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Liability of origin imprints: how do the origin imprints influence corporate innovation? Evidence from China

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In transforming emerging economies, many state-owned enterprises (SOEs) underwent privatization, transferring property rights from the state to private entities. This transition not only facilitated the establishment of entrepreneurial family firms but also encouraged the emergence of privatized family firms as property rights were transferred to individuals and families. Consequently, the roots of property rights in these settings can be traced back to either direct establishment or privatization. In this study, we examine how these origin imprints influence corporate innovation. By analyzing a dataset of A-share Chinese listed non-financial family firms spanning from 2005 to 2021, we find that pre-privatization organizational imprints which primarily focus on societal well-being, tend to persist within these privatized family firms, resulting in a lower degree of corporate innovation compared to their entrepreneurial counterparts. Moreover, additional subsample analysis indicates that the adverse impact of privatized family firms on corporate innovation is intensified by strong political connections while mitigated by a well-developed institutional environment in the region. Our results are robust to various econometric methods, alternative explanations, and approaches to address endogeneity concerns such as the two-stage least squares (2SLS), Generalized Method of Moments (GMM), and propensity score matching (PSM) techniques. Overall, this study highlights a source of heterogeneity within the family firms and reveals how organizational imprints inherited from a pre-privatization economic regime can diminish the positive effects usually associated with family ownership.

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"It is not the strongest of the species that survive, nor the most intelligent, but the one more responsive to change."

——*Charles Darwin*

Introduction

Innovation plays a vital role in economic development, and competitive advantage (Schumpeter 1934) and is considered an essential factor in the long-term sustainability of a business (Hult et al. 2004). Innovation is even more important for family firms (FFs) because it ensures their perseverance across generations (Ahmad et al. 2021). In recent years, research on innovation within family firms has experienced remarkable growth (Calabrò et al. 2019), leading to the emergence of contradictory perspectives and findings. Some scholars argue that family firms tend to be more innovative (Ahmad et al. 2021) and identified several contributing factors, such as long-term orientation (Werner et al. 2018), shared aspirations and objectives (Craig et al. 2014), familiness (Eddleston et al. 2008), strong identity (Casprini et al. 2017), family participation in top management team (Martínez-Alonso et al. 2022), founder-managers (Sun et al. 2024), chairperson's siblings (Xu et al. 2024), socioemotional wealth (Gjergji et al. 2022), generational diversity and non-family management diversity (Hillebrand et al. 2020) are considered to play a key role to enhance corporate innovation in family firms. On the other hand, other scholars argue that family firms tend to exhibit lower levels of innovation compared to their non-family counterparts (Matzler et al. 2015) and identified several factors adversely affecting corporate innovation such as risk avoidance (De Massis et al. 2015), conservative nature (Dunn 1996), resistance to collaborate and share authority with no-family members (Chrisman et al. 2015), priority to preserve socioemotional wealth (Gomez-Mejia et al. 2007), intergenerational conflicts (Kellermanns et al. 2012), and entrenchment effect (Lubatkin et al. 2005). Within this debate, scholars emphasize the need for further research to uncover the heterogeneity among family firms and to identify the factors that explain why some family firms perform better in terms of innovation while others lag behind (De Massis et al. 2015). One area that has received relatively less attention is the concept of origin imprints. This involves understanding how the way family firms are established—whether directly or indirectly—affects their strategies especially corporate innovation in later stages of development.

In the past decade, emerging economies have transitioned from state socialism to entrepreneurial capitalism, resulting in the widespread privatization of state-owned enterprises (SOEs) (Radić et al. 2021). In the case of the Chinese economy, before the "Reform and Opening Up" policy and economic reforms in 1978, the Chinese economy solely relied on SOEs as the only organizational structure with no presence of private ownership (Xu et al. 2014). The privatization process gained momentum in 1997 when the Chinese government launched the "grasping the large and releasing the small" (*Zhuada fang-xiao*) strategy. Under this policy, the Chinese government chose to retain large state-owned enterprises (SOEs) in strategic sectors under central government control and preferred to privatize smaller, inefficient, and non-strategic enterprises mostly owned by local governments (Haveman et al. 2017). This policy led to the restructuring of approximately 60,000 state-owned enterprises (SOEs), transferring property rights from the state to families, and facilitated the establishment of newly formed PFFs (Lin et al. 2021). This shift played a crucial role in restoring the legal status of private ownership (Li et al. 2006). Alongside privatization, the government relaxed various regulations, which facilitated the establishment of new private businesses, particularly the entrepreneurial family business in the economy. As a result, two distinct and diverse types of family firms emerged and became prevalent in the Chinese economy: privatized family firms (PFFs) and de novo family firms.

