprises prefer long-running technical innovation. Secondly, from the view of family stockholders, because of participating in the daily management of the business, family shareholders become more motivated and able to control the managers' behaviors, ensuring that their behaviors conform to the expectations of long-term operation of the family, thus preventing the company from falling into underinvestment in research and development (Schmieder, 2014). From the perspective of the relationship between shareholders and managers, because they are from the same family, the problem of information asymmetry would be alleviated to a great extent; moreover, the opportunism tendency of managers would also be reduced correspondingly (Le Breton-Miller et al., 2015). Hence the motivation of enterprises to invest in technological innovation would be increased.

The second problem illustrates that agency conflict of major and minor stockholders in family enterprises would also affect the technological innovation. Family enterprises often face the constraints of traditional financing methods in the process of expansion because family members are unwilling to dilute the control of enterprises (Nieto et al., 2015). As a countermeasure, family enterprises often use pyramid structure, dual-class share structure and other mechanisms for purpose of exchanging a few stock rights for more control, which would give rise to the situation of separation of two rights (Efferin and Hartono, 2015). Under the circumstances, a few academics state that family members are inclined to use tunneling to shift capitals or cash flows from subsidiaries with a high degree of separation of two rights at low costs (Bhaumik and Gregoriou, 2010). Since the strategy has the advantage of immediate profits and less risk than technological innovation, the positivity of companies to make innovations would decrease. On the other hand, family properties are bound up with the operation of family business. In order to protect assets and reputation of family, the major stockholders of family enterprises would be more conservative in their business strategies and have risk aversion tendency (Juliarto et al., 2013).

Apart from the two problems stated above, the problem between family members and between family and non-family members are specific phenomena of family enterprises. Some scholars state that altruism among family members is beneficial to collaboration among enterprise members and at the same time, altruism may cause the free-riding problem and bring difficulties to firms' supervision (Schulze et al., 2002). The free-riding problem here includes perquisite consumption, crony capitalism, privilege and so on (Tsao et al., 2016). These behaviors would lead to the partial occupation of the cash flow originally used in technological innovation, which would shorten the competency of human capital; accordingly, the technological innovation strength of enterprises would be reduced to a certain extent. On the other hand, the equity of the enterprise is gradually dispersed among each family member and potential family internal discord and interest conflicts begin to emerge (Eddleston and Kellermanns, 2007). In this case, family managers may avoid technological innovation which could prevent their own interests from the failure of innovation strategy. As for agency between non-family and family members, family altruism may also bring about a gap between family employees and non-family employees in promotion opportunities, salary, benefits and so on. In many cases, family members may not be required to have the same skills or talents and qualifications as non-family employees when they participate in the business, which would cause non-family members' psychology to be unbalanced (Poutziouris et al., 2015). This psychological gap would trigger a decline in their positivity for technological innovation.

2.2. *Behavioral agency theory and socioemotional wealth*

Though the classical agency theory proposes interpretations for family firms' technical innovation problem, with the development of further studies, its limitations gradually appear (Chua et al., 1999). A crucial expression is that the classical agency theory assumes that risk aversion of the agent is consistent, and the utility function is fixed, which is not consistent with the real situation (Lim et al., 2010). Moreover, scholars looked at differing types of families and their effect on decision making using agency theory (Corbetta and Salvato, 2004). On this basis, scholars who study family business put forward the behavioral agency theory (Berrone et al., 2012; Kumeto, 2015; Pepper and Gore, 2015), developing it into socioemotional wealth, which could strengthen the explanation of technical innovation problem of family firms.

On the basis of the behavioral agency theory, by contrasting present results of the company with the previous corporate performances or contrasting the results of the firm with the average results of the whole domain or contrasting the results of the firm's equity markets with the carrying value, enterprise could form anchoring effect (Larraza-Kintana et al., 2007). Driven by this effect, enterprises would adjust their business strategies according to the reference results. For example, in the case of poor reference results, enterprises would have higher motivation to take risks.

Socioemotional wealth theory is proposed on the logical foundation of behavioral agency theory, which further considers the duality of business objective of family enterprises. According to this theory, although family enterprises pursue economic interests, socioemotional wealth is the original objective of family enterprises (Gómez-Mejía et al., 2007). Non-financial target which meets emotional requirements is more important than financial ones. The family's pursuit of socioemotional wealth would also directly or indirectly affect the enterprises' technological innovation behavior. To be more specific, both family and non-family enterprises bear the profit and loss brought by technological innovation risk. However, on the other hand, family enterprises are also faced with inevitable and unique socioemotional wealth losses when carrying out technological innovation (Cennamo et al., 2012). This kind of losses includes two aspects. First, due to the high stake of technical innovation, if it fails, the fame of family would be soiled; alternatively, if it succeeds, the corporate history associated with old technology would be weakened. Moreover, once breakthroughs are made in technological innovation, the enterprise would also improve the capability requirements for employees, which would make family staff suffer the danger of elimination and weaken the emotional bond within the family (Cruz et al., 2012). Secondly, technological innovation may require the use of external funds, human resources, basic technologies or other help, which would weaken the control of family and autonomy in enterprises (Gómez-Mejía et al., 2017). Hence, many scholars believe family enterprises would adopt less technological innovation.

Moreover, some scholars also combine behavioral agency theory with socioemotional wealth to discuss influences of situational factors on technical innovation of family firms. The most crucial situational factor is performance level of the enterprise. When the real corporate performance is better than the prospective one, family enterprise would lack the positivity to undertake technical innovation due to damage of family socioemotional wealth caused by failures of innovation. While the company performance is not as good as expected, the socioemotional wealth such as family reputation and control power would be threatened with the decline of enterprise's performance (Vardaman and Gondo, 2014). At this point, family enterprise would face a choice between two kinds of decisions. The first one is to allow the company performance to fall and suffer the damage of family socioemotional wealth. The second is to adopt risk behaviors, like technical innovation, which could protect the socioemotional wealth by preventing the reduction of enterprise's performance at the expense of some risks. Certainly, for the purpose of protecting socioemotional wealth, the possibility of undertaking technological innovation behavior in family enterprises would be increased under the situation of performance dilemma (Schepers et al., 2014).

2.3. *Resource-Based view*

Some scholars emphasized the resource-based view to analyze family enterprises' technological innovation behavior. Carnes and Ireland

(2013) state that “familiness” is the most fundamental resource distinction between family and non-family enterprise. Familiness affects the enterprise’s technological innovation behavior by changing its social capital, financial capital and human capital. The resource-based view (Chisholm and Nielsen, 2009; Kelliher and Reinl, 2009) believes that enterprise has tangible and intangible resources, which are valuable assets of enterprises and could play a crucial role through correct use, thus forming unique competitiveness of enterprises. These resources are fixed and hard to imitate, which is the source and power for enterprises to obtain sustainable competitiveness (Bromiley and Rau, 2016).

From a financial capital perspective, a large amount of financial support is necessary for an enterprise to undertake technological innovation; “familiness” could influence firm’s financial capital both positively and negatively. From a positive perspective, in order to protect family control rights, family enterprises often construct family business groups and form internal capital markets with the help of control amplification mechanism (Subramanian, 2018). In this way, individual enterprises within the family group can get preferential financial support for innovation activities (Popli et al., 2017). The involvement of family management not only reduces the agency cost but also decreases the concerns of investors in the market about the information asymmetry of the enterprise agency, thus facilitating the family enterprises to obtain external research and development financing (Bennedsen et al., 2015). From the negative perspective, due to the protection of control rights, it is difficult for family enterprises to accept the transfer of equity in exchange for capital, which is obviously not conducive to the enterprise to obtain financial support from the equity market, thus limiting the amount of fund used for technical innovation (Michiels and Molly, 2017). Besides, family business agents tend to be economical because they concentrate their financial resources on family businesses and are self-financing (Nieto et al., 2015). Under the guidance of this tendency, family members are more conservative in the use of their own capital, which would inevitably influence the investment in technological innovation of enterprises.

The influence of human capital of family enterprise on technological innovation also shows its dual character. With a series of processes such as acquirement and use of family enterprise’s human resources, due to the stability of its social network and the specialization of members, family enterprises tend to hire employees within their own family or within their own social network, which ensures the improvement of organizational commitment and the reduction of information asymmetry (Cruz et al., 2011). This approach simplifies supervisions of the technological innovation process by the enterprise and improves the autonomy of the developer’s decision-making, which is essential in the highly uncertain and risky research and development activities. Moreover, family enterprises also tend to train employees more informally, using apprenticeships, in order to improve their mastery and sharing of enterprise’s knowledge (Steier et al., 2015) and the competency of enterprise members in technological innovation activities. However, “familiness” also has a negative impact on enterprise human capital. Family enterprises place more value on blood than on ability in hiring managers and employees, a phenomenon known as family nepotism (Liu et al., 2015). Due to the high requirement of knowledge for participants in technological innovation activities, the disadvantages of capital competency deficiency caused by family nepotism are significantly magnified, which further affects the performance of technological innovation (Firfiray et al., 2018).

