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Origin matters: Institutional imprinting and family firm innovation in China

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ABSTRACT

During the early 1990s, a swathe of small state-owned enterprises (SOEs) was privatized as family businesses in China. This paper examines whether and how the origin (i.e., restructured vs. entrepreneurial) of family firms affects corporate innovation. Using the data of Chinese family firms from 2009 to 2018, we find that restructured family firms generate fewer patents generally than entrepreneurial family firms, but create more high-quality patents than their entrepreneurial counterparts. This effect is more pronounced for those family firms which had formerly been SOEs for a more extended period, without generational succession, and previously controlled by governments entirely. Further mechanism tests show that restructured family firms have a higher likelihood of hiring professional managers, are subject to less intervention from family members, and have fewer informal hierarchies, providing direct evidence for the institutional imprinting channel. Our findings suggest that the institutional imprint underlying the origin of family firms can be critical to their innovation decisions.

1. Introduction

Innovation has long been regarded as a key engine of economic growth and played an increasingly important role in the sustainable development of private entities (Holmstrom, 1989; Chemmanur et al., 2014). As the most critical component of the private sector, a solid understanding of the determinants in family firms' innovation activities allows policymakers and firms to design stimulating innovation strategies. However, many previous studies employ a dichotomy between family and non-family businesses by treating them as homogeneous (Gomez-Mejia et al., 2010; Daspit et al., 2018; Eng et al., 2021), arousing controversies over evaluating the family firm's role in innovation performance. Therefore, we know relatively little about the heterogeneity within family businesses and the mechanism underlying their high-risk and creative activities (Brune et al., 2019). As the family business is the most prevalent organizational form (La Porta et al., 1999; Sharma, 2004), it is crucial to explore why some family firms have better innovation performance than others.

From a theoretical perspective, the historical background is associated with the process of firm evolution. In detail, it shapes the organizational structure and governance of firms from the longitudinal view and subsequently has a remarkable impact on operating performance (Colli, 2012). Popli et al. (2021) argue that organizational characteristics and routines formed in the past can leave a lasting influence on future corporate strategies, that is, an imprint effect of their founding environments (Marquis and Tilcsik, 2013).

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However, it remains unknown about the nexus between historical origin and current innovation. To fill this gap in the existing literature, we examine whether and how the historical background of Chinese family firms affects corporate innovation in later periods.

Our setting offers two main advantages to explore the consequences for innovation performance of heterogeneity across the foundation types of Chinese family firms. On the one hand, aiming at lifting the burden on small SOEs and promoting market economy, the central government implemented a policy of "*Grasp the Large, Let Go of the Small*" in the late 1990s, resulting in the restructuring of some SOEs into family firms. Consequently, the variance of the family firm origin is embedded into historical evolution, wherein current homogeneity shared across family firms makes the core explanatory variable more exogenous than the dichotomy based on family firms and non-family firms (Brune et al., 2019), which enables us to comprehensively investigate the causal effects of this formal institution, especially the governmental system, on family firm innovation using the imprinting theory. On the other hand, following the reform and opening-up policy in 1978, an increasing number of entrepreneurs, both individuals and families, had chosen to start their businesses during the structural transition from a planned economy to a market economy (Poutziouris et al., 2002). Due to the previous state ownership and ideal institutional environments at the foundation stage, restructured family firms are generally engaged in higher-quality corporate governance than entrepreneurial firms. This context renders the family firm origin to reflect the initial condition of corporate arrangement and family governance, which allows us to explore the innovation behavior from the perspective of organizational institution imprinting.

In China, governance environments plausibly affect corporate innovation (Jia et al., 2019; Choi et al., 2011). The ownership structure in the foundation period shapes the current quality of institutional environments through the imprinting effect, which provides heterogeneous formal institutions to support innovation. The imprinting effect of former ownership of SOEs drives restructured family firms to attach greater importance to substantial technological advancement to enhance competitiveness, witnessing the innovation quality increasing. On the contrary, family members imposing control over the companies would entrench the family governance, exacerbating short-termism in R&D activities (Cheng et al., 2022). The dearth of stability among this type of family firm hinders technological progress and further steers their attention towards the number of patents to meet expectations from investors and the public rather than the quality of technological advancement. From the previous vein, we predict that restructured family firms generate fewer patents but higher quality in comparison with entrepreneurial firms, and the institutional imprinting is a key mechanism for interpreting the heterogeneous innovation performance across family firms.

To test the theoretical prediction, we utilize a sample of publicly listed family firms from 2009 to 2018 to investigate the imprinting impact of family firm origin on corporate innovation. Our results show that restructured family firms generate fewer patents with higher quality than entrepreneurial family firms. Furthermore, we perform two tests assuaging endogenous concerns. First, as ancient confraternity culture facilitates the emergence of founding family firms (Li and Yu, 2017), we choose the number of ancient confraternities during the Ming and Qing dynasties at the provincial level as an instrumental variable to conduct a two-stage least square (2SLS) estimate. Second, we perform a placebo test by randomly reassigning fictitious origin to the existence of family firms. In addition, our baseline findings are robust to a series of robustness checks, such as altering dependent variables and estimation methods.

To provide further evidence, we conduct several cross-sectional tests derived from our main argument. First, since the imprinting effect is rooted in divergent experiences as former SOEs or entrepreneurial businesses, a longer period before SOEs restructuring should consolidate institution superiority, suggesting that the age of being SOEs should amplify the innovation quality advantage of restructured family firms compared to their entrepreneurial counterparts. Second, if institutional imprinting serves as a critical determinant of family firm innovation, the innovation effect of ownership origin should be stronger for family firms without generational succession. Third, since restructured firms can be distinguished by state-controlling enterprises and solely state-owned enterprises, if the ownership origin shapes family firm innovation, we would expect to observe that firms restructured from entire state-ownership enterprises pay more attention to substantial technology advancement rather than the number of patents. The estimation results are consistent with these predictions.

Finally, we investigate the underlying mechanism through which family firm origin has an imprinting effect on corporate innovation. Overall, those family firms that started as SOEs have better formal decision-making arrangements, which have been passed down from the initial institutional environments hinging on state ownership. Specifically, unlike entrepreneurial ones, restructured family firms have a higher probability of hiring professional managers, are exposed less to family intervention, and suffer fewer informal board hierarchies. In other words, institutional imprints of restructured family firms can lead to potential qualitative advantages over entrepreneurial ones. Additionally, we exclude several alternative explanations related to resource endowment, founder's capability and traditional culture.

Our paper contributes to various strands of the governance and growth literature. First, our study contributes to the debate on family firm innovation. Substantial studies claim that the family business is a kind of economic organization featured by active innovation (Carillo et al., 2019; Erdogan et al., 2020; Dibrell and Moeller, 2011; Zahra et al., 2007). In contrast, other scholars hold the point that family businesses are less potentially able to innovate than those widely held firms (Block et al., 2013; Li et al., 2022). This long-standing controversy has blocked further understanding of family business behaviors. The privatization of China's SOEs in the late 1990s provides a unique setting to explicate the heterogeneity across family businesses. We attempt to add new evidence to deepen the understanding of family business by introducing more detailed investigations.

Second, this study contributes to the imprinting theory. The concept of imprinting has always been used to establish the connection between entrepreneurship and individual characteristics, for instance, entrepreneurs' birthplace, attitudes and work experiences (Mathias et al., 2015). However, it is unclear what organizational heritage imprints family firms and their future performance. The historical background of family firms, based on two different formation types, facilitates the analysis, and is conducive to interpreting the long-term impact of the initial institutional conditions. In this paper, we investigate how organizational features at the foundation

stage reshape a firm's current behaviors, which helps illustrate the imprinting effect of family firm origin on corporate innovation.

Third, our study contributes more broadly to the existing literature on the relationship between the institution and business efficiency. Previous studies have shown that the interaction between culture and formal institutions plays a pivotal role in China, while our findings further illustrate that an institution impacts less on quantity but rather on long-term patent quality. Culture is unable to compensate for a threadbare formal institution. In this paper, we provide a better understanding of the decision-making process through the organizational institutions, which is crucial to explaining contradictory innovation among family firms under the background of economic transformation.

Forth and finally, our study is also related to the literature that exploring the unique development path, finance, and governance mechanism in China. According to De Massis et al. (2016), 73% of studies in the field of the family business are based on contexts of European and American, failing to fully reveal the nature of family business operations in countries such as China. China's unique progressive market-oriented reforms (Lin et al., 2001) generate more different economic organizations and vibrant business practices, giving rise to a crowd of family businesses with heterogenous origins and evolutions (Cheng et al., 2022). This allows us to identify a causal relation between initial institutional environments and innovation achievements thank to predominant similarities in core characteristics presently. For instance, restructured family businesses and entrepreneurial ones share the same ownership, legal status, and operating objectives. Furthermore, different from SOEs, in China's intertwined financial system, family businesses are difficult and costly in financing. To overcome the challenge of financing for innovation, family business should focus more on formal institution construction and governance improvement. The institutional environment divergence caused by initial features provide a lens through which we can observe the role played by micro-level governance and macro-level systems in shaping family business behavior.

The remainder of this paper is organized as follows: Section 2 discusses the institutional background and develops our main hypothesis; Section 3 describes the sample and research design; Section 4 provides the empirical results and robustness checks; Section 5 explores the potential mechanisms, and Section 6 concludes.