These two types of businesses have distinct origins, stemming either from the direct incorporation of new enterprises or the privatization of state-owned enterprises, which underscores the varied pathways through which property rights were established. There are only a limited number of studies that provide additional insights into the implications of private property ownership based on their distinctive origins. Ding (2025) examines the degree of internationalization in PFFs compared to the entrepreneurial FFs and finds that restructured family businesses, which originate from privatized SOEs, tend to have a lower degree of internationalization compared to entrepreneurial family businesses. Furthermore, the liability of ownership origin can pose legitimacy challenges for PFFs, affecting their desire for control and internationalization strategies (Jin and Hu 2024). Additionally, PFFs exhibit higher total factor productivity (TFP) than their entrepreneurial counterparts, attributed to the institutional imprints from their origins (Cheng et al. 2022a). Huang et al. (2024) examine the association between the historical ownership of FFs and the incidence of corporate fraud and find that privatized FFs tend to commit more fraudulent activities compared to entrepreneurial family firms. Finally, Cheng et al. (2022b) explore the impact of institutional imprinting on green innovation within family businesses and find that PFFs with a strong institutional imprint tend to be more proactive in implementing environmentally friendly practices. Eventually, the historical origins of family firms significantly influence their strategies and organizational behavior (Cheng et al. 2022b); however, there remains a gap between private ownership origin imprints and corporate innovation. These ownership transformations foster the cultivation of family characteristics in these privatized family firms and provide a sensitive period to imprint. This unique situation provides insights into the continuation of historical imprint (Simsek et al. 2014), organizational inertia (Gilbert 2005), and intra-cohort heterogeneity, which may affect innovation performance despite the presence of family characteristics. In this paper, we theorize that pre-privatization organizational imprints continue to influence PFFs, unlike entrepreneurial family firms, regardless of the privatization process and the adoption of family characteristics.

To test the theoretical predictions, we analyzed a sample of Chinese A-share non-financial family firms listed on the Shenzhen and Shanghai stock exchanges from 2005 to 2021 and found that compared to entrepreneurial family firms, PFFs have a lower degree of corporate innovation. Additionally, in the subsample additional analysis, we find that political connections strengthen the negative effects between privatized family firms and corporate innovation. Nonetheless, a developed institutional environment reduces the negative association between privatized family firms and corporate innovation. Overall, this study underscores a source of heterogeneity within FF, revealing that organizational imprints inherited from a pre-privatization economic regime diminish the positive effects typically associated with family ownership.

Our research significantly contributes to the existing research in several ways. Firstly, by focusing on pre-privatization imprints or origin imprints, this study contributes to and advances the imprinting theory. Our study is the first to introduce the concept of *liability of origin imprints* by drawing insight from the imprinting theory. The concept of the origin imprint is still emerging and developing within academic literature. While prior studies have primarily focused on individual-level imprints and highlighted how individual levels imprints such as CEO's

ideological imprints (Han and Zheng 2016), CEO/board chair famine imprints (Hu et al. 2017; Cui et al. 2022; Han et al. 2022; Jebran et al. 2023; Chen et al. 2024), entrepreneurs with Internet-era imprints (Liu et al. 2023a), SARS outbreak experience (Liu and Marquis, 2024), childhood poverty experiences (Liu et al. 2023b), Military experience imprints (Zhang et al. 2022), and overseas experience (Zhang et al. 2022) influence organizational outcomes. Our research focuses on the imprinting effects on the organizational level and explores how the private ownership origin helps the pre-privatization imprints to persist within the privatized family firms irrespective of the inculcation of entrepreneurial characteristics. Our study provides deeper insights into the causes and sources of heterogeneity within family businesses. It also clarifies why, even after the privatization of SOEs and the transfer of property rights to families, these privatized family firms often lag behind their counterparts in corporate innovation.