From the capital perspective, the social capital of family enterprises could be categorized into internal social capital and external social capital (Arregle et al., 2007). Due to long-term service, employees of family enterprises have higher knowledge understanding, knowledge sharing level and other forms of internal social capital (Carrasco-Hernandez and Jimenez-Jimenez, 2013), which meets the high requirement of enterprise’s technological innovation for information exchange. Sanchez-Famoso et al. (2014) state that high internal social capital is beneficial to progressive and radical innovation. In the aspect of external social capital, the stability and scale of family enterprises are limited. Because the family has higher management and control, the enterprise members tend to have stable ideas and job security, which makes the enterprise stakeholder policies stable, enabling long-term implementation. It is beneficial for family enterprises to establish stable and strong social networks with stakeholders like employees, suppliers and customers (Li et al., 2013). Research shows that stable social networks could make it easier for enterprises to gain the funding for technological innovation. It is also conducive to expand the market for products developed by enterprises. This provides more possibilities for enterprises to cooperate with network members in technological innovation (Molina-Morales and Martínez-Fernández, 2010). However, due to protections of family control and emotional connections, the social network of family enterprises is often limited in scale, which makes it difficult for them to obtain broader opportunities for technological innovation cooperation (Gronum et al., 2012).

2.4. *Internationalization strategy*

Internationalization strategy is closely related to family involvement and an enterprise’s technological innovation. On the one hand, as an internal factor, internationalization strategy has an important influence on the implementation of business strategies. On the other hand, internationalization strategy also has direct and indirect impact on the company’s technical innovation. Moreover, previous studies (Kafouros et al., 2008) have shown that internationalization strategy has both positive and negative impacts on technological innovation. Reviewing the literature (e.g., Altomonte, et al., 2013; Boermans and Roelfsema, 2016) on internationalization strategy helps further analyze the adjustment of internationalization strategies in the relation between family involvement and enterprise’s innovation. Still some authors see this as a very discontinuous process based on behavioral agency theory (Kuiken et al., 2021).

Monopolistic advantage theory was proposed by American scholar Stephen Hymer in 1960. The theory states that transnational operation is an inevitable choice for enterprises to make use of their existing monopoly advantages to obtain greater profits. It assumes that market imperfection is the primary cause of outward foreign direct investment (OFDI) and that the monopoly advantage of multinational corporations is the qualification for making profits from OFDI. This theory emphasizes that enterprises could replicate their previous advantages in overseas markets to obtain greater incomes.

The research object of internalization theory is transnational corporations. It mainly explains the circumstances under which foreign investment would be more beneficial than export and the reasons why most enterprises invest abroad. The theory states that the essence of OFDI is the extension of governance and control of companies based on ownership rather than the capital shift. The outcome is to transfer the internal market to external market and achieve profit maximization by reducing transaction costs through internal strengths (Buckley and Strange, 2011). Internalization strategy assumes that the market is in imperfect competition and the purpose of the enterprise is to pursue profit maximization. The incompleteness of intermediate product market makes enterprises create internal market through external investment to overcome the defects of external market (Rugman, 1980). Multinational corporations are the transnational products of the process of market internalization (Narula et al., 2019).

3. Hypotheses and Conceptual Model

3.1. *The impact of family ownership involvement on Company’s technical innovation*

From the perspective of family ownership involvement, the uniqueness of family businesses is that the family members own a large amount of assets and stock equities, having control over the family business

(Chung, 2013). Family ownership is centered on enterprise owners' family responsibilities. Authors have investigated family firm entrepreneurial orientation based on behavioral agency theory (Lee and Chu, 2017) and others reviewed efforts on family firms that focused on technological innovation (De Massis et al., 2013). We take this thought further by testing our first hypothesis below expanding on the behavioral agency theory tenant of do family decision makers' act as stewards or agents.

As the involvement of family ownership reduces the conflicts of interest among scattered shareholders, family enterprise owners would focus attention on the overall interests of the family when making decisions and measure the loss and gain of the family's socioemotional wealth brought about by the decision (Sciascia et al., 2014). Families have absolute controlling stake in enterprises, which makes it difficult to clearly define what the family wealth is and what the enterprise assets are. Hence, the family often considers the enterprise as the main asset; the rise and fall of family is strongly associated with the enterprise's development. As an important activity of an enterprise, technological innovation is characterized by high investment, high risk, long cycle and uncertainty of the outcome. Once the research and development fail, the reputation and wealth of the family would be threatened, or the control of the family would be weakened. Therefore, higher level of ownership involvement means that family owners are more opposed to the unknown risks brought about by such uncertainty to socioemotional wealth. At this time, family ownership involvement would affect the investment in technological innovation of the enterprise. To avoid the threat of social status and property security of family caused by the failures of management strategies, enterprise managers tend to invest conservatively and avoid risks when family ownership is more involved (De Massis et al., 2015). Yet authors have used the case study method to show that family controlled large firm often exhibit a willingness to provide resources over longer periods of time than their non-family based counterparts in the high tech arena (Morone, 1993). Others used agency theory to understand capital decision making in family business (Romano et al., 2001). To further understand this specifically in a technology innovation environment in China this study proposes the following hypothesis.

Hypothesis 1: There is a negative correlation between family ownership involvement and investment of enterprise's technological innovation.

3.2. *The impact of family management involvement on Company's technical innovation*

Family management involvement refers to family members serving on the senior management team of company and participating in important strategic decisions of the enterprise (Diéguez-Soto et al., 2016). As enterprise's senior managers, family members would necessarily focus more on firm's further development strategy and overall responsibility. Therefore, the involvement of family management could bring certain advantages to family enterprise, including the following three points. First, family members participate in operation and governance of enterprise directly and supervise important strategic decisions of the enterprise, which reduces the agency cost of the firm to a certain extent and avoids the possibility of the major shareholders of the family embezzling the investment funds for technological innovation for personal gain (Revilla et al., 2016). Second, manager's tenure in family enterprises is relatively long. Due to the relatively stable position, senior managers have high degree of loyalty. Senior managers usually play a good role of "housekeeper," trying their best to make suggestions for the management of family business, allocating enterprise's resources prudently, fostering strengths and circumventing weaknesses, while reducing the risk of enterprise's research and development investment. Third, family mangers consider the interests of family while seeking the development of the whole enterprise, in order to maintain social bonds, protect the socioemotional wealth of family and also gain the support of family members (Chrisman et al., 2012). Therefore, family management involvement is beneficial to technological innovation of enterprises. Morone (1993) used the case study method to show large technology-based US family-controlled businesses utilized "patient capital" or investment to move technological to the marketplace. Some authors used behavioral agency theory to study the relationship between "financial slack" and R&D investments in Korean firms (Kim et al. 2008). Here we further this effort to investigate investment decisions in technological innovation in Family firms in China by utilizing the following hypothesis.

Hypothesis 2: There is a positive correlation between family management involvement and investment of technological innovation of enterprise.

3.3. *The moderating effect of internationalization strategy*

According to the monopoly advantage theory, family enterprises adopt international strategies to compete in the international market, which is an expansion of their existing advantages. It could not only boost the profits of the enterprise and inspire its enthusiasm but also absorb heterogeneous culture and resources and broaden its vision (Kontinen and Ojiala, 2010). However, entering the international market means facing another group of target consumers whose demands are also different due to cultural and regional differences. To meet the requirements of target groups, it is important for enterprises to reform old technologies and undertake research and development of new products, which promotes enterprises to undertake technological innovation. Even if the family enterprise succeeds in developing new technologies and meets the needs of the international market, the old technologies would not be eliminated from the technology market immediately. It would also last for a while so that enterprises do not have to scrap old machines immediately or eliminate family members who are attached to old technologies (Kellermanns et al., 2012). Authors have found that family business with family members in active management help to limit the agency problems often brought by increased firm internationalization and in general reap benefit in terms of innovation (Tsao and Lien, 2013).

If family enterprises plan to implement the internationalization strategy, it is necessary for companies to create a new organizational department and change original structures. Menendez-Requejo (2005) presented internationalization as a factor promoting family firm growth utilizing agency theory. Enterprises would select some new staff members with the ability to enter the new management team. It could provide promotion opportunities for internal staff members within family enterprise. Meanwhile, successful research and development of new technologies creates new employment opportunities that could not only absorb more local or domestic human capital but also gain a reputation for family enterprises, which could mitigate the negative impact of emotional problems on technological innovation (De Massis et al., 2017). Several researchers have used agency theory and resource-based perspective of the firm to investigate financing decisions in family businesses (Michiels and Molly, 2017). Yet this "patient capital" (Morone, 1993) or "financial slack" (Kim et al., 2008) financial decision making designed to grow value surprisingly does not translate to high valued Initial Public Offerings (IPO's) for family firms (Kotlar et al., 2018). There are some unique aspects of the effect of family-owned firm effects and internationalization in Chinese based family firms (Yang et al., 2020). Here we investigate the role that internationalization plays in modifying family businesses technology innovation decisions through the following hypothesis.

Hypothesis 3: As the level of internationalization increases, the adverse impact of family ownership involvement on enterprise's technical innovation would decrease.

Hypothesis 4: As the level of internationalization increases, the promoting effect of family management involvement on enterprise's technical innovation would improve.

3.4. A theoretical Model of the impact of family involvement on Enterprise's technical innovation

This research addresses the connection between family involvement and technological innovation of company. It also explains the adjustment of internationalization strategy in their relation. Starting from perspectives of family ownership involvement and family management involvement, the study posits the hypotheses that family ownership involvement has negative correlation with technological innovation, family management involvement has positive correlation with the technical innovation of enterprise, and the internationalization strategy would pose positive adjustments for the relation between them. The theoretical model is showed in Fig. 1 below.

4. Methodology

4.1. Research design

Based on our literature review, we developed a series of hypotheses. The influence of relevant variables on the investment in enterprise's technological innovation has passed the theoretical or empirical test of other scholars. Since this research studies impacts of family involvement on technological innovation, continuous variable method is more suitable for measuring family involvement (Calabrò et al., 2019). The continuous variable method is mainly measured by ratio of family ownership as well as family management. Considering the actual situation, family ownership and family control right could be measured by one index (Goel et al., 2011). Therefore, this study mainly measures family involvement through the lens of family ownership involvement as well as family management involvement.