2. Hypothesis development

Most Chinese family firms were formed as a result of the SOE privatization and entrepreneurship campaign after the reform and opening-up policy in 1978. Increased involvement in globalization and the ambition ensued of shining in international trade have galvanized China into eagerly establishing highly competitive enterprises (Hong, 2018). As the slogan "*Grasp the Large, Let Go off the Small*" has been advocated by the central government, privatization and restructuring SOEs became a predominant policy throughout China's transition period in the late 1990s (Jia et al., 2019). Consequently, from 1996 to 2005, about 60,000 state-owned industrial enterprises in China were privatized through restructuring. Meanwhile, the explosions of entrepreneurial family businesses have subsequently emerged in improved environments following economic liberalization (Poutziouris et al., 2002; Qin and Deng, 2016). These two sources make family firms a prevailing economic organization form with distinctive heterogeneities, even in the whole cohort of listed firms (see Fig. A1).

Tradition should be employed as a critical strategic tool to understand the innovation activities of family firms (De Massis et al., 2016). The institution formed at the founding stage of family firms can be typically regarded as an important tradition that has a lasting imprint on decisions (Simsek et al., 2015; Erdogan et al., 2020). Features of the foundation stage persistently influence trajectories (Immelmann, 1975). The imprinting theory implies that the organization structure at the foundation stage has a long-standing impact on subsequent business routines, value sharing, decision-making and orientation (Marquis and Tilcsik, 2013). The establishment pattern in the foundation stage is an important factor of family firm heterogeneity. During the establishment, over-reliance on the founders' network increases the firm's exposure to family members' influence and decision-making power (Cheng et al., 2022). Consequently, compared to restructured family firms, entrepreneurial firms rely more heavily on family governance during the foundation stage. Additionally, the lack of formal organizational management has made entrepreneurial family firms rely more on the decisions of originators and informal relationships to stay afloat. The imprint of the original institution influences the family firms' orientation to innovate, which results in different innovation tendencies among family businesses.

The routine of the family involvement can persistently affect firms' behaviors, and the urge of maximizing family interest incentivizes entrepreneurial family businesses to cater to innovation-stimulating policies, further distorting innovation strategies (Anderson and Reeb, 2004; Fan et al., 2022). In entrepreneurial family firms, pining for benefits enabled by seizing control rights has stimulated family members to put a stranglehold over the enterprise (Fan et al., 2022). However, maintaining family control makes the innovation strategy contradict economic goals. The incomplete institutions have amplified the cost of developing novel technologies for entrepreneurial families, considering that innovation project is full of uncertainty and has a high probability of failure. Owing to capital market pressure and scrutiny by investors, family firms would be pressured to pursue innovation activities. Therefore, entrepreneurial family firms are more likely to quantify innovative outcomes, such as the number of patent applications, which ensures that they perform well in innovation activities but at the expense of efficiency. In other words, a weak institutional history leads entrepreneurs to seek for short-term benefits, resulting in a greater quantity of innovation (Barrick et al., 2015). By contrast, restructured family firms already have pre-founding experiences of management under state control, and so the resilient formal institutions make them more quality-oriented and focus less on innovation quantity. Accordingly, we have the first hypothesis as follows:

Hypothesis 1. *Restructured family firms produce fewer patents than entrepreneurial firms.*

Existing empirical studies suggest that SOEs have better quality and efficiency of innovation. Gao et al. (2018) compare the innovation activities of public and private firms, indicating that the former invests more in exploitative and productive innovation, while the latter implements exploratory and fruitful innovation. Due to the favorable governance system of restructured family

businesses before the transformation, these firms tend to achieve higher efficiency in decision-making processes, and although non-profit-oriented, the strategies were quality-focused. In addition, it is well acknowledged that SOEs have great advantages in terms of institution and can engage in time-intensive and long-term projects. Thus, the executives place more value on innovation quality (Cao et al., 2020). As restructured family firms were originally born from SOEs, they are more likely to continue the institutional legacy and decades-old routines. Such a solid institutional form of procedures differentiates former SOE family firms from entrepreneurial family firms.

Particularly, SOEs have always been characterized by formal institutional environments, which enables them to play a dominant role in technological progress. The imprint effect suggests that organizations would prefer to follow the paradigm formed at the foundation stage (Marquis and Tilcsik, 2013). The institutional environment at the time of establishment leaves a lasting effect on firms' capabilities and strategies. These organizational heritages persistently influence firms' future actions (Simsek et al., 2015). Therefore, institutions featured during the period of SOEs can have a remarkable impact on the contemporary behaviors of restructured family firms (Li and Zhang, 2021).

Organizational routines formed during the nascent stage of firms are not easily changed and so imprint their future strategies (Tilcsik, 2014). As such, the organizational structures and practices imprinted from SOEs of restructured family firms ensure a higher level of innovation efficiency, which persistently makes the incumbent firms concentrate more on the quality of innovation activities. In other words, restructured family firms are more likely to exploit high-quality institutions to ensure efficient innovation decisions due to the legacies of state-owned governance. Thus, these family firms are more likely to have better institutional arrangements and imprinted rational decision-making processes, and ultimately cultivating environments favorable to innovation quality. Hence, we propose the second hypothesis as follows:

Hypothesis 2. *Restructured family firms have higher-quality patents than entrepreneurial firms.*

3. Empirical design

3.1. Sample and data

In line with Bunkanwanicha et al. (2013), family businesses are considered as the enterprise whose largest stakeholder is owned by founding family. In addition, direct ownership is held by the founders or their family ties, such as siblings, spouses as well as children. Besides, there should be at least a family member participating in the top management of the business. To investigate the impact of family firm origin on corporate innovation, we utilize publicly-traded family firms listed on the Shanghai and Shenzhen A-share stock exchanges in China from 2009 to 2018.

To capture the influences of family firm origin, the basic structure pattern at the time of establishment is focused on as an indicator of origin. To make the information as accurate as possible, we use a variety of search engines, including Google. For each family firm, we also employ the initial public offering (IPO) prospectus and annual reports to manually collect information on the founding ownership. Financial data are available from the database of China Stock Market and Accounting Research (CSMAR). Referring to previous studies, we exclude the observations with missing values and those that have been listed less than one year and the family firms in the financial industries (i.e., bank, security, insurance and real estate). To mitigate the potential estimation bias caused by extreme outliers, we winsorize all continuous variables at 1% and 99%. Finally, we obtain a sample of 5558 firm-year observations consisting of 964 family companies.

3.2. Variables and measurements

3.2.1. Family firm origin

Following Cheng et al. (2022), we define two types of family firms according to their origins. A restructured family firm is established from privatization, whose former ownership is subject to the state or government. Typically, when a family firm is established by entrepreneurs, it is recognized as an entrepreneurial family firm. The dummy variable, *Origin*, takes the value of 1 for restructured family firms and 0 for entrepreneurial family firms.

3.2.2. Innovation quantity and quality

In line with previous studies on the innovation performance within family firms (Block, 2012; Bendig et al., 2020), the innovative outcomes are measured by the total number of patents applied. We collect the patent data from China National Intellectual Property Administration, which provides detailed information on firm patent applications.

Following the existing literature (Chemmanur et al., 2014; Chang et al., 2015), we use adjusted patent citations (*Adjcite*) to measure innovation quality. Since the number of patent citations represents the technological attribution and the recognition by relevant patent peers, it can highlight the essence of innovation. We use the patent citations as a proxy to accurately measure innovation quality. The calculation method divides the actual number of citations by the average number of citations of patents granted in the same year and technical field (*Adjcite*). However, there are some challenges when constructing this index. On the one hand, the inability to access the corresponding IPC classification makes it impossible to define the technical field of a granted patent. On the other hand, the increasingly cross-integrated technology means that a patent could fall into different buckets, and a non-specific IPC number would not help directly categorize the technical fields of the patent. Therefore, we adjust patent citations as follows.

We first identify the technical field by using the IPC classification of a patent of family firm i in year t provided by the CSMAR

database. The weight is set according to the degree of the IPC categories involved (the weight of field *s* is the proportion of occurrences of *s* category to all categories). Next, the number of patents ($count_{its}$) and citations ($cite_{its}$) in field *s* are obtained by multiplying the weight of field *s* by the actual number of patents and citations within company *i*, respectively. Then, $count_{its}$ and $cite_{its}$ has been totaled on the firm level respectively to generate $\sum_i cite_{its}$ and $\sum_i count_{its}$. As presented in Eq. (1), $\sum_i cite_{its}$ divided by $\sum_i count_{its}$ yields the average citations per patent (adw_{ts}) in field *s*, which serves as a criterion gauging patents' quality in field *s* for any firm.

$$adw_{ts} = \frac{\sum_i cite_{its}}{\sum_i count_{its}} \tag{1}$$

Consequently, the ratio $cite_{its}/adw_{ts}$ would reflect the innovation quality in field *s* for firm *i*.

Ultimately, to fully describe the overall quality of a firm's innovation, we need to comprehensively consider each field that a firm's patents could be attributed. Eq. (2) demonstrates our indicator measuring the innovation quality of firms *i*, which is the sum of the ratio $cite_{its}/adw_{ts}$ on the field level, with a higher value indicating a better innovation quality.

$$Adjcite_{it} = \sum_s (cite_{ist}/adw_{st}) \tag{2}$$

3.2.3. Control variables

To better understand the influence of family firm origin on corporate innovation orientation, we control for several firm-relevant variables to account for factors that may correlate with innovation. Specifically, we add the following indicators as control variables: *Size* is measured by the natural logarithm of the family firm's total assets plus one. *Age* gauges the firm's established time and equals to the observation year minus the year of establishment. *Roa* represents firm's operational performance and is measured by net income over total assets. *Lev* is measured by the ratio of liabilities divided by total assets. *Ppe* indexes the ratio of tangible expenditures to total assets. *Cash* is the logarithm of total cash holding. *Cfo* is the ratio of operating cash flow to total assets. *Growth* is defined as the growth rate of sales revenue. *Top1* is the ratio of the shares of the controlling shareholders. *Dual* is a dummy variable, which takes value 1 if the family member serves as chairman and general manager and 0 otherwise. Since the proportion of independent directors affects decision-making, we control the proportion of independent directors on the Board *Ind*. *Boards* is also controlled in our study, which accounts for the natural logarithm of the total number of boards. Appendix Table A1 provides the definitions of the key variables used in our regressions.