Secondly, we explore the persistence or decay of organizational imprinting from a fresh perspective. While previous studies have primarily focused on factors that maintain organizational stability (Burton and Beckman 2007), they have paid insufficient attention to elements that might alter these imprints. Our research investigates factors that may either augment or attenuate the effects of origin imprints, providing a broader view of organizational change. Specifically, we build on existing research that has identified a negative impact of political connections on corporate innovation (Wu 2011; You and Du 2012; Zhang et al. 2014; Cheng and Li 2023; Zhao et al. 2024). Although political connections can enhance a firm's legitimacy and reputation (Liu et al. 2019), they can also quickly become a liability for the firm's innovation. Prior studies have typically examined political connections through the resource-based view (RBV) theory (Zhang et al. 2019; Wang et al. 2020). However, we expand upon this body of knowledge by highlighting an additional confounding effect of political connections, viewed through the perspective of imprinting theory. We find that political connections act as a channel for transmitting and sustaining historical origin imprints from the pre-privatization era, which, in turn, negatively affects corporate innovation.

Thirdly, we contribute to the literature on privatization by introducing the concept of "imprint-environment fit" (Tilcsik 2014). There is increasing recognition of certain features that help preserve organizational imprints and how these imprints evolve, such as through reforming or coupling, even beyond the initial establishment phase (De Cuyper et al. 2020). For instance, when there is a mismatch between imprints and the environment due to institutional changes, it necessitates the adoption of new decision-making logic. This is because the existing logic and new behaviors are not compatible with one another (Greve and Zhang 2017). Similarly, the institutional environment in a region significantly influences corporate innovation by affecting managers' motivations for risk-taking (Shu et al. 2014; Xu et al. 2019) and shaping their innovation-related decisions. Institutional development creates a context that encourages managers to embrace risk and pursue innovative strategies, thereby driving corporate growth and competitiveness. Our study demonstrates that organizational imprints can change based on the level of imprint-environment fit, and institutional development helps to alleviate these inherited pre-privatization imprints. Our finding confirms that the institutional environment can act as a contingency factor when privatized family firms adversely impact innovation performance.

Theoretical framework

Background. Since 1990, nearly three decades have seen a notable transition from state to private ownership, which had a profound impact on ownership structures throughout the world (D'Souza et al. 2017). The existing literature indicates that privatization occurs for various reasons, including reduction of state intervention in a particular sector (Haskel and Syzmanski 1993), improving performance through effective management (Parker and Wu, 1998), alleviating the financial obligation from the state (Newberry and Pallot 2003) and encouraging private investments (Fairbrother et al. 2002). Property rights theory explains the differences in economic behavior between private and public ownership (De Alessi 1980; Bos 1991). Property rights theory posits that private ownership operates more effectively than public ownership because it effectively aligns the interests of principles and agents through strong oversight and well-designed incentives (Vickers and Yarrow 1988). Therefore, property rights theory suggests that privatization can promote firm performance (Huang and Wang 2011) and corporate innovation (Carreira and Deza 2009; Tan et al. 2020) through the synchronization of the interests of shareholders and managers, leading to more effective business practices.

However, the property rights theory overlooks the persistence of ideological and historical founding imprints (Marquis and Qiao, 2020), thereby restricting the applicability of this theory. Therefore, in the absence of an imprinting theory, property rights theory fails to explain the factors behind the negative implications of privatization on operational efficacy and corporate innovation. To understand this complex issue and explain how founding and pre-privatization imprints persist and continue the performance and decision-making, the imprinting theory provides a solid foundation. Organizational imprinting helps explain that the initial stages of incorporation are the most critical and sensitive phase in the history of a firm (Marquis and Tilcsik 2013). During this period, executives play a crucial role in structuring and selecting features to deal with contemporary environmental pressures and uncertainties (Hannan and Freeman 1977), which affects the firm for a long time after its incorporation (Johnson 2007). The lasting impact of these structures and features can be attributed to the enduring institutional environment and historical imprint of the pre-privatization era which continue to influence firms long after privatization and restructuring (Marquis and Tilcsik 2013). These imprints are so deeply embedded that, even after the privatization and restructuring of SOEs, they can overshadow the positive attributes typically associated with family ownership. Therefore, we propose that although SOEs have undergone privatization and adopted family characteristics, the lasting historical origins and founding imprints from the pre-privatization era negatively impact corporate innovation.