4.2. Family ownership involvement

In the paper, family ownership refers to the ultimate ownership or ultimate equity ratio of the listed company directly or indirectly held by the family or family natural persons, which is represented by family ownership involvement (FOI). In this research, the measurement of FOI is ultimate controller's proportion of shareholding.

4.3. Family management involvement

In this paper, family management involvement (FMI) refers to the involvement of the actual controller (the family or family natural persons) which serves as the senior management of the family enterprise and participates in the business decisions. Chrisman et al. (2005) suggest making an indicator of family management by measuring the number of family members elected as senior managers. However, the number of senior management team members in different enterprises varies greatly. The number of family members elected as top executives is not a variable that could scientifically estimate the impact of family members on enterprise's management. Therefore, the ratio of family executives accounting for the total number of senior executive members is adopted as an indicator to measure the family management involvement in this paper.

4.4. Technology innovation intensity of enterprises

Intensity of technological innovation (TI) is measured by relative indicators and expressed by the proportion of enterprises' expenditure on technology innovation (Matzler et al., 2015). The specific measurement method is total R&D expenditure divided by main business income.

4.5. Internationalization strategy

Since the moderating effect of internationalization strategy (IS) involved in this paper is mainly realized by the "depth" of internationalization, the method of total overseas sales divided by main business income is used to measure the level of internationalization strategy (Graves and Thomas, 2008).

4.6. Control variable

For purpose of analyzing the relation between family involvement and enterprise technology innovation accurately, according to the previous research, the following variables are controlled from the aspects of enterprise's basic characteristics and enterprise's management level: enterprise's age, enterprise's size, profitability, financial leverage, ratio of independent directors, year, and industry (Min et al., 2016). Enterprise's age is represented by "Age" and is defined as the natural

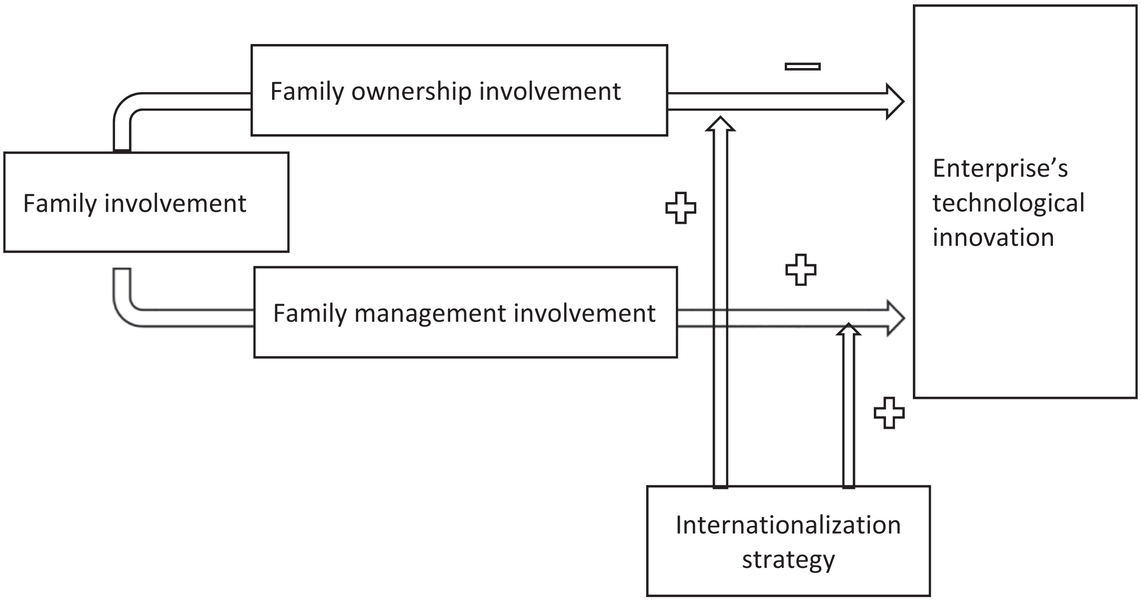
Family ownership involvement
−
Family involvement
+
+
Enterprise's technological innovation
Family management involvement
+
Internationalization strategy

Fig. 1. Conceptual model.

logarithm of the number of days that the enterprise has been established. Enterprise's size is represented by "Size" and is defined as the logarithm of the company's general asset. Profitability is represented by "Prof" which is used as proxy variable of enterprise's performance and is explained as net profit divided by total assets. Financial leverage is represented by "FL" which is defined as total liability divided by total asset. Independent directors is represented by "ID" which is defined as numbers of independent directors divided by numbers of all directors. Year and industry ("Ins") are used as dummy variables. The main variables involved in this paper are shown in Table 1.

4.7. Data

Chinese listed family firms were chosen as the research objects in the paper. Therefore, referring to the relevant literature on the definition of listed family enterprises, Zhou, Tam, and Yu (2013) state that listed firms that meet the following conditions would be regarded as family listed enterprises. First, ultimate control of a family enterprise is held by natural person and family. Second, the ultimate owner directly or indirectly holds the firm's equity, and the ultimate controller is the largest shareholder of the whole enterprise. Third, the proportion of actual controller's control rights is equal to or higher than 10 percent and family members participate in the senior executive team.

A total 180 Chinese family listed enterprises from 2010 to 2018 were selected as the initial samples. Further screening was conducted according to the definition of family enterprise mentioned above and those family businesses that are technology based. To ensure data integrity, financial listed companies with abnormal operating conditions were excluded (based on published news). Next, the enterprises that did not directly disclose overseas sales revenue and the R&D investment information were deleted. Finally, the nine-year data of 44 Chinese family listed enterprises were selected as the sample of study. The research sample is based on the family enterprises listed in Shanghai and Shenzhen market from 2010 to 2018. Data was collected from the annual reports and listing announcements of listed enterprises. Control variables such as enterprise's age, enterprise's size, financial leverage and other indicators were collected from China Stock Market & Accounting Research Database (CSMAR). Active family management was determined through the review of annual reports and finding that family members were president or C-suite managers.

Table 1
Definition and explanation of main variables *Sampling and Data Collection.*

Variable	Variable name	Code	Description
Dependent variable	Intensity of technological innovation	TI	R&D expenditure/business income
Independent variable	Family ownership involvement	FOI	The shareholding ratio of ultimate controller
	Family management involvement	FMI	The proportion of family executives in the total number of senior executives
Moderator variable	Internationalization strategy	IS	Total overseas sales/main business income
Controlled variable	Enterprise's age	Age	The natural logarithm of the number of days the enterprise has been established
	Enterprise's size	Size	The logarithm of the total assets of the enterprise
	Profitability	Prof	Net profit/total assets
	Financial leverage	FL	Total liability/total asset
	Independent directors	ID	Numbers of independent directors/numbers of all directors
	Year	Year	Dummy variables
	Industry	Ins	Dummy variables

4.8. Model specification

Based on the family management involvement connection or lack thereof between family involvement and enterprise's technological innovation, as well as the impact of internationalization strategy on the relation between them, four hypotheses are put forward and the corresponding models are established. Based on the collected data, index analyses are formed to verify the rationality of the hypotheses. From the perspective of family ownership involvement and management involvement, the following models are proposed to verify the correlation between them and enterprise's technological innovation.

Model 1:.$TI = \alpha_1 FOI + \sum_{i=2}^{6} \alpha_i CV + C + \varepsilon$

Model 2: .$TI = \beta_1 FMI + \sum_{i=2}^{6} \beta_i CV + C + \varepsilon$

In Model 1 and 2, TI is the predicted variable, representing the enterprise's investment in technological innovation. FOI and FMI are explanatory variables, representing family ownership involvement and family management involvement, respectively. CV represents controlled variable, including enterprise's age, enterprise's size, profitability, financial leverage, and proportion of independent directors. Models 1 and 2 are used to verify the influence of family involvement on the company's technical innovation.

As for internationalization strategy, verifying its moderating effect on the correlation between family involvement and technical innovation of company, following models could be established.

Model 3a: .$TI = \gamma_1 FOI + \gamma_2 IS + \sum_{i=3}^{7} \gamma_i CV + C + \varepsilon$

Model 3b: .$TI = \gamma_1 FOI + \gamma_2 IS + \gamma_3 FOI{*}IS + \sum_{i=4}^{8} \gamma_i CV + C + \varepsilon$

Model 4a: .$TI = \delta_1 FMI + \delta_2 IS + \sum_{i=3}^{7} \gamma_i CV + C + \varepsilon$

Model 4b: .$TI = \delta_1 FMI + \delta_2 IS + \delta_3 FMI{*}IS + \sum_{i=4}^{8} \gamma_i CV + C + \varepsilon$

In Model 3a, Model 3b, Model 4a and Model 4b, the variables represented by TI, FOI, FMI and CV are the same as those in Model 1 and 2. IS represents the internationalization strategy of enterprises. FOI * IS represents the product of family ownership involvement and internationalization strategy, FMI*IS represents the product of family management involvement and internationalization strategy. Model 3b and 4a are used to verify the adjustment of internationalization strategy in influence of family involvement on enterprise's technological innovation by adding interaction terms of international strategy and family ownership involvement and family management involvement.

5. Results

Correlation analysis measures the correlativity between two or more variables to gain the level of closeness between variables. An accurate measurement of the analysis results was obtained by briefly analyzing the correlation between variables before the regression analysis, making a preliminary estimate of correlation between variables.