3.3. Summary statistics

Table 1 reports the summary statistics of the main variables used in the benchmark analysis.[1] The observations, mean, standard deviation, minimum, median and maximum are reported in Columns 1 to 6. The mean value of *Origin*, which equals 1 if the firm is formerly a restructured family business and 0 if the entrepreneurial family business, is 0.150, indicating that 15% of family firms are established from restructuring. Specifically, as for corporate innovation variables, the standard deviation of *LnPatent* is 14.888 and that of *Adjcite* is 5.118, implying that the variation in innovation quantity among family firms is substantial and requires interpretation.

We then partition the full sample based on the origins of firms. If a family firm was formed from restructuring, it is classified as the restructured group, whilst it is classified as the entrepreneurial group if established by entrepreneurs. Panel B of Table 1 provides the mean values of the main variables for the two groups and tests the significance in their differences. The mean value for *LnApply* is significantly smaller in the restructured subsample than in the entrepreneurial subsample, demonstrating that restructured family firms generate fewer patent applications than family firms founded by entrepreneurship. At the same time, the mean value of *Adjcite* is statistically significantly higher in the restructured group compared with that of the entrepreneurial group, suggesting that patent citations are more emphasized in restructured family firms than in entrepreneurial ones. Taken together, these univariate comparison results are consistent with our main hypotheses: Restructured family firms attach less importance to innovation quantity but are more likely to increase innovation quality relative to entrepreneurial family firms.

3.4. Econometric specification

To test the hypotheses regarding the effect of family firm origin on corporate innovation, we consider the following econometric specification:

$$Innovation_{i,t+1} = \alpha_0 + \alpha_1 Origin_i + \alpha_2 Controls_{it} + Year_t + Industry_i + \mu_{i,t+1}. \tag{3}$$

The dependent variable *Innovation* represents both innovation quantity and quality of family firm *i* in year *t*, as previously described, including the natural logarithm of patent applications and adjusted citations. The main explanatory variable of interest is *Origin*, which equals 1 for the restructured family firm, and 0 for the entrepreneurial family firm. As stated in our hypothesis, we predict it to be negative when the dependent variable is innovation quantity, and positive when the dependent variable is innovation quality. *Controls* denotes a vector of firm-level characteristics. Further, we control for year and industry fixed effects to address the potential concern about omitted variables.

[1] Appendix Table A2 provides the correlation matrix.

Table 1
Descriptive statistics.

Variable	Obs.	Mean	Std.	Min	Median	Max
Panel A: Full sample						
Origin	5558	0.150	0.357	0	0	1
LnApply	5558	23.707	14.888	0	25.649	68.732
Adjcite	5558	−0.251	5.118	−11.450	0	11.450
Size	5558	21.746	0.990	17.779	21.670	26.186
Age	5558	5.909	5.721	0	4	26
Roa	5558	0.050	0.050	−0.146	0.047	0.195
Lev	5558	0.201	0.126	0.095	0.362	0.713
Ppe	5558	0.372	0.181	0.003	0.184	0.555
Cash	5558	0.361	0.143	0.100	0.347	0.762
Cfo	5558	0.204	0.140	0.004	0.161	0.902
Growth	5558	0.023	0.055	−0.308	0.023	0.432
Top1	4913	0.200	0.400	−0.502	0.133	2.505
Dual	5520	0.392	0.488	0	0	1
Ind	5361	0.375	0.053	0.250	0.333	0.667
Boards	5361	2.099	0.181	1.386	2.197	2.890

Panel B: Sub-samples					
Variables	Restructured family firms		Entrepreneurial family firms		Difference in Mean
	Mean	Std.	Mean	Std.	
LnApply	19.634	16.493	25.923	14.417	−6.289***
Adjcite	1.568	4.873	−0.627	5.098	2.195***
Size	22.158	1.220	21.789	0.939	0.369***
Age	19.354	4.745	14.386	5.634	4.968***
Roa	0.057	0.089	0.058	0.096	−0.002
Lev	48.926	20.398	36.625	18.003	12.301***

This table reports the descriptive statistics for our sample over the period 2009–2018. Variable definitions can be found in Appendix Table A1 and all continuous variables have been winsorized at 1% in order to mitigate the influence of outliers. Panel A provides size, mean, standard deviations, minimum values, median and maximum values of all variables based on the baseline regressions. Panel B reports the weighted difference of the mean values between two types of the family business samples. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are reported in parentheses.

4. Empirical results

4.1. Baseline estimation

Table 2 reports the results of baseline estimations on the effects of family firm origin on firm innovation. We present all the estimated coefficients by gradually including control variables.

Columns 1 to 4 report the coefficients when the regression is carried out using *LnApply* as the dependent variable. Column 1 reports the coefficient of *Origin* without control variables. Our main estimated coefficient, *Origin*, is negatively associated with the measurement of innovation quantity, which is represented by *LnApply*. In Columns 2 to 3, a set of firm-level characteristics have gradually added into the estimation to mitigate the concerns of omitted variable. As expected, both the coefficients are significantly negative. Furthermore, the coefficient of *Origin* observed in Column 4, which includes all control variables and the industry and year fixed effects, is statistically significant and negative. These results indicate that the number of patent applications is less for restructured family firms compared to entrepreneurial family firms, which is consistent with hypothesis 1. Thus, our results reveal the imprint effect of original institutional environments in family firms, which induces a predominant divergency in the innovation preference, that is, restructured one cares less about good-looking innovation data.

Columns 5 to 8 of Table 2 report the regression results from estimating Eq. (3) with the dependent variable replaced by *Adjcite*. We can find that all coefficients are positive and statistically significant at the 1% level, suggesting that restructured family firms tend to post more emphasis on patents' capacity to be cited than the quantity, which is consistent with hypothesis 2. The main findings support our hypothesis that family firm origin has an economic effect on corporate innovation. More informatively, our estimations imply that restructured family firms are less likely to pursue innovation quantity, instead attaching greater importance to innovation quality. For brevity, we only provide the results for *Origin* in the subsequent tests.

4.2. Endogenous analysis

Although we control for firm characteristics in our baseline regressions, and include industry and year fixed effects in Table 2, our findings may be potentially influenced by endogenous problems. In the absence of a time-invariant independent variable, our empirical evidence could not eliminate any time-invariant unobserved factors by estimating with firm fixed effect. In this section, we account for endogeneity using two empirical frameworks, namely, two-stage least-squares procedure and placebo test.

Table 2
Effect of family firm origin on innovation.

Variable	*LnApply*				*Adjcite*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Origin	−0.340	−1.100**	−1.522***	−1.497***	2.394***	2.287***	2.745***	2.768***
	(−0.617)	(−1.974)	(−2.659)	(−2.587)	(12.599)	(11.408)	(12.656)	(12.598)
Size		4.082***	2.131***	2.004***		0.387***	0.534***	0.548***
		(22.370)	(6.422)	(6.013)		(5.897)	(4.250)	(4.327)
Age		−0.103***	−0.095**	−0.093**		−0.002	−0.017	−0.016
		(−2.894)	(−2.318)	(−2.262)		(−0.195)	(−1.065)	(−1.042)
Roa			0.485	0.302			−1.037	−1.025
			(0.222)	(0.139)			(−1.255)	(−1.240)
Lev			0.033***	0.031**			−0.011**	−0.010**
			(2.607)	(2.433)			(−2.253)	(−2.160)
Ppe			0.026*	0.026*			−0.004	−0.005
			(1.776)	(1.749)			(−0.686)	(−0.895)
Cash			1.413***	1.377***			0.164*	0.153
			(5.588)	(5.396)			(1.713)	(1.583)
Cfo			0.066***	0.066***			0.026***	0.028***
			(2.799)	(2.766)			(2.890)	(3.075)
Growth			−0.488	−0.412			0.068	0.071
			(−1.227)	(−1.036)			(0.453)	(0.473)
Top1				−0.006				−0.003
				(−0.403)				(−0.563)
Ind				−1.489				−0.710*
				(−1.491)				(−1.872)
Boards				0.442***				0.003
				(3.060)				(0.061)
Constant	1.500***	2.970***	6.783***	−10.452***	18.805***	6.415***	−65.783***	−69.775***
	(8.546)	(4.376)	(3.426)	(−5.041)	(36.804)	(3.263)	(−12.266)	(−12.778)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	5558	5558	4006	4006	5558	5558	4006	4006
Adj_R^2	0.021	0.213	0.087	0.261	0.019	0.220	0.108	0.318

This table reports baseline regression results of the effect of family firm origin on innovation quantity (We take *LnApply* as the dependent variable, and the results are exhibited in Columns 1 to 4) and innovation quality (We take *Adjcite* as the dependent variable, and the results are exhibited in Columns 5 to 8). The definitions of all variables are shown in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

4.2.1. *Instrumental variable analysis*

To alleviate potential endogeneity concerns caused by unobserved factors, a two-stage least-squares IV (2SLS) specification has been adopted to examine the effect of the family firm origin on innovation performance. Following Li and Yu (2017), we use the natural logarithm of the total number of ancient confraternities in the Ming (1368–1644) and Qing Dynasty (1644–1912) at the provincial level as an instrument. Motivation for the instrument comes from two sources. First, the instrument should be correlated with the family firm origin. Given the long-standing impact of entrepreneurial culture on entrepreneurship, we use the number of ancient business groups within a province to proxy entrepreneurial culture, which affects the emergence and prosperity of current entrepreneurial family firms (Cruz et al., 2012). Second, a valid instrument should be exogenous. With regards to the exclusion

Table 3
IV regressions with the instrument of ancient confraternities.