Hypothesis development

Privatized family firms and corporate innovation. The historical evolution of property rights in China shows that due to the "Reforms and Opening Up" policy in 1978, private ownership got a legitimate status and private enterprises began to flourish, leading to significant transformations in the economic landscape. The transition from a centrally controlled economy to a market-driven system led to the gradual growth of market mechanisms and increased competition. This shift highlighted the inefficiencies, lack of competitiveness, and operational and managerial shortcomings within state-owned enterprises (SOEs), particularly when compared to private firms (Ji et al. 2021). Therefore, in 1990, the Chinese government adopted the "grasping the large and letting go of the small" policy, which led to the privatization of thousands of SOEs. This move encouraged private ownership and led to the emergence of a new wave of privatized family firms. These privatized family firms opposed to entrepreneurial family

businesses exhibit features resembling SOEs and heavily rely on formal standardized bureaucratic procedures with relatively low family involvement and intergenerational orientation. D'Souza et al. (2017) argue that after privatization, these businesses behave differently in terms of performance, financial constraints, legal obligations, and susceptibility to corruption. The imprinting theory provides insight into the reasons behind this heterogeneity by explaining how Privatized Family Firms inherit historical features from the pre-privatization era. These inherited characteristics erodes both the positive effects of privatization and family characteristics, ultimately setting PFFs apart from entrepreneurial family firms. We propose that origin of private ownership leaves a distinct imprint on these privatized family firms, subsequently influencing corporate innovation through the following mechanisms.

First, despite privatization efforts since the 1990s, China's market-led reforms were not intended to completely abandon socialist ideals. Instead, these reforms introduced market socialism, which preserved socialism as the dominant political ideology while granting certain freedoms to organizations and individuals. Before these reforms, state-owned enterprises (SOEs) were primarily responsible for fulfilling political, social, and administrative responsibilities (Megginson and Netter 2001). These responsibilities included providing employee healthcare, housing, and pension benefits (Zhou et al. 2006). These costly obligations deplete the firm's resources and compel managers to adhere to existing norms to benefit from such programs (Justin Tan and Litsschert 1994). During the socialist economic regime, these norms and cultures created lasting imprints on these employees that were incompatible with the state-capitalist system. The logic of state socialism, which promotes a "preference for security rather than risk", leads individuals to adopt more risk-aversive behaviors (Wyrwich 2013). Consequently, these workers tend to prefer more secure jobs and steady returns (Alas and Rees 2006), try to avoid positions that endanger their personal interests (Danis et al. 2011), maintain a low profile (Schwartz and Bardi 1997), experience inner fear of anti-capitalist sentiment (Pop-Eleches and Tucker 2014) and also express feelings "we are lost generation" (Hollander 1994). Therefore, the person-environment misfit within privatized family firms makes it challenging to fully leverage their origin-imprinted workforce to drive technological breakthroughs, impart new knowledge, and foster innovation.

Secondly, privatization alone was not enough to change the old ways of doing things; some communist norms and cultures remained intact, discouraging innovation. During the founding period, technological and economic conditions imprinted certain capabilities within the organization (Marquis and Tilcsik 2013). The socialist economic system established at the inception of a firm created a strong imprint that limited its ability to adjust to the new socialist-capitalist system after the transition. As a result, older firms from the socialist era have vested interests and entrenched structures that resist adopting contemporary governance practices. Therefore, the firm-specific capabilities developed during the socialist economic system were designed to meet the needs of that system. These socialist imprints persist for a long time and undermine knowledge routines and competition even after the economic transition has taken place (Shinkle and Kriauciunas 2012). As a result, these imprints hinder a firm's capability to pursue change, invest in corporate innovation, and operate differently from newly established de novo family firms.