It shows that as an independent variable, family ownership involvement (FOI) is significantly negatively correlated with intensity of technological innovation (TI) at 1%, which is consistent with the hypothesis that family ownership involvement has a negative correlation with technical innovation of enterprise. The correlation coefficient between Age and TI is 0.068 and the correlation coefficient between Size and TI is −0.053, indicating that there is no significant correlation between these two variables and TI. Prof and TI are positively correlated at the 5% level. However, the correlation coefficient is only 0.020, indicating their correlation is relatively weak. The correlation coefficient between FL and TI is −0.244, indicating that they are negatively correlated at 1%. The correlation coefficient between ID and TI is 0.036. There is no significant correlation between them.

The table shows that as an independent variable, family management involvement (FMI) is significantly positively correlated with the intensity of technological innovation (TI) at the level of 1%, which is consistent with the hypothesis that family management involvement has a positive correlation with enterprise's technological innovation.

Consistent with Table 2, there is no significant correlation between Age, Size, ID and TI. There is a weak positive correlation between Prof and TI at 5% level. FL and TI are positively correlated at 1% level (Table 3).

According to the correlation analysis of the two tables above and judging from the significance level of the correlation coefficient, it can be stated that the correlation between certain variables is not significant. It indicates the necessity of using multiple regression analysis to further analyze the connection between family involvement and company's technical innovation. The insignificance of correlation is probably because the influence of other controlled variables has not been eliminated. In order to gain the accurate relationship between variables, it is essential to control for remaining variables before making further regression analysis.

5.1. Regression analysis

Based on relevant literature reviews and previous research results, to protect the socioemotional wealth, enterprise managers prefer to avoid technological innovation to reduce high investment cost and high risk, while the degree of family ownership involvement is high. Hence, Hypothesis 1 is posited, and Model 1 is established. The regression analysis result of Model 1 is presented in Table 4.

The dependent variable of both the basic model and Model 1 is intensity of technological innovation (TI). The basic model only incorporates controlled variable into the regression model and the independent variable in Model 1 is family ownership involvement (FOI). Through regression results, the fitting degree of two models is high and the significance level is relatively well.

As shown in Table 4, in the basic model, R-squared is 0.403, adjusted R-squared is 0.379 and F value is 7.707 which is significant at 1%, indicating that the basic model is significant. The regression coefficient of enterprise's age is 0.001, with a low significance level, showing that there is no significant positive correlation between enterprise's age and technological innovation. Because technologies develop rapidly, both new and old enterprises should accelerate technological innovation to promote the transformation and upgrading. Hence, the relationship between enterprise's age and technological innovation is not so significant in the present era when technology is important to stimulate enterprise's vitality. The regression coefficient of enterprise size is 0.008, which is significant at 5% level, indicating that enterprise's size has a positive correlation with technical innovation. The bigger the enterprise, the more risk bearing capacity it has.

The enterprise would be willing to undertake technological innovation to obtain high return. The regression coefficient of profitability is 0.090, which is significant at 1%. It shows that enterprise's profitability has a positive correlation with technical innovation. The enterprise will have more additional capital to invest in technological innovation if it has a greater profitability. The regression coefficient of financial leverage is −0.120, which is significant at 1%, indicating that the enterprise's financial leverage is negatively correlated with technological innovation. High financial leverage means that the enterprise has a high asset-liability ratio, which could lead to high debt pressure. Under high debt pressure, the enterprise would lack motivation to promote technological innovation. The regression result of independent directors is 0.096, which is significant at 10%. It indicates that more and more Chinese family enterprises are attaching great value to the role of independent directors and that their governance function is increasingly prominent.

In Model 1, R-squared is 0.438, adjusted R-squared is 0.416, and F value is 8.278 which is significant at 1%. It indicates that Model 1 is significant. The regression coefficient of family ownership involvement (FOI) is −0.063, which is significant at 1%. It shows family ownership involvement has significantly negative correlation with the investment in technological innovation of enterprises. Family enterprises tend to reduce investment in technological innovation to protect family wealth when the level of family ownership involvement is higher. Therefore, Hypothesis 1 is verified.

Moreover, the regression coefficient of enterprise's age is 0.000, which is not significant, indicating that enterprise's age has no significant correlation with technological innovation. The regression coefficient of enterprise's size is 0.008, which is significant at 5%, indicating that enterprise's size is significantly positively correlated with technological innovation. The regression coefficient of enterprise's profitability is 0.127, which is significant at 5% level, indicating that profitability is significantly positively correlated with technological innovation. The regression coefficient of financial leverage is −0.119, which is significant at 1%, indicating that financial leverage is significantly negatively correlated with technological innovation. The regression coefficient of independent directors is 0.111, which is significant at 5%, showing that independent directors have a significantly positive correlation with technological innovation. As previously mentioned, while family members become senior managers, there would be relatively light agency effect. It would be easy to get support from other family members, which could promote the technological innovation, thus improving the interests of the whole family. According to this reason, Hypothesis 2 is posited, and Model 2 is established. The regression analysis of Model 2 is presented in Table 5.

The dependent variable of both the basic model and Model 2 is

Table 2

The relation between Family Ownership Involvement and Enterprise's Technical Innovation.

	Intensity of technological innovation (TI)	Family ownership involvement (FOI)	Enterprise's age (Age)	Enterprise's size (Size)	Profitability (Prof)	Financial leverage (FL)	Proportion of Independent directors (ID)
Intensity of technological innovation (TI)	1	−0.189 ***	0.068	−0.053	0.020**	−0.244***	0.036
Family ownership involvement (FOI)	−0.189 ***	1	−0.096	0.005	0.075	−0.005	0.099**
Enterprise's age (Age)	0.068	−0.096	1	0.343***	−0.224***	0.090	0.001
Enterprise's size (Size)	−0.053	0.005	0.343***	1	−0.070	0.476***	0.003
Profitability (Prof)	0.020**	0.075	−0.224***	−0.070	1	−0.421***	−0.028
Financial leverage (FL)	−0.244***	−0.005	0.090	0.476***	−0.421***	1	0.060
Proportion of independent directors (ID)	0.036	0.099**	0.001	0.003	−0.028	0.060	1

Notes: *** correlation is significant at 1%.

** correlation is significant at 5%.

* correlation is significant at 10%.

Table 3
The relation between Family Management Involvement and Enterprise's Technical Innovation.

	Intensity of technological innovation (TI)	Family management involvement (FMI)	Enterprise's age (Age)	Enterprise's size (Size)	Profitability (Prof)	Financial leverage (FL)	Proportion of Independent directors (ID)
Intensity of technological innovation (TI)	1	0.383 ***	0.068	−0.053	0.020**	−0.244***	0.036
Family management involvement (FMI)	0.383 ***	1	−0.148***	−0.023	0.176***	0.089	−0.061
Enterprise's age (Age)	0.068	−0.148***	1	0.343***	−0.224***	0.090	0.001
Enterprise's size (Size)	−0.053	−0.023	0.343***	1	−0.070	0.476***	0.003
Profitability (Prof)	0.020**	0.176***	−0.224***	−0.070	1	−0.421***	−0.028
Financial leverage (FL)	−0.244***	0.089	0.090	0.476***	−0.421***	1	0.060
Proportion of independent directors (ID)	0.036	−0.061	0.001	0.003	−0.028	0.060	1

Table 4
The regression analysis shows the relation between Family Ownership Involvement and Enterprise's Technical Innovation.

	Basic model	Model 1
Family ownership involvement (FOI)		−0.063*** (0.001)
Enterprise's age (Age)	0.001 (0.192)	0.000 (0.213)
Enterprise's size (Size)	0.008** (0.043)	0.008** (0.033)
Profitability (Prof)	0.090*** (0.009)	0.127** (0.013)
Financial leverage (FL)	−0.120*** (0.000)	−0.119*** (0.000)
Proportion of independent directors (ID)	0.096* (0.056)	0.111** (0.022)
Year	controlled	controlled
Industry	controlled	controlled
R-squared	0.403	0.438
Adjusted R-squared	0.379	0.416
F	7.707***	8.278***

Table 5
The relation between Family Management Involvement and Enterprise's Technical Innovation.

	Basic model	Model 2
Family management involvement (FMI)		0.123*** (0.000)
Enterprise's age (Age)	0.001 (0.192)	0.002 (0.164)
Enterprise's size (Size)	0.008** (0.043)	0.005** (0.046)
Profitability (Prof)	0.090*** (0.009)	0.086*** (0.007)
Financial leverage (FL)	−0.120*** (0.000)	−0.126*** (0.000)
Proportion of independent directors (ID)	0.096* (0.056)	0.123* (0.060)
Year	controlled	controlled
Industry	controlled	controlled
R-squared	0.403	0.460
Adjusted R-squared	0.379	0.447
F	7.707***	8.671***

intensity of technological innovation (TI). The basic model only incorporates controlled variable into the regression model and the independent variable in Model 2 is family management involvement (FMI). The fitting degree of the two models is high and the significance level is relatively well.

The regression analysis of the basic model is consistent with Table 1. In Model 2, R-squared is 0.460, adjusted R-squared is 0.447 and F value is 8.671 which is significant at 1%. It shows that Model 2 is significant. Regression coefficient of family management involvement (FMI) is 0.123, which is significant at 1%. It shows that family management involvement has a positive correlation with technical innovation. Family members would have high loyalty as the degree of family management involvement is higher. Family managers would begin to pursue a familial sense of achievement beyond their own individual interests. Therefore, managers enhance investment of technological innovation to promote development of family enterprises.