Variable	First stage	Second stage	
	(1) *Origin*	(2) *LnApply*	(3) *Adjcite*
Origin		−12.436***	2.867**
		(−3.248)	(2.059)
Ancient confraternities	−0.125***		
	(−10.004)		
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Obs.	4006	4006	4006
Adj_R^2	0.320	0.256	0.261
F-statistic	100.071		

This table presents the estimation results of 2SLS regressions. In Column 1, we present the first stage regression result of 2SLS and the second stage regression results in Columns 2 and 3. The instrumental variable is the total number of ancient confraternities in Ming and Qing dynasties at the provincial level. All variables are defined in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

condition, the firm-level innovation of a given family business is executed by the board and is not likely to be directly affected by the historical number of ancient confraternities.

Column 1 of Table 3 shows the first-stage regression result using *Origin* as the dependent variable to check the relevance of the instrument. The main variable of interest is *Ancient confraternities*. The coefficient is negative and significant at the 1% level. Since the F-statistic of the first-stage regression is large, the instrument is highly correlated with *Origin*, which excludes the weak IV concern. Columns 2 and 3 report the results of second-stage regressions. Consistent with the findings aforementioned, the coefficient of *Origin* is negative with *LnApply* and positive with *Adjcite*, which is basically similar to our baseline regressions. In summary, the results of 2SLS lend further buttress to our hypothesis that family firm origin affects innovation performance. Specifically, compared to entrepreneurial family firms, restructured family firms produce less in terms of innovation quantity, but attach more importance to innovation quality.

4.2.2. Placebo test

As a further validity check on the identification framework, following Cai et al. (2016), we conduct a permutation test using a fiction variable *Origin* as the independent variable, which is constructed by random assignment. We re-estimate Eq. (3) using the simulated data to obtain the placebo coefficients of *Origin*. Specifically, instead of using the true value of *Origin*, we randomly assign the origin status that serves as a pseudo-independent variable 2000 times and compare the baseline effect to the distribution of the randomly generated effects. In theory, if any significant variable indeed exists, the coefficient of placebo test should be significantly different from 0. Fig. 1. plots the distribution of the coefficients for placebo effects after 2000 iterations. The red vertical lines mark the location of baseline regression coefficients (−1.497 for *LnApply* and 2.768 for *Adjcite* in Table 2). Consistent with our theoretical predictions, the results indicate that all the coefficients of *Origin* in our baseline regressions deviate from the concentrated distribution of placebo coefficients. Overall, the randomization tests suggest our baseline results are not seriously biased by any significant omitted variable.

4.3. Additional robustness checks

4.3.1. Sample selection bias

4.3.1.1. Private interest selection. An alternative explanation springs up after noting the private benefits theory proposed by Demsetz and Kenneth (1985), which is that family firms are more likely to be established when private interests are involved, incurring a self-selection problem. If the existence of the family firm is mainly explained by the rationality of large private benefits, there should be huge differences in industry distribution between family and non-family firms. To address this concern, we calculate the industry distribution of family firms with different ownership origins. Fig. 2 plots the industry distribution, and we present the top 20 industries with the highest frequency across different family firms. As illustrated in Fig. 2, the industry frequency ranking of family firms and non-family firms run parallels up to the 16th (C13). We find no hint about divergence in industry distribution between family firms and non-family private firms, assuaging selection bias concern resulting from private interests.

4.3.1.2. Propensity score matching. The coefficient of the core independent variable could be swayed by the specific equation form and pliable to the coefficients of control variables in the commonly used regression method. Next, we employ propensity score matching to

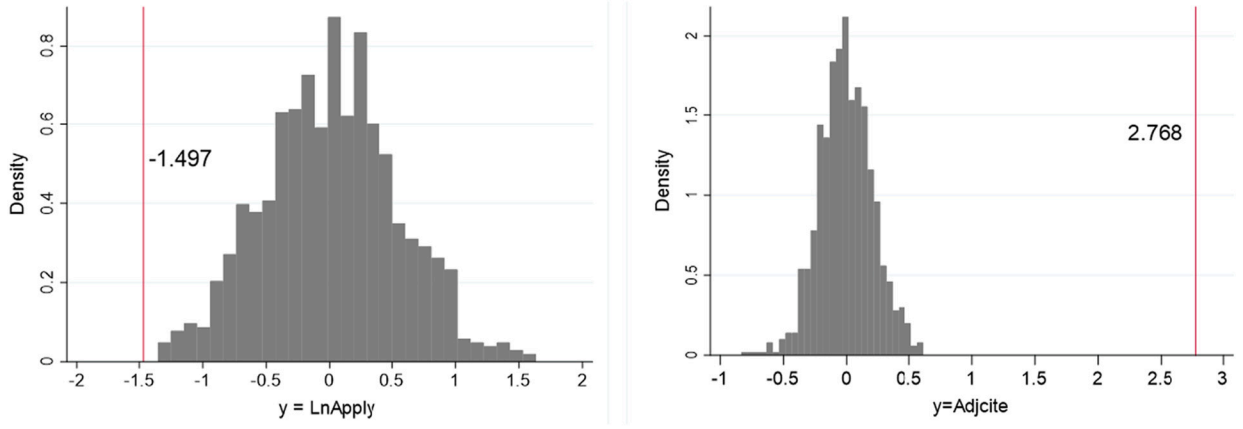

Fig. 1. Placebo test results.
This figure reports the placebo test results by randomly assigning dummy values of family firm origin across firms following Cai et al. (2016). We repeat the simulations 2000 times and get a distribution of the values of the coefficients in front of *Origin*, where the solid red lines represent the values (see Table 2) of the coefficients in our baseline regression. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

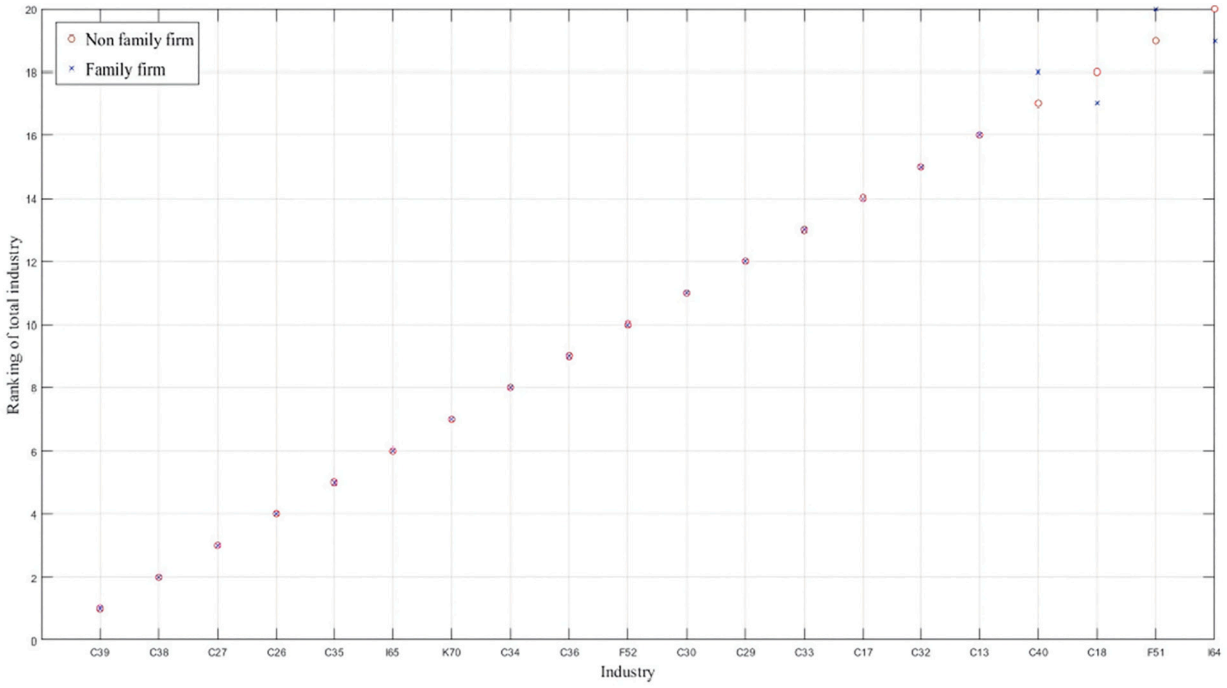

Fig. 2. Industry distribution between family businesses and non-family businesses.
This figure respectively describes the industry distribution between family businesses and non-family businesses. We select industries that rank in the top 20 in terms of frequency by these two types of business. The circles represent non-family businesses and the crosses represent family firms.

match each restructured family firm with an entrepreneurial family firm using the one-to-one nearest-neighbor method based on the observed firm characteristics, and our final samples respectively contain 1115 and 1266 firm-year observations. Table 4 reports the estimation results. In predicting the outcome of the *LnApply* in Column 1, we can find that the variable of interest, *Origin*, remains negative and significant, which is similar to our benchmark results. Column 2 presents the results with *Adjcite* as the dependent variable, and the coefficient of *Origin* is still significantly positive. These results based on the matched sample are consistent with those reported in Table 2.

4.3.1.3. Innovation-related and high-tech industry bias. Fig. 2 corresponds with the reality that most family firms are within the manufacturing industry. We further conduct a robustness check by restricting samples to family firms within the manufacturing industry. We collect the industry information from the CSMAR database and report the results in Columns 3 and 4 of Table 4. The estimated coefficients corroborate again that the effect of the family firm origin is negative with *LnApply*, but positively associated with *Adjcite*.

Another concern is that certain better-performed family firms are recognized as high-tech enterprises as they satisfy a higher innovation standard. The existence of high-tech samples may lead to a biased estimation owing to their disproportionately large innovation capacity. To confirm the robustness of our results, we exclude family firms that belong to the high-tech industry from full

Table 4
Sample selection biases.

Variable	Propensity score matching		Manufacturing firms		Non-high-tech family firms	
	(1) *LnApply*	(2) *Adjcite*	(3) *LnApply*	(4) *Adjcite*	(5) *LnApply*	(6) *Adjcite*
Origin	−1.953**	2.772***	−1.070*	2.913***	−1.850***	2.624***
	(−2.466)	(8.934)	(−1.668)	(11.570)	(−3.009)	(11.314)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	1115	1266	3270	3270	3539	3539
Adj_R^2	0.434	0.282	0.220	0.283	0.320	0.274

This table shows the results of different subsamples. To form the matched sample, we use the PSM (propensity score matching) method to match a restructured family firm with an entrepreneurial family firm and the results are presented in Columns 1 to 2. As for Columns 3 to 4, we report the results by using manufacturing family firms as a subsample. Columns 5 and 6 report the results by excluding high-tech family firms as a subsample. All variables are defined in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are reported in parentheses.

sample. The high-tech industry includes telecommunications value-added services, IT, medical and health industries, and Internet. We repeat our baseline regression specification by focusing on the non-high-tech family firms. As shown in Columns 5 and 6 of Table 4, the coefficients of these two regressions align with the hypotheses. We can observe that the coefficient of *Origin* is also negative with *LnApply*, and stays positive with *Adjcite*.

Taken together, these results consistently show that our findings are not subject to the selection concerns of industry distribution, systematic differences between the treatment group and the control group, or certain sample characteristics. In support of our main argument, restructured family firms apply for fewer patents, but their innovation outputs have a stronger influence compared to entrepreneurial firms.

4.3.2. Additional checks

4.3.2.1. Replacing the measurements of innovation quality and quantity. In this subsection, we consider that the measurement of innovation could to a certain extent be an implicit concern. One may argue that innovation activities are viewed as carriers of multiple components, so it may not be convincing to only represent innovation quantity and quality by the number of patents applied and adjusted citations. Therefore, we use alternative measurements to repeat our benchmark estimation. We construct two alternative proxies of innovation quantity and quality. First, we use the natural logarithm of 1 plus the number of patents granted *ApplyGrant* over a given year to measure the innovation quantity. Under this specification, the result presented in Column 1 of Table 5 shows that the coefficient of *Origin* is −0.190, significant at the 1% level. Second, following previous studies (Greenhalgh and Rogers, 2006), we use an alternative measure for innovation quality based on *Ratio_int*, which is measured by the change in the ratio of intangible assets to total assets. Based on this definition, we obtain a significant and positive coefficient in Column 2 of Table 5, which yields conclusions similar to the baseline estimation. Overall, with these two alternative measures, we obtain essentially the same results regarding the effects that the family firm origin has on innovation. Our results provide striking evidence that restructured family firms are more likely to achieve quality-oriented innovation, whilst an entrepreneurial family firm is more active in corporate innovation quantity.

4.3.2.2. Using the Tobit model. Instead of using OLS models in the above regressions, the structure of our data leads us to consider other models. It is worth noting that a large proportion of observations of our two dependent variables, which are patent applications and citations, take the value of 0. Therefore, we examine the relationship between family firm origin and corporate innovation by employing the Tobit model. Columns 3 and 4 of Table 5 report the results of the effects of family firm origin on *LnApply* and *Adjcite*. The coefficient of *Origin* is −2.020 and significant at 1% in the patent quantity regression, which is similar to our baseline results, suggesting that restructured family firms have fewer patent applications than entrepreneurial family firms. Further, the coefficient remains positive in the patent quality regression, implying that restructured family firms pursue more substantial technological development than entrepreneurial family firms. These findings provide further evidence that our baseline findings are not sensitive to estimators.

4.3.2.3. The influence of self-citation on innovation quality. As mentioned above, we measure innovation quality by adjusted patent citations. However, since family firms may devote themselves to the same technical field based on their business line and technological superiority, it is likely that family firms tend to cite their early-stage patents. Thus, a potential measurement error problem caused by self-citation arises. In theory, self-citation would magnify the innovation quality of businesses with a long history of technological innovation. Given the restructured firms are mainly established earlier than their entrepreneurial counterparts and the duration time of innovation activities undertaken by family firms may be correlated with the origin, both them affects *Adjcite*, which may lead to biased estimation. In order to test for robustness about whether self-citation has an influence on our findings, we replace the measurement of innovation quality by subtracting self-citation from the total number of patents cited before adjusting the value according to the technical field in Section 3.2.2. Columns 5 of Table 5 reports the estimation results. We find that *Origin* has a positive impact on innovation quality at a significant level of 1%, indicating that our findings are robust to self-citation.

4.4. Cross-sectional tests

In this section, we examine whether the effects of family firm origin are more pronounced in certain situations, to provide further evidence for our main argument. Specifically, we conduct a battery of heterogeneity analysis along three dimensions: time of being as SOEs, intergenerational inheritance, and former ownership.

4.4.1. SOE experience duration

We further explore whether the imprinting effect on innovation is more substantial in firms with a longer formative period under state control before the restructuring. Simsek et al. (2015) argue that a firm's experience plays a critical role in strengthening organizational imprints. These rituals and routines formed at the foundation stage are more likely to survive with development over time. The imprint of initial institutional environments should be adaptable, which is unlikely to disappear despite the subsequent governance structure changes. Therefore, the longer the sensitive period as SOEs for imprint formation is, the more profound the imprint effect is.

Consequently, we hypothesize that restructured family firms with a long existence may possess a deeper managerial legacy. We define the time from establishment to restructuring as the imprinting time length for restructured family firms. We separate our sample

Table 5
Robustness checks using alternative variables or an alternative model.

Variable	*ApplyGrant*	*Ratio_int*	*LnApply*	*Adjcite*	*Citation*
	(1)	(2)	(3)	(4)	(5)
Origin	−0.190***	0.049***	−2.020***	2.768***	2.945***
	(−3.398)	(2.909)	(−3.019)	(12.666)	(13.156)
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Obs.	3960	3961	4006	4006	4006
Adj_R^2	0.305	0.251	0.053	0.049	0.258
Model	OLS	OLS	Tobit	Tobit	OLS

Columns 1 and 2 report the results based on two alternative innovation quantity and quality as follows: (i) patent quantity *ApplyGrant*, measured by the natural logarithm of one plus the number of patents granted over a given year; (ii) patent quality *Ratio_int*, measured by the change in the ratio of intangible assets to total assets. Columns 3 and 4 report the results from a Tobit model. In Column 5, the indicator of innovation quality is updated by subtracting number of self-citations. All variables are defined in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are reported in parentheses.

into two cohorts according to the average time spent as SOEs. Specifically, family firms with a shorter time as SOEs are categorized as a *short-time* cohort, otherwise, a *long-time* cohort. We estimate our baseline regression with these two sub-samples and present the results in Columns 1 to 4 of Table 6. The effect of being restructured on innovation quantity does not exhibit statistical significance in Column 1 but is significantly negative in Column 2, indicating that the underlying imprint effect is stronger for restructured family firms that were under state ownership for a longer period before transition. Columns 3 and 4 report the results that both coefficients are positively significant, and the economic magnitude is larger in Column 4, implying more attention has been garnered on innovation quality in family firms that experienced a longer SOE-time before restructuring. Similarly, these subsample findings reveal that the length of time spent as an SOE affects imprinting effects. That is, a long period of being SOEs would amplify the impact of organizational imprints on strategies, decisions, and behavioral patterns.

4.4.2. Intergenerational succession

We assume that the imprint effect of family firm origin is a crucial contributor to innovation outcomes. The change of a firm's leader would naturally disturb the routine, and then dilute the imprint effect. Succession is one of the most important attributes of a family firm (Bennedsen et al., 2007), and we next the heterogeneity based on intergenerational succession. We divide our sample into two cohorts based on whether there is family succession. Specifically, those family firms managed by a family successor are categorized as a *done* cohort, and otherwise are categorized as a *not-done* cohort. Columns 5 to 8 of Table 6 demonstrate a more evident relationship between family firm origin and patent quantity or quality among those without succession. The coefficient is insignificant in Column 5, while negatively significant at the 1% level in Column 6, revealing the inattention to innovation quantity among restructured firms without succession. Consistently, the larger magnitude of the coefficient of being restructured in Column 8 compared to Column 7 accentuates the eagerness to improve innovation quality among restructured firms without succession. Overall, these findings suggest that the continuity of family firms' leaders would better preserve the imprint effect, and steer restructured family firms further towards focusing on innovation quality and entrepreneurial ones towards quantity.

4.4.3. The ownership before restructuring

To explore whether different ownership prior to restructuring would leave a different degree of institutional imprints, we manually collect the information of firms' former ownership. We generally sort pre-restructuring family firms into two groups: state-controlling enterprises and solely state-owned enterprises. We argue that the proportion of state equity is associated positively with the level of institutional imprinting, and the entire state-ownership would exacerbate the discrepancy of innovation quantity and quality focal point between those having been restructured and their entrepreneurial counterparts. We repeat our benchmark estimation in these two cohorts and the results are shown in Columns 9 to 12 of Table 6. We find that the coefficient is insignificant with *LnApply* in the group of SOEs, whereas the results are both significant and in line with the main results in the subset of wholly state-owned enterprises. The above findings imply that more intact the formal institutions delivered by entirely state-owned enterprises would exert a more pronounced imprint effect on bolstering innovation quality for restructured firms.