Moreover, the regression coefficient of enterprise's age is 0.002, which is not significant, indicating that enterprise's age has no significant correlation with technological innovation. The regression coefficient of enterprise's size is 0.005, which is significant at 5%, indicating that enterprise's size is significantly positively correlated with technological innovation. The regression coefficient of enterprise's profitability is 0.086, which is significant at 1%, indicating that profitability is significantly positively correlated with technological innovation. The regression coefficient of financial leverage is −0.126, which is significant at 1% level, indicating that financial leverage is significantly negatively correlated with technological innovation. The regression coefficient of independent directors is 0.123, which is significant at 10% level, indicating that independent directors have positive correlation with technological innovation.

According to relevant theories and previous research, this study believes that internationalization strategies would broaden the market of enterprises and increase the competition of enterprises. To reach the requirements of new customers and markets, enterprises need to boost the intensity of technical innovation. The development of new markets would attract more family members and provide them with more employment chances. Meanwhile, the success of the new technology would bring high reputation to the family and improve social influences. According to this, Hypotheses 3 and 4 are proposed and relevant models, 3a, 3b, 4a and 4b, are established. The regression results of model 3a, 3b, 4a and 4b are presented in Table 6.

The dependent variable of the above models is intensity of technological innovation (TI). The independent variable of Model 3a and 3b is family ownership involvement (FOI). Among them, Model 3a only adds internationalization strategy (IS) and Model 3b brings both IS and the interaction term FOI * IS into the regression model. This is similar in case of Model 4a and 4b. From the regression results, it is evident that these models have high goodness of fit and good significance level.

In Model 3a, R-squared is 0.468, adjusted R-squared is 0.420 and F value is 8.505 which is significant at 1%. Therefore, Model 3a is significant. Regression coefficient of family ownership involvement is −0.059 and internationalization strategy is −0.035. They are both significant at 1%. It indicates that internationalization strategy is

Table 6
Analysis of the moderating effect of internationalization strategy on the influence of family involvement on enterprise's technological innovation.

	Basic model	Model 3a	Model 3b	Model 4a	Model 4b
Family ownership involvement (FOI)	−0.063***	−0.059***	−0.074***		
	(0.001)	(0.002)	(0.001)		
Family management involvement (FMI)	0.123***			0.119***	0.142***
	(0.000)			(0.000)	(0.000)
Internationalization strategy (IS)		−0.035***	−0.081***	−0.017***	−0.017***
		(0.005)	(0.033)	(0.011)	(0.011)
FOI*IS			0.104**		
			(0.023)		
FMI*IS					0.231**
					(0.034)
Enterprise's age (Age)	0.001	0.000	0.001	0.002	0.005
	(0.192)	(0.260)	(0.186)	(0.275)	(0.337)
Enterprise's size (Size)	0.008**	0.010**	0.010**	0.006**	0.006**
	(0.042)	(0.013)	(0.012)	(0.011)	(0.012)
Profitability (Prof)	0.091***	0.086***	0.097***	0.082***	0.063***
	(0.009)	(0.004)	(0.003)	(0.008)	(0.008)
Financial leverage (FL)	−0.120***	−0.117***	−0.119***	−0.125***	−0.113***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Proportion of independent directors (ID)	0.096*	0.153*	0.161*	0.139*	0.138*
	(0.056)	(0.055)	(0.053)	(0.055)	(0.060)
Year	controlled	controlled	Controlled	controlled	controlled
Industry	controlled	controlled	Controlled	controlled	controlled
R-squared	0.403	0.468	0.473	0.513	0.529
Adjusted R-squared	0.379	0.420	0.422	0.491	0.511
F	7.707***	8.505***	8.669***	9.437***	10.433***

negatively correlated with technological innovation. This is because the internationalization strategies of most Chinese enterprises are in the early stage.

There would be resource contentions between internationalization strategy and technical innovation to a certain extent. When the interaction term FOI * IS is added, R-squared rises from 0.468 to 0.473, adjusted R-squared from 0.420 to 0.422 and F is at 8.669 which is significant at 1% level, indicating that Model 3b is generally significant. The regression coefficient of family ownership involvement is −0.074 and internationalization strategy is −0.081 which are both significant at 1%. However, the interaction term FOI * IS is positively correlated with technological innovation, with a regression coefficient of 0.104. It indicates that although there are resource competitions between internationalization strategy and technological innovation, it could moderate the negative correlation between family ownership and technological innovation, which verifies Hypothesis 3.

In Model 4a, R-squared is 0.513, adjusted R-squared is 0.491 and F value is 9.437 which is significant at 1%. It shows that Model 4a is significant. Family management involvement is significantly positively correlated with the technology innovation at 1% and their regression coefficient is 0.119. There is a negative correlation between internationalization strategy and technical innovation and the regression coefficient is −0.017. However, after adding the interaction term FMI * IS, FMI * IS is positively correlated with the technical innovation at level 5%, with a regression coefficient of 0.231. It shows that internationalization strategy has a moderating effect and could enhance the positive correlation between family management involvement and technological innovation, which verifies Hypothesis 4.

6. Discussions and conclusion

Our theoretical focus was to further the extant literature in family firm-based technology innovation. We furthered researchers' efforts such as De Masses et al. (2013) who suggested that his conceptualization of existing knowledge was only the first step in assisting family businesses and policy makers to embrace technology innovation in family firms. This spurred not only our efforts but efforts like Feranita et al. (2017) who, for example, furthered this effort by researching collaborative efforts to increase innovative performance in family firms. We add to the literature base by furthering conceptualization efforts like De Masses et al. (2013). We further describe how technology innovation in family firm's resident in big emergent economies (China) is negatively affected by the lack of family management involvement. We further extended efforts like Feranita's et al. 2017 by providing effective measures to increase technology innovation in family firms. Here we focus on the role of investment in family firms' technical innovation that help minimize the traditional disadvantages of family business involved in technology innovation.

We did this by basing our study on relevant family business research where we combined differing theoretical basis. Many scholars as we discussed in our literature review utilized theory contributions in a more individual manner and created research gaps. We integrated internationalization strategy, family involvement and enterprise's technical innovation. We utilized internationalization strategy as a moderating factor to analyze its adjustment effect on impacts of family involvement and technological innovation of family firms.

We found that internationalization strategy aided in adjusting the influence of family involvement on enterprise's innovation. Further that implementing internationalization strategy, helped to expand the firm share in global markets. It also helps to promote the internationalization of family brands (Liang et al., 2014). Further work is required to offer the correct balance of family management involvement and the process of internationalization strategy in order to optimize the acceleration of technical innovation and best enhance the degree of innovation. Further research is also required to investigate the relation of technology innovation as an attractant for new talented workers and investors. Our study provided this value by analyzing the impacts of family involvement on the technological innovation of Chinese family companies. We did this from two perspectives: family ownership involvement and family management involvement. Moreover, it explored whether the internationalization strategy could adjust the correlation between family involvement and technological innovation.

Our results show that family ownership has significantly negative relations with enterprise's technological innovation and that family management involvement has positive relations with enterprise's technological innovation. Besides, internationalization strategy would reduce negative impacts of family ownership on enterprise's technical innovation and enhance positive impacts of family management involvement. Our work provides both theoretical and practical significance.

6.1. Practical implications

Family business is important around the globe but nowhere more so than family businesses in many big emerging economies. However, as these family businesses take their place in the global family companies' community, it important to understand their lack of relative global business knowledge and experience. Chinese family enterprises are young, with advantages such as fast decision-making speed and strong entrepreneurship ability (Boyd et al., 2015). However, there are also some disadvantages, such as conservative and slow acceptance of new things. Many Chinese family enterprises develop late and lack of relevant experience in family members. It is important for the new generation of enterprise managers to adjust and optimize family involvement and implement innovation strategies.

Previous research has shown that family ownership involvement not to be fully beneficial to company's technical innovation. Yet restructuring firm ownership helps to guarantee the continuity of family enterprises (Giovannini, 2010). However, when this occurs managers of family enterprises are often unwilling to undertake what they consider risky technological innovation. They do this to maintain their socioemotional wealth. Our research shows that with the utility of an effective international strategy family member manager involvement takes on a much more proactive role in technology innovation.

Our research suggests that enterprise managers should optimize the ownership structure. Utilize an effective international strategy to encourage family managerial involvement especially in innovation investment. The resultant change promotes capital investment in family firms. This optimizes the allocation of resources, implement effective management of technical innovation, and reduce risks of technical innovation (Dou and Li, 2013).

Increasing the family management involvement in family businesses can then be used to promote its positive impact on technological innovation. However, as mentioned, the Chinese family firms we analyzed in our study are young to global business and many family members lack international strategic knowledge. Therefore, the management of enterprises need to be restricted to a certain extent (Steier et al., 2015). Family enterprises need to improve the international strategic professional knowledge level of family members to establish a professional family management team. Meanwhile, family enterprises should introduce specialized talents actively and recruit appropriate external managers to enter senior management and mentoring roles to enhance the family firm's management capability.

6.2. Limitations

The research object of this paper was the listed family enterprises. However, many family enterprises choose to not go public to maintain absolute control of the company. Therefore, some important samples are missing. Moreover, the samples selected in this paper were family enterprises that had been listed in 2010. These enterprises were established earlier and have developed relatively steadily. However, family enterprises that have gone public in recent years were not included in the research. If these missing data are included in future research, it would increase the diversity and comprehensiveness of the research. This paper mainly analyzed family ownership involvement and family management involvement, which are reasonable to some extent. But the indicators of family involvement are still insufficient and lack comprehensiveness. Future research should place emphasis on building more reasonable and comprehensive indicators of family involvement.

CRediT authorship contribution statement

Nazrul Islam: Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. **Qidong Wang:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft. **Yorgos Marinakis:** Conceptualization, Data curation, Formal analysis, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Steven Walsh:** Conceptualization, Formal analysis, Investigation, Methodology, Resources, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Ahlstrom, D., Yang, X., Wang, L., & Wu, C. (2018). A global perspective of entrepreneurship and innovation in China. *Multinational Business Review., 26*(4), 302–318. https://doi.org/10.1108/MBR-08-2018-0058

Altomonte, C., Aquilante, T., Bekes, G., & Ottaviano, G. I. P. (2013). Internationalization and innovation of firms: Evidence and policy. *Economic Policy., 28*(76), 663–700.

Arregle, J.-L., Hitt, M. A., Sirmon, D. G., & Very, P. (2007). The Development of Organizational Social Capital: Attributes of Family Firms. *Journal of Management Studies., 44*(1), 73–95. https://doi.org/10.1111/j.1467-6486.2007.00665.x

Babu, M. M., Dey, B. L., Rahman, M., Roy, S. K., Alwi, S. F. S., & Kamal, M. M. (2020). Value co-creation through social innovation: A study of sustainable strategic alliance in telecommunication and financial services sectors in Bangladesh. *Industrial Marketing Management, 89*, 13–27.

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

Chavez, V. A., Stinnett, R., Tierney, R., & Walsh, S. (2017). The importance of the technologically able social innovators and entrepreneurs: A US national laboratory perspective. *Technological forecasting and social change, 121*, 205–215.

Bennedsen, M., Fan, J. P. H., Jian, M., & Yeh, Y. (2015). The Family Business Map: Framework, Selective Survey, and Evidence from Chinese Family Firm Succession. *Journal of Corporate Finance., 33*(1), 212–226. https://doi.org/10.1016/j.jcorpfin.2015.01.008

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.

Bhaumik, S. K., & Gregoriou, M. (2010). 'Family' Ownership, Tunneling and Earnings Management: A Review of the Literature. *Journal of Economic Surveys., 24*(4), 705–730. https://doi.org/10.1111/j.1467-6419.2009.00608.x

Block, J. H. (2012). R&D Investments in Family and Founder Firms: An Agency Perspective. *Journal of Business Venturing., 27*(2), 248–265. https://doi.org/10.1016/j.jbusvent.2010.09.003

Boermans, M. A., & Roelfsema, H. (2016). Small firm internationalization, innovation, and growth. *International Economics and Economic Policy., 13*(2), 283–296.

Boyd, B., Royer, S., Pei, R., & Zhang, X. (2015). Knowledge transfer in family business successions: Implications of knowledge types and transaction atmospheres. *Journal of Family Business Management., 5*(1), 17–37. https://doi.org/10.1108/JFBM-05-2014-0009

Bromiley, P., & Rau, D. (2016). Operations Management and the Resource Based View: Another View. *Journal of Operations Management., 41*(1), 95–106. https://doi.org/10.1016/j.jom.2015.11.003

Buckley, P. J., & Strange, R. (2011). The Governance of the Multinational Enterprise: Insights from Internalization Theory. *Journal of Management Studies., 48*(2), 460–470. https://doi.org/10.1111/j.1467-6486.2010.00920.x

Cabrera-Suárez, K., De Saá-Pérez, P., & García-Almeida, D. (2001). The succession process from a resource-and knowledge-based view of the family firm. *Family Business Review, 14*(1), 37–48.

Calabrò, A., et al. (2019). Innovation in Family Firms: A Systematic Literature Review and Guidance for Future Research. *International Journal of Management Reviews., 21*(3), 317–355. https://doi.org/10.1111/ijmr.12192

Carnes, C. M., & Ireland, R. D. (2013). Familiness and Innovation: Resource Bundling as the Missing Link. *Entrepreneurship: Theory and Practice., 37*(6), 1399–1419. https://doi.org/10.1111/etap.12073

Carrasco-Hernandez, A., & Jimenez-Jimenez, D. (2013). Can family firms innovate? sharing internal knowledge from a social capital perspective. *Electronic Journal of Knowledge Management., 11*(1), 30–37.

Cennamo, C., Berrone, P., Cruz, C., & Gómez-Mejía, L. R. (2012). Socioemotional Wealth and Proactive Stakeholder Engagement: Why Family-Controlled Firms Care More About Their Stakeholders. *Entrepreneurship: Theory and Practice., 36*(6), 1153–1173. https://doi.org/10.1111/j.1540-6520.2012.00543.x

Chisholm, A. M., & Nielsen, K. (2009). Social Capital and the Resource-Based View of the Firm. *International Studies of Management & Organization., 39*(2), 7–32.

Chrisman, J. J., Chua, J. H., Pearson, A. W., & Barnett, T. (2012). Family Involvement, Family Influence, and Family-Centered Non-Economic Goals in Small Firms. *Entrepreneurship: Theory and Practice., 36*(2), 267–293. https://doi.org/10.1111/j.1540-6520.2010.00407.x

Chrisman, J. J., Chua, J. H., Kellermanns, F. W., & Chang, E. P. C. (2007). Are family managers agents or stewards? An exploratory study in privately held family firms. *Family Influences on Firms, 60*(10), 1030–1038.

Chrisman, J. J., Chua, J. H., & Sharma, P. (2005). *Trends and Directions in the Development of a Strategic Management Theory of the Family Firm. Entrepreneurship: Theory and Practice, 29*, 555–575.

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., Kellermanns, F. W., Chan, K. C., & Liano, K. (2010). Intellectual foundations of current research in family business: An identification and review of 25 influential articles. *Family Business Review, 23*(1), 9–26.

Chua, J. H., Chrisman, J. J., & Bergiel, E. B. (2009). An Agency Theoretic Analysis of the Professionalized Family Firm. *Entrepreneurship Theory and Practice., 33*(2), 355–372.

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

Chung, H. M. (2013). The role of family management and family ownership in diversification: The case of family business groups. *Asia Pacific Journal of Management., 30*, 871–891. https://doi.org/10.1007/s10490-012-9284-x

Corbetta, G., & Salvato, C. (2004). Self-serving or self-actualizing? Models of man and agency costs in different types of family firms: A commentary on "Comparing the agency costs of family and non-family firms: Conceptual issues and exploratory evidence". *Entrepreneurship: Theory & Practice, 28*(4), 355–362.

Cruz, C., Justo, R., & De Castro, J. O. (2012). Does Family Employment Enhance MSEs Performance? *Integrating. Journal of Business Venturing., 27*(1), 62–76. https://doi.org/10.1016/j.jbusvent.2010.07.002

Cruz, C., Firfiray, S., & Gómez-Mejía, L. R. (2011). Socioemotional Wealth and Human Resource Management (HRM) in Family-Controlled Firms. *Research in Personnel and Human Resources Management., 30*(7), 159–217. https://doi.org/10.1108/S0742-7301(2011)0000030006

Cucculelli, M. (2012). Family Firms, Entrepreneurship and Economic Development. *Journal of Applied Economics., 31*(2), 1–8.

Daily, C. M., Dalton, D. R., & Rajagopalan, N. (2003). Governance through ownership: Centuries of practice, decades of research. *Academy of Management Journal, 46*(2), 151–158.

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

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. https://doi.org/10.5465/amp.2015.0017

De Massis, A., Frattini, F., Pizzurno, E., & Cassia, L. (2015). Product Innovation in Family versus Nonfamily Firms: An Exploratory Analysis. *Journal of Small Business Management., 53*(1), 1–36. https://doi.org/10.1111/jsbm.12068

De Massis, A., Frattini, F., Majocchi, A., & Piscitello, L. (2017). Family Firms in the Global Economy: Toward a Deeper Understanding of Internationalization Determinants, Processes, and Outcomes. *Global Strategy Journal., 8*(1), 3–21. https://doi.org/10.1002/gsj.1199

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.

Diéguez-Soto, J., Manzaneque, M., & Rojo-Ramírez, A. A. (2016). Technological Innovation Inputs, Outputs, and Performance: The Moderating Role of Family Involvement in Management. *Family Business Review., 29*(3), 327–346. https://doi.org/10.1177/0894486516646917

Dominici, G., Yolles, M., & Caputo, F. (2017). Decoding the dynamics of value cocreation in consumer tribes: An agency theory approach. *Cybernetics and Systems, 48*(2), 84–101.

Dou, J., & Li, S. (2013). The Succession Process in Chinese Family Firms: A Guanxi Perspective. *Asia Pacific Journal of Management., 30*(3), 893–917. https://doi.org/10.1007/s10490-012-9287-7

e Cunha, M.P., Leitão, M.J.S., Clegg, S., Hernández-Linares, R., Moasa, H., Randerson, K. and Rego, A. (2021). Cognition, emotion and action: persistent sources of parent–offspring paradoxes in the family business. *Journal of Family Business Management*.

Eddleston, K. A., & Kellermanns, F. W. (2007). Destructive and productive family relationships: A stewardship theory perspective. *Journal of Business Venturing, 22*(4), 545–565.

Eddleston, K. A., & Morgan, R. M. (2014). *Trust, commitment and relationships in family business*. Challenging conventional wisdom.

Efferin, S., & Hartono, M. S. (2015). Management Control and Leadership Styles in Family Business: An Indonesian Case Study. *Journal of Accounting and Organizational Change., 11*(1), 130–159. https://doi.org/10.1108/JAOC-08-2012-0074

Eisenhardt, K. M. (1989). Agency Theory: An Assessment and Review. *The Academy of Management Review., 14*(1), 57–74.