5. Further analysis

5.1. Mechanism tests

The previous examinations provide plausibly causal evidence that supports the influence of family firm origin on its current innovation strategies. In this section, we conduct several tests to explore the potential channel underlying our baseline findings. As a result of immersing in the institutional imprint, restructured family firms are more likely to generate fewer innovative outputs, but perform better on innovation quality than their entrepreneurial counterparts. The primary contribution of our paper is to establish a causal link between the historical establishment imprint of Chinese family firms and subsequent innovation activities. Understanding

Table 6
Heterogeneity analyses.

Variable	SOE experience duration				Family succession				Former ownership			
	LnApply	*Adjcite*			*LnApply*		*Adjcite*		State-controlling		Entirely state-owned	
	(1) short	(2) long	(3) short	(4) long	(5) yes	(6) no	(7) yes	(8) no	(9) *LnApply*	(10) *Adjcite*	(11) *LnApply*	(12) *Adjcite*
Origin	−0.574	−3.695***	2.494***	2.948***	−0.600	−2.108***	1.615***	2.879***	−1.232	2.949***	−2.073***	2.564***
	(−0.799)	(−4.578)	(9.124)	(9.576)	(−0.453)	(−3.271)	(3.152)	(11.813)	(−1.641)	(10.426)	(−2.617)	(8.715)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3625	3604	3625	3604	1021	3012	1021	3012	3472	3472	3019	3019
Adj_R^2	0.275	0.309	0.270	0.254	0.293	0.342	0.303	0.258	0.291	0.265	0.305	0.254

This table provides the results of several cross-sectional tests. In Columns 1 to 4, *SOE* experience duration is measured by the time from establishment to restructure of restructured family firms. In Columns 5 to 8, *Family succession* is treated to be another grouping variable, which denotes whether the second generation participates in a family firm. In Columns 9 to 12, *Former ownership* is employed to describe whether restructured family firms are state-controlling or entirely state-owned. All variables are defined in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

the existence of this link is essential to fully comprehend the effect of family firm origin on corporate decision-making.

As discussed in Section 2, we predict that formal institution imprints have provided for restructured family firms milder organizational environments relative to entrepreneurial ones, which leaves a long-standing impact on current corporate decisions. Based on the imprint effect, the institutional structure is more likely to make restructured family firms focus less on innovation quantity, and incites motivation to pursue innovation quality achievement. For entrepreneurial family firms, the weak formal institution triggers psychological family-oriented governance, which leads to myopic behaviors under pressure. Consequently, it is possible that institution acts as imprinter that features the different behavior of family firms. Therefore, in this section, we discuss the plausibility of the mentioned potential mechanisms.

Prior literature reveals that the SOEs build better formal institutions, for the interests of their employees and even society, to regulate interactions and form expectations in corporate operations (Lin et al., 2001). Therefore, we examine the channel of the formal institution through which family firm origin influences innovation. Restructured family firms are likely to follow the management mode shaped before the restructuring, which endows them with a more normative institution in comparison to entrepreneurial family firms. Therefore, quantity-oriented decision-making can be alleviated, and quality-orientation decision-making is more emphasized in restructured family firms.

We adopt three indicators to measure the formal institution in firms. First, professional manager employment has been considered an efficient option to remedy the weak institution and family-dominated governance. To explore the role played by manager employment in our main causal relation, we construct a binary variable, *Professional manager*, which equals 1 if the family firm engages professional management, and 0 otherwise. The results in Columns 1 and 2 of Table 7 demonstrate how the origin affects family firms taking up professional outsiders. We observe a positive effect that is statistically significant at the 1% level, suggesting that restructured family firms are less reliant on family members than entrepreneurial family firms, and tend to introduce more expert managers.

Second, the degree of family intervention is also an important perspective in evaluating the institutional environments. The trade-off between boosting financial performance and maintaining relatives-network would inevitably result in family members' direct intervention in strategic decision-making if the formal constraint was insufficient in family enterprises (Gomez-Mejia et al., 2018). We next try to connect firm origin with the extent of intervention. With the support of the CSMAR database, we construct *Family intervention*, which is measured by the number of family members on the board. The results are shown in Columns 3 to 4 of Table 7. As anticipated, the significantly negative association between *Origin* and *Family intervention* illustrates lighter family member entanglement among restructured family firms, implying better-established institutional environments in which restructured family businesses survive and thrive.

Finally, previous studies have documented the influential role of the informal hierarchy in swaying managing organizational tasks on board (Wang et al., 2021). A clear informal hierarchy on the board is more likely to reflect that family firms attach great importance to the network, and has guanxi-dominated practices. In turn, the informal hierarchy may exacerbate the harmful influence of weaker institutional environments, disrupting technological direction and advancement.

Consistent with He and Huang (2011), we use the *Gini* coefficient to measure the informal hierarchy on the board. A standard specification of the *Gini* coefficient is as follows:

$$Gini = \frac{2cov(y, r_y)}{N\bar{y}}, \tag{4}$$

where *Gini* represents the Gini coefficient; y denotes the total number of board members who participate in another firm's board; r_y denotes the rank of each director; $cov(y,r_y)$ is the covariance of y and r_y; N is the total number of directors, and $\bar{y}$ is the mean value of y. The *Gini* coefficient ranges from 0 to 1, with a higher value indicating a scarcer internal supervision. The estimated coefficients in Columns 5 and 6 of Table 7 are negatively associated with *Informal hierarchy,* at the 1% significance level, revealing fewer informal hierarchies of board in a restructured family firm, which could translate into a shield against the repercussion of informal institutional environments.

Overall, these results are consistent with our expectations, that is, family firm origin affects corporate innovation through

Table 7
The mechanism of imprinting effect: Institutional environments.

Variable	Professional manager		Family intervention		Informal hierarchy	
	(1)	(2)	(3)	(4)	(5)	(6)
Origin	0.259***	0.253***	−0.086***	−0.077***	−0.015***	−0.021***
	(21.638)	(16.869)	(−18.717)	(−15.193)	(−5.987)	(−7.430)
Controls	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	5558	4033	5552	4028	5355	3886
Adj_R^2	0.134	0.127	0.115	0.154	0.042	0.128

This table reports the results of the mechanism examinations. We adopt three indicators to measure the formal institutions, including (i) *Professional manager*, *measured by a dummy* which equals 1 if the family firm engages professional management, and 0 otherwise; (ii) *Family intervention*, measured by the number of family members on the board; (iii) *Informal hierarchy*, measured by the *Gini* coefficient proposed by He and Huang (2011). All variables are defined in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are reported in parentheses.

institutional imprints. A better institution sets a restructured family firm apart from its entrepreneurial counterparts, and drives differences in innovation decision-making. Thus, we illuminate how the persistence of the past institutional environments can be functional for different innovation performances.

5.2. Innovation differentiations based on initial ownership(1990s)

As the previous section illuminates, family firms' origin may have a lasting effect on firms' subsequent preference, strategy, and decision-making. Naturally, the difference should exist at the beginning of the imprinting formation, which is the prerequisite of the imprinting effect. We examine the innovation outputs of SOEs and private firms in the 1990s to confirm that whether innovation quantity and quality exhibit the same tendency as present. Specifically, we use a new sample consists of SOEs and private firms with unchanged ownership from 1990 to 1999. We exclude foreign-owned firms and collectively-owned firms. *Origin* is 1 for state-owned firms and 0 for private firms. As for dependent variables, we also identify the corporate innovation by *LnApply* and *Adjcite* to respectively indicate the quantity and quality. We presume that SOEs generate fewer innovation quantity but create a higher level of innovation quality than private firms.

The regression results are shown in Table 8. The results presented in Columns 1 and 2 demonstrate that state-owned enterprises generate less in term of patent applications (*LnApply*) compared to private businesses. Whereas, Columns 3 and 4 report a positive association, which suggests that state-owned enterprises have a higher level of adjusted patent citations (*Adjcite*). We interpret this finding as supportive evidence for the mechanism of the institutional effect of family firm origin on corporate innovation.

5.3. Alternative explanations

5.3.1. Resource endowment

It is possible that our measurement of family firm origin is a partial representation and reflection of the original resource endowment. As discussed in Section 2, the institutional imprints can linger over time, so a potential concern is that the resources at the foundation stage may also leave a lasting imprint on subsequent corporate strategy. On the one hand, restructured family firms are former SOEs which have more access to government officers, thus making it easier to obtain advanced technology and policy preference, enabling them to effectively invest in costly long-term projects due to the advantages of resources. On the other hand, most entrepreneurial family firms set up businesses through kinship bonding among family members (Sanchez-Ruiz et al., 2019), and the resources transferred from the government are too scarce to meet the requirement for long-term innovation investments. Therefore, restructured family firms might improve innovation quality through access to more resources to engage in costly innovative activities. In other words, restructured family firms have better innovation quality, and may not be driven by the influence of institutional imprints.

To rule out this alternative explanation, we use two indicators, *Government subsidy* and *Tax return* represented by the natural logarithm of subsidy received and tax return from the government in a given year, as proxies for the resource endowment of family firms. Since subsidy received and tax return from the government vary across industries, we cluster regression analysis on the industries. The estimated results are presented in Columns 1 and 2 of Table 9, with *Government subsidy* and *Tax return* as two additional control variables.[2] Evidently, the same pattern emerges. We can find that family firm origin has a significantly negative association with *LnApply* but has a positive relation to *Adjcite*, which is in line with our main regression results. Additionally, financial constraints and venture capital holding are simultaneously related to both origin and the firm's innovation, leading up to a competitive explanation similar with the resource endowment hypothesis. To mitigate the concerns about our mechanism, we add these two control variables based on baseline regressions,[3] suggesting that our mechanism is still valid. Overall, these findings suggest that our benchmark analysis is unlikely to be explained by the resource endowment.