Elmanizar, H. F., Nugraha, A. T., Yakub, A., & Cahyono, B. P. (2019). The application of agency theory in supply chain finance: A case of Indonesian manufacturing firms. *International Journal of Supply Chain Management (IJSCM), 8*(3), 23–32.

Evert, R. E., Martin, J. A., McLeod, M. S., & Payne, G. T. (2016). Empirics in Family Business Research: Progress, Challenges, and the Path Ahead. *Family Business Review., 29*(1), 17–43. https://doi.org/10.1177/0894486515593869

Feranita, F., Kotlar, J., & De Massis, A. (2017). Collaborative innovation in family firms: Past research, current debates and agenda for future research. *Journal of Family Business Strategy, 8*(3), 137–156.

Firfiray, S., Cruz, C., Neacsu, I., & Gómez-Mejía, L. R. (2018). Is Nepotism so Bad for Family Firms? A Socioemotional Wealth Approach. *Human Resource Management Review., 28*(1), 83–97. https://doi.org/10.1016/j.hrmr.2017.05.008

Gary, R.F., Fink, M., Belousova, O., Marinakis, Y., Tierney, R. and Walsh, S.T., 2020. An introduction to the field of abundant economic thought, Technological Forecasting and Social Change, p.119796.

Giovannini, R. (2010). Corporate Governance, Family Ownership and Performance. *Journal of Management and Governance., 14*(2), 145–166. https://doi.org/10.1007/s10997-009-9093-x

Goel, S., He, X., & Karri, R. (2011). Family Involvement in a Hierarchical Culture: Effect of Dispersion of Family Ownership Control and Family Member Tenure on Firm Performance in Chinese Family Owned Firms. *Journal of Family Business Strategy, 2*(4), 199–206. https://doi.org/10.1016/j.jfbs.2011.10.003

Gomez-Mejia, L. R., Nunez-Nickel, M., & Gutierrez, I. (2001). The role of family ties in agency contracts. *Academy of management Journal, 44*(1), 81–95.

Gómez-Mejía, L. R., Haynes, K. T., Núñez-Nickel, M., Jacobson, K. J. L., & 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. https://doi.org/10.2189/asqu.52.1.106

Gómez-Mejía, L. R., Cruz, C., Berrone, P., & De Castro, J. O. (2017). The Bind That Ties: Socioemotional Wealth Preservation in Family Firms. *Academy of Management Annals., 5*(1), 653–707. https://doi.org/10.5465/19416520.2011.593320

Graves, C., & Thomas, J. (2008). Determinants of the Internationalization Pathways of Family Firms: An Examination of Family Influence. *Family Business Review., 21*(2), 151–167. https://doi.org/10.1111/j.1741-6248.2008.00119.x

Groen, A. J., & Walsh, S. T. (2013). Introduction to the field of creative enterprise. *Technological forecasting and social change, 80*(2), 187–190.

Gronum, S., Verreynne, M.-L., & Kastelle, T. (2012). The Role of Networks in Small and Medium-Sized Enterprise Innovation and Firm Performance. *Journal of Small Business Management., 50*(2), 257–282. do.

Hauck, J., & Prügl, R. (2015). Innovation activities during intra-family leadership succession in family firms: An empirical study from a socioemotional wealth perspective. *Journal of Family Business Strategy, 6*(2), 104–118.

Herrero, I. (2018). How familial is family social capital? Analyzing bonding social capital in family and nonfamily firms. *Family Business Review, 31*(4), 441–459.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics, 3*(4), 305–360.

Juliarto, A., Tower, G., Van der Zahn, J., & Rusmin, R. (2013). Managerial Ownership Influencing Tunnelling Behaviour. *Australasian Accounting, Business and Finance Journal, 7*(2), 25–46. https://doi.org/10.14453/aabfj.v7i2.3

Kafouros, M. I., Buckley, P. J., Sharp, J. A., & Wang, C. (2008). The role of internationalization in explaining innovation performance. *Technovation., 28*(1–2), 63–74.

Kallmuenzer, A. (2015). Agency theory and the family business. In M. Nordqvist, L. Melin, M. Waldkirch, & G. Kumeto (Eds.), *Theoretical Perspectives on Family Businesses* (pp. 58–77). Cheltenham: Edward Elgar Publishing. https://doi.org/10.4337/9781783479665.00011.

Karra, N., Tracey, P., & Phillips, N. (2006). Altruism and Agency in the Family Firm: Exploring the Role of Family, Kinship, and Ethnicity. *Entrepreneurship Theory and Practice., 30*(6), 861–877.

Kellermanns, F. W., Eddleston, K. A., Sarathy, R., & Murphy, R. (2012). Innovativeness in Family Firms: A Family Influence Perspective. *Small Business Economics., 38*(1), 85–101. https://doi.org/10.1007/s11187-010-9268-5

Kelliher, F., & Reinl, L. (2009). A resource-based view of micro-firm management practice. *Journal of Small Business and Enterprise Development., 16*(3), 521–532.

Kim, H., Kim, H., & Lee, P. M. (2008). Ownership structure and the relationship between financial slack and R&D investments: Evidence from Korean firms. *Organization Science, 19*(3), 404–418.

Kontinen, T., & Ojiala, A. (2010). The Internationalization of Family Businesses: A Review of Extant Research. *Journal of Family Business Strategy., 1*(2), 97–107. https://doi.org/10.1016/j.jfbs.2010.04.001

Kosnik, R. D., & Bettenhausen, K. L. (1992). Agency theory and the motivational effect of management compensation: An experimental contingency study. *Group & Organization Management, 17*(3), 309–330.

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

Kuiken, A., Naldi, L., & Nordqvist, M. (2021). Internationalization of Family Firms as a Discontinuous Process: The Role of Behavioral Theory. In *The Palgrave Handbook of Family Firm Internationalization* (pp. 135–171). Cham: Palgrave Macmillan.

Kumeto, G. (2015). Behavioural agency theory and the family business. In M. Nordqvist, L. Melin, M. Waldkirch, & G. Kumeto (Eds.), *Theoretical Perspectives on Family Businesses* (pp. 78–98). Cheltenham: Edward Elgar Publishing.

Lazonick, W., 2017. Innovative Enterprise Solves the Agency Problem: The Theory of the Firm, Financial Flows, and Economic Performance. Institute for New Economic Thinking Working Paper Series. 62. https://doi.org/10.2139/ssrn.3081556.

Le Breton-Miller, I., Miller, D., & Bares, F. (2015). Governance and Entrepreneurship in Family Firms: Agency, Behavioral Agency and Resource-Based Comparisons. *Journal of Family Business Strategy., 6*(1), 58–62. https://doi.org/10.1016/j.jfbs.2014.10.002

Lee, T., & Chu, W. (2017). The relationship between entrepreneurial orientation and firm performance: Influence of family governance. *Journal of Family Business Strategy, 8*(4), 213–223.

Li, C., Lin, C., & Huang, H. (2013). Top Management Team Social Capital, Exploration-Based Innovation, and Exploitation-Based Innovation in SMEs. *Technology Analysis and Strategic Management., 26*(1), 69–85. https://doi.org/10.1080/09537325.2013.850157

Liang, Q., Li, X., Yang, X., Lin, D., & Zheng, D. (2013). How does family involvement affect innovation in China? *Asia Pacific Journal of Management, 30*(3), 677–695.

Liang, X., Wamg, L., & Cui, Z. (2014). Chinese Private Firms and Internationalization: Effects of Family Involvement in Management and Family Ownership. *Family Business Review., 27*(2), 126–141. https://doi.org/10.1177/0894486513480885

Lim, E. N. K., Lubatkin, H. M., & Wiseman, R. M. (2010). A Family Firm Variant of the Behavioral Agency Theory. *Strategic Entrepreneurship Journal., 4*(3), 197–211. https://doi.org/10.1002/sej.91

Linton, J. D., & Walsh, S. T. (2004). Roadmapping: From sustaining to disruptive technologies. *Technological Forecasting & Social Change, 1*(71), 1–3.

Litz, R. A. (1997). The family firm's exclusion from business school research: Explaining the void; addressing the opportunity. *Entrepreneurship Theory and Practice, 21*(3), 55–71.

Liu, W., Yang, H., & Zhang, G. (2012). Does family business excel in firm performance? An institution-based view. *Asia Pacific Journal of Management, 29*(4), 965–987.

Liu, C., et al. (2015). The Weakness of Strong Ties: Sampling Bias, Social Ties, and Nepotism in Family Business Succession. *The Leadership Quarterly, 26*(3), 419–435. https://doi.org/10.1016/j.leaqua.2015.02.007

Liu, J., 2017. The Advantages and Disadvantages of Running a Family Business. Global Market Information Guide. 46 (1), 145-145.

Madison, K., Li, Z., & Holt, D. T. (2016). *Agency theory in family firm research*. The Routledge Companion to Family Business.

Mahto, R., McDowell, W. C., & Davis, P. (2020). Influence and values: The connection between participation and commitment in family firms. *Journal of Business Research, 112*, 354–362.

Man-zhi, L.F.C.L., 2002. Trust Expansion and Family Enterprises' Innovation and Development [J]. *China Industrial Economy*, *9*.

Marrone, J. V. (2017). *Cultural assimilation as a human capital formation process: Theory and empirical evidence*. The University of Chicago.