5.3.2. Founder's capability

Much literature on upper echelon theory underlines the role of leaders in shaping corporate policies (Hambrick and Mason, 1984). Therefore, leaders' characteristics would extend the imprinting effect on the individual level, further introducing another concern that the discrepancy in the founder's ability may contribute to different decision-orientation (Tilcsik, 2014). In our case, leaders in post-restructured SOEs may be more capable than their counterparts in entrepreneurial family firms. If heterogeneous individual competencies underpin the main explanation about different innovation performances between entrepreneurial and restructured family firms, the effect of firms' ownership origin would be weakened after incorporating the founder's ability in the regressions. We include the age of founders when they start a business (*Founder age*) and their educational attainment (*Founder degree*) in the econometric specifications. The results are shown in Columns 3 and 4 of Table 9. The statistical significance and economic magnitude of the coefficient of *Origin* barely budged compared with our benchmark regression, corroborating again the decisive role played by formal institutions in persistently shaping innovation performance between restructured and entrepreneurial family firms. The evidence does not support the divergent leader's capacities between the two types of family firms as a major channel that interprets innovation performance.

[2] We provide the descriptive statistics of *Government subsidy* and *Tax return* in Appendix Table A4.

[3] We add financial constraints and venture capital as the additional control variables, and the results are listed in Appendix Table A3.

Table 8
The effect of business ownership on innovation in the 1990s.

Variable	*LnApply*		*Adjcite*	
	(1)	(2)	(3)	(4)
Origin	−0.468**	−0.409*	0.142*	0.234***
	(−2.100)	(−1.811)	(1.677)	(2.624)
Constant	−12.433***	−10.091***	−1.943***	−2.167*
	(−7.644)	(−3.009)	(−3.140)	(−1.652)
Controls	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	Yes
Industry FE	No	Yes	No	Yes
Obs.	1749	1749	1749	1742
Adj_R^2	0.035	0.040	0.010	0.039

This table reports the innovation comparison between state-owned enterprises and private firms. The dependent variables are *LnApply* and *Adjcite*, respectively presenting innovation quantity and quality. *Origin* equals 1 if the business belongs to state-owned enterprises and takes the value of 0 when the business is possessed by private firms. All variables are defined in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are reported in parentheses.

Table 9
Alternative explanations.

Variable	Resource endowment		Founder's capacity		Traditional culture		All	
	(1) *LnApply*	(2) *Adjcite*	(3) *LnApply*	(4) *Adjcite*	(5) *LnApply*	(6) *Adjcite*	(7) *LnApply*	(8) *Adjcite*
Origin	−4.802**	2.283***	−1.277**	2.605***	−5.144***	2.373***	−3.642*	2.094***
	(−2.787)	(7.113)	(−2.057)	(11.121)	(−8.191)	(10.832)	(−2.041)	(5.470)
Government subsidy	0.239**	0.051***					0.217**	0.050***
	(2.583)	(4.229)					(2.448)	(2.978)
Tax return	0.475***	0.041**					0.421***	0.033
	(4.567)	(2.565)					(3.840)	(1.598)
Founder age			−0.018	−0.010*			−0.050	−0.012**
			(−1.343)	(−1.958)			(−1.368)	(−2.830)
Founder degree			0.293	0.208**			0.176	0.162
			(1.270)	(2.394)			(0.594)	(1.089)
Confucian shuyuan					2.290**	0.219	2.186***	0.286
					(2.092)	(0.573)	(3.343)	(0.514)
Imperial scholar					−1.506**	−0.202	−1.419***	−0.275
					(−2.428)	(−0.934)	(−3.757)	(−0.530)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3690	3690	3497	3497	4009	4009	3185	3185
Adj_R^2	0.328	0.253	0.309	0.272	0.188	0.257	0.225	0.266

This table presents the results of three alternative explanations. In Columns 1 and 2, we exclude the alternative explanation of resource endowment by controlling two additional control variables, i.e., *Government subsidy* and *Tax return*, measured by the natural logarithm of subsidy received and tax return from the government over total assets. In Columns 3 and 4, we rule out the alternative explanation of founder's capacity by adding two additional control variables, i.e., *Founder age* and *Founder degree*, measured by the age of founders when they start a business and their educational attainment. In Columns 5 and 6, we exclude the alternative explanation of traditional culture by adding two additional control variables, i.e., *Confucian shuyuan* and *Imperial scholar*, measured by the total number of Confucian academies and the number of ancient Chinese candidates titled "Jinshi" at the provincial level. In Columns 7 and 8, we include all the additional control variables at the same time. All variables are defined in Appendix Table A1.*** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

5.3.3. Chinese traditional culture

Following the above discussion, the formal institutional imprint delivered by pre-SOEs is the main reason why restructured family firms outperform their entrepreneurial counterparts in the aspect of innovation quality. Nevertheless, previous literature documents that entrepreneurship tends to emerge in regions surrounded by strong Confucian culture (Cruz et al., 2012). Therefore, entrepreneurial family businesses gradually grow up influenced by the social environments where traditional culture leaves a lasting imprint on entrepreneurs (Redding, 1995). As an informal institution, Confucianism is of great importance to business ethics, which has an essential impact on corporate governance (Du, 2015). As an extension, the ideology of Confucianism that emphasizes family ties makes it possible for entrepreneurial family firms to have relationship-dominated governance and gives rise to opportunism. As a result, catering to scrutiny by investors and the government, they are likely to perform well on innovation quantities at the expense of efficiency. However, restructured family firms develop with better institutional arrangement and less family intervention, which weaken opportunism, and offset the defect of formal institution of family firms.

In order to investigate whether Chinese traditional culture could remedy the adverse impact on current innovation derived from the

initial formal institutional deficiency, we incorporate two Confucianism variables into the estimation. Following existent studies (Xu and Yao, 2015; Chen et al., 2020), we use the total number of Confucian academies at the provincial level (*Confucian shuyuan*) and the number of ancient Chinese candidates titled "Jinshi"[4] (*Imperial scholar*) to proxy the informal institution induced by traditional culture. Columns 5 and 6 of Table 9 present the estimation results. Unsurprisingly, being restructured is still associated with smaller patent quantity and linked to superior patent quality, thus confirming again the principal contribution of formal institutions in streamlining innovation for restructured family firms instead of their entrepreneurial counterparts.

6. Conclusion

From the dynamic perspective of historical formation and ownership during the formative period, this paper aims to provide a more nuanced understanding of why family firms innovate differently. Much existing literature on family firms adopts a more homogeneous approach, and most empirical studies focus on the comparison between family firms and non-family firms. However, this paper provides strong evidence that the innovation tendency differs within family firms and echoes. We document two types of Chinese family firms that shape the incumbent decision-making processes. Our research into the original patterns of Chinese family firms reveals an evident variation among family firms, and their primary condition forming during the foundation stage features prominently in subsequent organizational corporate innovation. The results further demonstrate that the imprinting effect is a particularly useful approach to understanding the drivers of family firm innovation and further identifies how innovation orientation varies with divergent origins. We provide new insights into the relationship between naturally inherent differences and enterprise policy, which advance our knowledge of why they innovate differently and enrich our understanding of the importance of family firm origin.

Using the sample of Chinese family firms listed in China's A-share market from 2009 to 2018, our results show that family firms originating from SOE privatization have a more standardized institutional environment, and tend to attach more importance to innovation quality than those family firms that originated from founders. In contrast to restructured family firms, impaired institutions caused by network-dominated management distort entrepreneurial ones' intention of innovation, and steer them towards quantity preference. Our results are robust to the instrumental variable estimate and a placebo test. Additionally, the innovation quality improvement effect is more pronounced for restructured family firms without succession, with a longer period as SOEs, and evolved entirely from state ownership, implying the importance of formal institutions in boosting patent quality. Moreover, the explicitly different institutional that imprint endures through firms' formative years have been identified as the chief mechanism underlying later innovation performance disparity.

The past substantially impacts on present corporate strategies and organizational routines, further being reflected in different innovative activities (Kammerlander et al., 2015). Our empirical results serve as evidence that family firm behaviors are associated with different types of origins, which consequently affect corporate innovation. Using insights from an imprinting perspective, the results help advance our understanding of heterogeneity in family firms and how the past imprints influence future corporate strategies. We provide evidence that the founding stage may be an important factor to explain variation in the subsequent development of family firms. Chief leaders should take advantage of this unique period to promote their strategic management and cultivate quality-oriented values. Moreover, our evidence also provides implications for the government. It is noteworthy that strategies of businesses are not immune to local policies, and the policies to stimulate innovation should aim at long-term mechanisms and atmosphere cultivation. Finally, our findings can help lead other researchers to further examine the other imprinting effects of corporate origin on family firms.

Declaration of Competing Interest

We have no relevant or material financial interests that related to the research described in this paper.

Data availability

Data will be made available on request.

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Appendix A. Appendix

[4] Jinshi: Successful candidate in the highest imperial examination held in the palace under the emperor's supervision. The historical data come from the Ming Dynasty (1368–1644) and the Qing Dynasty (1644–1912). We provide the descriptive statistics of *Confucian shuyuan* and *Imperial scholar* in Appendix Table A5.

Table A1
Description of variables.

Variable	Definition	Construction
Dependent variables		
LnApply	Patent quantity	Natural logarithm of a family firm's patent applications plus one in a given year.
Adjcite	Patent quality	Adjusted patent citations of a family firm in a given year.
Independent variable		
Origin	Family firm origin	A dummy variable that equals 1 for the restructure SOEs and 0 for entrepreneurial family firms.
Control variables		
Size	Firm size	Natural logarithm of total assets plus one.
Age	Firm age	The observation year minus the year of establishment.
Roa	Profitability	Ratio of net profits divided to total assets.
Lev	Leverage	Ratio of total liabilities divided by total assets.
Ppe	Tangibility	Ratio of property, plant and equipment expenses to total assets.
Cash	Cash holdings	Ratio of cash holdings over total assets.
Cfo	Cash flow	Ratio of operating cash flow to total assets.
Growth	Sales growth	Growth rate of sales revenues.
Top1	Largest shareholder	Ratio of the shares of the largest shareholder.
Dual	Duality	Dummy variable, which assumes value 1 if the family member serves as chairman and general manager and zero otherwise.
Ind	Independent directors	Proportion of independent directors.
Boards	Board Size	Natural logarithm of the number of directors on board.

This table presents definitions of the key variables used in regressions, including dependent variables, independent variables and key control variables.

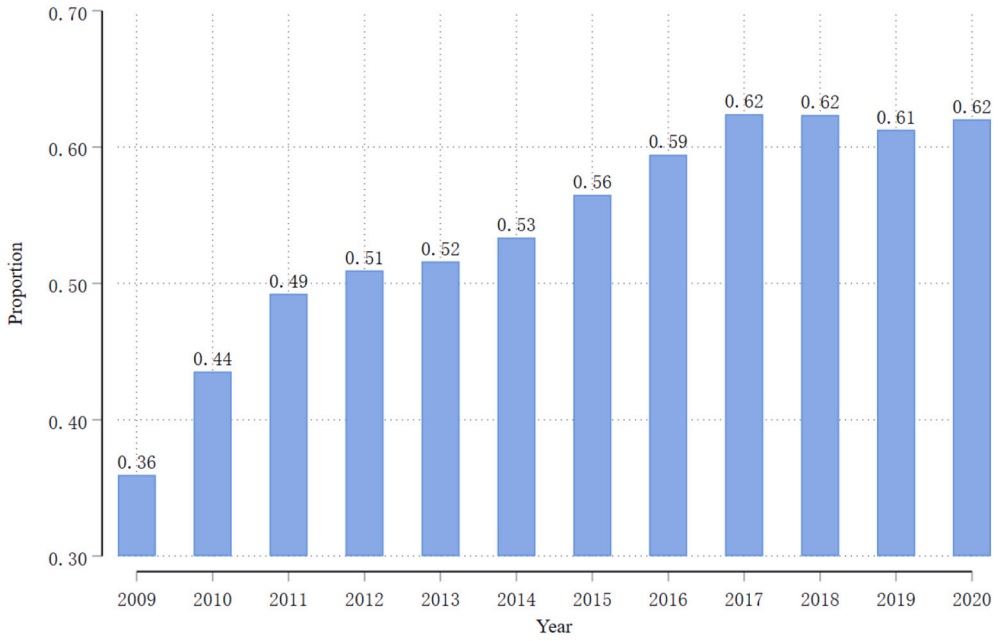

Fig. A1. The proportion of Chinese family firms in listed firms.
This figure respectively portrays the proportion of Chinese family firms in listed firm from 2009 to 2020, suggesting the trend of the importance of family firms in Chinese economy.

Table A2
Correlation matrix.

Variable	*LnApply*	*Adjcite*	*Origin*	*Size*	*Age*	*Roa*	*Lev*	*Ppe*	*Cash*	*Cfo*	*Growth*	*Top1*	*Ind*	*Boards*
LnApply	1													
Adjcite	0.022	1												
Origin	−0.138***	0.144***	1											
Size	0.250***	−0.005	−0.149***	1										
Age	0.032**	−0.128***	−0.324***	0.154***	1									
Roa	0.016	0.009	0.019	0.024*	−0.0220	1								
Lev	0.037**	0.041***	−0.243***	0.470***	0.107***	−0.058***	1							
Ppe	0.098***	0.030*	0.092***	−0.022	−0.092***	0.036**	0.019	1						
Cash	0.193***	0.056***	−0.065***	0.685***	0.038***	0.037***	0.228***	−0.136***	1					
Cfo	0.065***	0.043***	0.059***	−0.026	−0.049***	0.026*	−0.177***	0.236***	0.095***	1				
Growth	−0.027*	0.028*	−0.138***	0.086***	0.025*	0	0.096***	0.051***	0.070***	0.035**	1			
Top1	−0.028**	0.054***	0.093***	−0.014	−0.111***	0.0130	−0.031**	0.022	0.077***	0.077***	−0.015	1		
Ind	−0.020	−0.037***	0.005	−0.020	0.016	−0.005	−0.006	−0.037**	−0.026**	0.024	0	0.007	1	
Boards	0.054***	0.043***	0.042***	0.159***	−0.040***	0.013	0.086***	0.028*	0.150***	−0.014	0.002	−0.042***	−0.283***	1

This table presents the correlation matrix among the key variables used in regressions. All variables are defined in Appendix Table A1.*** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

Table A3
Control financial constraints and venture capital holding additionally.

Variable	*LnApply*				*Adjcite*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Origin	−0.340	−0.919*	−1.136**	−1.123*	2.394***	2.420***	2.833***	2.868***
	(−0.617)	(−1.677)	(−1.994)	(−1.948)	(12.599)	(11.864)	(13.038)	(13.035)
Size		3.737***	2.097***	2.004***		0.453***	0.565***	0.581***
		(20.113)	(6.341)	(6.028)		(6.543)	(4.480)	(4.581)
Age		−0.180***	−0.161***	−0.151***		0.014	−0.003	−0.004
		(−4.271)	(−3.432)	(−3.214)		(0.867)	(−0.189)	(−0.241)
SA		−3.690***	−3.845***	−3.486***		0.617*	0.490	0.425
		(−3.670)	(−3.406)	(−3.074)		(1.649)	(1.139)	(0.982)
VC		3.004***	3.156***	3.061***		0.739***	0.678***	0.705***
		(8.268)	(7.653)	(7.391)		(5.466)	(4.311)	(4.461)
Roa			0.287	0.136			−1.052	−1.039
			(0.133)	(0.063)			(−1.277)	(−1.261)
Lev			0.038***	0.036***			−0.010**	−0.009*
			(3.030)	(2.867)			(−1.979)	(−1.861)
Ppe			0.023	0.023			−0.005	−0.006
			(1.586)	(1.555)			(−0.923)	(−1.139)
Cash			1.387***	1.343***			0.152	0.135
			(5.528)	(5.324)			(1.588)	(1.404)
Cfo			0.061***	0.060**			0.025***	0.026***
			(2.593)	(2.540)			(2.788)	(2.936)
Growth			−0.458	−0.384			0.072	0.077
			(−1.162)	(−0.972)			(0.481)	(0.514)
Dual				−1.003**				0.128
				(−2.465)				(0.825)
Ind				−1.424				−0.691*
				(−1.437)				(−1.825)
Boards				0.370***				−0.003
				(2.581)				(−0.048)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	5558	5414	4035	4006	5558	5414	4035	4006
Adj_R^2	0.220	0.304	0.326	0.329	0.213	0.225	0.262	0.265

In Columns 1 to 4, *the dependent variable is LnApply,* which denotes innovation quantity. In Columns 5 to 8, the dependent variable is *Adjcite*, which measures innovation quality. *Origin* takes the value of 1 for restructured family firms and 0 for entrepreneurial ones. According to and (Chen (2022)), we add financial constraint (*SA*) and venture capital (*VC*) as control variables. All variables are defined in Appendix Table A1. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

Table A4
Descriptive statistics of *Government subsidy* and *Tax return*.

Variable	Obs.	Mean	Std.	Min	Median	Max
Panel A: Full sample						
Government subsidy	5143	14.391	4.413	0	15.586	20.773
Tax return	5558	11.674	7.286	0	15.1123	22.541

Panel B: Sub-samples					
Variable	Restructured family firms		Entrepreneurial family firms		Difference in Mean
	Mean	Std.	Mean	Std.	
Government subsidy	14.125	4.868	14.436	4.329	−0.312*
Tax return	10.366	7.701	11.905	7.187	−1.538***

Panel A of this table provides size, mean, standard deviations, minimum values, median and maximum values of *Government subsidy* and *Tax return*. Panel B reports the weighted difference of the mean values between two types of the family business samples. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

Table A5
Descriptive statistics of *Confucian shuyuan* and *Imperial scholar*.

Variable	Obs.	Mean	Std.	Min	Median	Max
Panel A: Full sample						
Confucian shuyuan	5537	5.651	4.413	1.609	5.953	6.898
Imperial scholar	5520	9.811	7.286	0.693	10.247	11.132

(*continued on next page*)

Table A5 (*continued*)

Variable	Obs.	Mean	Std.	Min	Median	Max
Panel B: Sub-samples						
Variable	Restructured family firms		Entrepreneurial family firms		Difference in Mean	
	Mean	Std.	Mean	Std.		
Confucian shuyuan	5.192	1.267	5.731	1.046	−0.539***	
Imperial scholar	9.142	2.26	9.927	1.786	−0.784***	

Panel A of this table provides size, mean, standard deviations, minimum values, median and maximum values of *Confucian shuyuan* and *Imperial scholar*. Panel B reports the weighted difference of the mean values between two types of the family business samples. *** $p \leq 0.01$, ** $p \leq 0.05$, and * $p \leq 0.10$; t-statistics are in parentheses.

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ememar.2022.100990.

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