Marinakis, Y., Harms, R., Ahluwalia, S., & Walsh, S. T. (2017). Explaining product adoption and diffusion at the base of the pyramid. *International Journal of Technology Intelligence and Planning, 11*(4), 345–365.

Matzler, K., Veider, V., Hautz, J., & Stadleret, C. (2015). The impact of family ownership, management, and governance on innovation. *Journal of Product Innovation Management., 32*(3), 319–333. https://doi.org/10.1111/jpim.12202

Menendez-Requejo, S. (2005). Growth and internationalisation of family businesses. *International Journal of Globalisation and Small Business, 1*(2), 122–133.

Michiels, A., & Molly, V. (2017). Financing Decisions in Family Businesses: A Review and Suggestions for Developing the Field. *Family Business Review., 30*(4), 369–399. https://doi.org/10.1177/0894486517736958

Min, Y., Chen, Z., & Li, R. (2016). Family Involvement and Firm Technological Innovation. *Foreign Economics & Management., 38*(3), 86–98. https://doi.org/10.16538/j.cnki.fem.2016.03.007

Molina-Morales, F. X., & Martínez-Fernández, M. T. (2010). Social Networks: Effects of Social Capital on Firm Innovation. *Journal of Small Business Management., 48*(2), 258–279. https://doi.org/10.1111/j.1540-627X.2010.00294.x

Morck, R., & Yeung, B. (2003). Agency Problems in Large Family Business Groups. *Entrepreneurship Theory and Practice., 27*(4), 367–382.

Morone, J. G. (1993). *Winning in high-tech markets: The role of general management*. Harvard Business Press.

Narula, R., Asmussen, C. G., Chi, T., & Kundu, S. K. (2019). Applying and advancing internalization theory: The multinational enterprise in the twenty-first century. *Journal of International Business Studies., 50*, 1231–1252. https://doi.org/10.1057/s41267-019-00260-6

Newbert, S., & Craig, J. B. (2017). Moving beyond socioemotional wealth: Toward a normative theory of decision making in family business. *Family Business Review, 30*(4), 339–346.

Nieto, M. J., Santamaria, L., & Fernandez, Z. (2015). Understanding the Innovation Behavior of Family Firms. *Journal of Small Business Management., 53*(2), 382–399. https://doi.org/10.1111/jsbm.12075

Nordqvist, M., Habbershon, T. G., & Melin, L. (2008). Transgenerational entrepreneurship: exploring entrepreneurial orientation in family firms. In *Entrepreneurship, Sustainable Growth and Performance: Frontiers in European entrepreneurship Research* (p. 93).

Pepper, A., & Gore, J. (2015). Behavioral Agency Theory: New Foundations for Theorizing About Executive Compensation. *Journal of Management., 41*(4), 1045–1068.

Popli, M., Ladkani, R. M., & Gaur, A. S. (2017). Business Group Affiliation and Post-Acquisition Performance: An Extended Resource-Based View. *Journal of Business Research., 81*(1), 21–30. https://doi.org/10.1016/j.jbusres.2017.08.003

Porfírio, J. A., Felício, J. A., & Carrilho, T. (2020). Family business succession: Analysis of the drivers of success based on entrepreneurship theory. *Journal of Business Research, 115*, 250–257.

Poutziouris, P., Savva, C. S., & Hadjielias, E. (2015). Family Involvement and Firm Performance: Evidence from UK Listed Firms. *Journal of Family Business Strategy., 6*(1), 14–32. https://doi.org/10.1016/j.jfbs.2014.12.001

Revilla, A. J., Pérez-Luño, A., & Nieto, M. J. (2016). Does Family Involvement in Management Reduce the Risk of Business Failure? The Moderating Role of Entrepreneurial Orientation. *Family Business Review., 29*(4), 365–379. https://doi.org/10.1177/0894486516671075

Romano, C. A., Tanewski, G. A., & Smyrnios, K. X. (2001). Capital structure decision making: A model for family business. *Journal of business venturing, 16*(3), 285–310.

Ronen, J., & Kashi, R. (1995). Agency theory: An approach to incentive problems in management accounting. *Asian Review of Accounting*.

Rugman, A. M. (1980). Internalization Theory and Corporate International Finance. *California Management Review., 23*(2), 73–79. https://doi.org/10.2307/41164920

Sanchez-Famoso, V., Maseda, A., & Iturralde, T. (2014). The role of internal social capital in organisational innovation. An empirical study of family firms. *European Management Journal., 32*(6), 950–962. https://doi.org/10.1016/j.emj.2014.04.006

Schepers, J., Voordeckers, W., Steijvers, T., & Laveren, E. (2014). The Entrepreneurial Orientation-Performance Relationship in Private Family Firms: The Moderating Role of Socioemotional Wealth. *Small Business Economics., 43*(1), 39–55. https://doi.org/10.1007/s11187-013-9533-5

Schmieder, J. (2014). *Innovation in the Family Business: Succeeding Through Generations*. New York: Springer.

Schulze, W. S., Lubatkin, M. H., & Dino, R. N. (2002). Altruism, Agency, and the Competitiveness of Family Firms. *Managerial and Decision Economics., 23*(4/5), 247–259. https://doi.org/10.5465/apbpp.2000.5535893

Sciascia, S., Nordqvist, M., Mazzola, P., & De Massis, A. (2014). Family Ownership and R&D Intensity in Small- and Medium-Sized Firms. *Journal of Product Innovation Management, 32*(3), 349–360. https://doi.org/10.1111/jpim.12204

Shapiro, S. P. (2005). Agency theory. *Annual Review of Sociology, 31*, 263–284.

Sharma, P., Chrisman, J. J., & Chua, J. H. (1997). Strategic management of the family business: Past research and future challenges. *Family Business Review, 10*(1), 1–35.

Shi, W., Connelly, B. L., & Hoskisson, R. E. (2017). External corporate governance and financial fraud: Cognitive evaluation theory insights on agency theory prescriptions. *Strategic Management Journal, 38*(6), 1268–1286.

Steier, L. P., Chrisman, J. J., & Chua, J. H. (2015). Governance Challenges in Family Businesses and Business Families. *Entrepreneurship Theory and Practice., 39*(6), 1265–1280. https://doi.org/10.1111/etap.12180

Subramanian, S. (2018). Stewardship Theory of Corporate Governance and Value System: The Case of a Family-Owned Business Group in India. *Indian Journal of Corporate Governance., 11*(1), 88–102. https://doi.org/10.1177/0974686218776026

Tate, W. L., Ellram, L. M., Bals, L., Hartmann, E., & Van der Valk, W. (2010). An agency theory perspective on the purchase of marketing services. *Industrial Marketing Management, 39*(5), 806–819.

Tsai, W. H., Hung, J. H., Kuo, Y. C., & Kuo, L. (2006). CEO tenure in Taiwanese family and nonfamily firms: An agency theory perspective. *Family Business Review, 19*(1), 11–28.

Tsao, C., Chen, S., & Wang, Y. (2016). Family Governance Oversight, Performance, and High Performance Work Systems. *Journal of Business Research., 69*(6), 2130–2137. https://doi.org/10.1016/j.jbusres.2015.12.020

Tsao, S. M., & Lien, W. H. (2013). Family management and internationalization: The impact on firm performance and innovation. *Management International Review, 53*(2), 189–213.

Van Den Berghe, L. A. A., & Carchon, S. (2003). Agency Relations within the Family Business System: An exploratory approach. *Corporate Governance: An International Review., 11*(3), 171–179.

Vardaman, J. M., & Gondo, M. B. (2014). Socioemotional Wealth Conflict in Family Firms. *Entrepreneurship: Theory and Practice., 38*(6), 1317–1322. https://doi.org/10.1111/etap.12126

Walsh, S., & Linton, J. (2011). The Strategy-Technology Firm Fit Audit: A guide to opportunity assessment and selection. *Technological Forecasting and Social Change., 78*(2), 199–216.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal, 5*(2), 171–180.

Westhead, P., Cowling, M., & Howorth, C. (2001). The Development of Family Companies: Management and Ownership Imperatives. *Family Business Review, 14*(4), 369–385.

Williamson, O. E. (2010). Transaction cost economics: The natural progression. *American Economic Review, 100*(3), 673–690.

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

Wright, P., Mukherji, A., & Kroll, M. J. (2001). A reexamination of agency theory assumptions: Extensions and extrapolations. *The Journal of Socio-Economics, 30*(5), 413–429.

Xiang, et al. (2019). Towards Continuous Access Control Validation and Forensics, CCS '19. In *Proceedings of the 2019 ACM SIGSAC Conference on Computer and Communications Security* (pp. 113–129). https://doi.org/10.1145/3319535.3363191

Zellweger, T. (2017). Managing the Family Business: Theory and Practice. Edward Elgar, Cheltenham.

Xiangqian, Y. (2007). Discussion on the Succession and Innovation of Institution in the Family Business [J]. *Academic Monthly, 100*.

Yang, X., Li, J., Stanley, L. J., Kellermanns, F. W., & Li, X. (2020). How family firm characteristics affect internationalization of Chinese family SMEs. *Asia Pacific Journal of Management, 37*(2), 417–448.

Yang, J., Ma, J., Zhao, H., Cater, J., & Arnold, M. (2019). Family involvement, environmental turbulence, and R&D investment: Evidence from Listed Chinese SMEs. *Small Business Economics, 53*(4), 1017–1032.

Zhou, J., Tam, O. K., & Yu, P. (2013). An Investigation of the Role of Family Ownership, Control and Management in Listed Chinese Family Firms. *Asian Business and Management., 12*(2), 197–225. https://doi.org/10.1057/abm.2012.40

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