Finally, family members exhibit a pronounced inclination towards retaining long-term control of a family business (Zellweger et al. 2012) as this authority facilitates the attainment of both financial and non-financial objectives and helps to safeguard their interests within the company (Gomez-Mejia et al. 2007). Typically, such control is connected with holding a majority of the shares and holding essential managerial and strategic positions (Bertrand et al. 2008). Additionally, the family business owners aim to transfer the ownership control to future generations to continue the family legacy, sustain wealth across generations, and preserve the family dynasty. Succession planning encourages family owners to adopt a more futuristic approach and make long-term investments that benefit the succeeding generations (Gu et al. 2019) and promote corporate innovation (Hillebrand 2019). However, the legitimacy deficiency arising from the illegal transfer of property rights from the state to families negatively affects the intention of family owners to pass on these privatized family firms to the next generation (Jin and Hu 2024). Research indicates that although not all state-owned enterprises were privatized illegally (Frye 2006), a significant number underwent privatization through legally questionable and non-transparent processes. In some cases, these enterprises were transferred to private ownership at prices that were extremely low or nearly free (Ji et al. 2021). This situation indirectly diminishes the sense of control among family owners. Resultantly, the family owners of these firms face difficulties in securing financial resources from external stakeholders which further adversely affects firm performance and diminishes their capabilities to maintain robust cash flows (Miller et al. 2013). Consequently, family owners in these privatized family firms might choose to avoid generational investment decisions that affect future generations, refrain from investing altogether, or even strip assets from their firms if those assets are considered illegitimate (Cull and Xu 2005; Frye 2006). Such actions can negatively affect corporate innovation, as innovation is inherently risky, requires a long-term commitment, and depends on a steady cash flow.

Therefore, on the one hand, privatized family firms with imprinted socialist values show significant resistance to market-based changes. Instead of fostering an entrepreneurial orientation that encourages innovation, they exhibit inertia, limiting the positive impact of both privatization and family characteristics on innovation. On the other hand, due to the transition from centrally-planned regimes, these privatized family firms face ineffective managerial expertise (Ismail et al. 2013), inadequate operational capabilities (Kriauciunas and Kale 2006), and possess the pre-privatization origin imprints which in turn discourage corporate innovation despite the presence of familial characteristics in these PFFs, making them different for the de novo family firms. Thus, we present our hypothesize as follows:

Hypothesis 1: *Those firms where the ownership transferred from the state to families mainly suffer from inherited pre-privatization social and origin imprints; therefore, compared to the De novo family firms these privatized family firms exhibit lower levels of innovation performance.*

Methods

Sample and data. In this study, we created a distinctive panel dataset that includes A-share listed family firms listed on the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE), covering the period from 2005 to 2021. We selected 2005 as the starting year because, since 2003, the China Securities Regulatory Commission (CSRC) required publically listed companies to disclose extensive details about their senior executives and board members. This regulation enhances the transparency and accountability of these firms, making 2005 an appropriate point of reference for our analysis. Hall et al. (2001) noted that citations for issued patents typically reach their peak value several years after issuance. Additionally, the application for patents and receiving final approval have a particular time lag, while its citation approaches the maximum number after three to

five years from its approval time which may affect corporate innovation (Jaffe and Trajtenberg 1996; Wagner and Wakeman 2016). Hence, we restrict our sample scope to include data only up to the year 2021.

We obtained data about corporate innovation, specifically, the citation counts for each company, from the State Intellectual Property Office of China (SIPO). We collected information on family ownership from two sources: the CSMAR database and the annual reports of publicly listed companies, which we reviewed manually. The handling process is as follows. Firstly, following prior literature (Anderson and Reeb 2003; Burkart et al. 2003; Ashraf et al. 2020), we define family firms where the family members serve as the CEO or chairperson of the board or general manager and ultimately retain at least 15% of the voting rights (Villalonga and Amit 2006; Isakov and Weisskopf 2014), while different thresholds of 20% and 50% were considered in robust tests. Secondly, we reviewed annual reports for each to identify how the firm was established. The family firm was classified as a privatized family firm if it was privatized from being a former state-owned enterprise (SOE), or we classified it as a de novo family firm or entrepreneurial family firm if it was incorporated and managed by family members from the first day of establishment (D'Souza et al. 2017). Finally, We created a binary categorical variable of PFF based on their initial nature of establishment. A value of 1 is assigned to PFF if family firms were transformed from state-owned enterprises (SOEs) and later owned and controlled by families and 0 to those family firms if the firm was incorporated and managed by family members from the first day of establishment.

Data regarding other firm-level variables is collected from the CSMAR Database. Thereafter, the collected data was cross-linked and organized through a unique company code. The ultimate sample encompassed a total of 2955 companies, providing us with a dataset of 19408 firm-year observations spanning from 2005 to 2021. A detailed description of the sample distribution categorized by year and industry is provided in Appendices II, III, and V.

Variables

Dependent variables

Corporate innovation: Consistent with earlier studies, we utilized several proxies to measure our main dependent variable, corporate innovation. These measures included the total number of patents granted within a given year, the total number of patent applications submitted during that year, and the number of patent citations a firm received in that specific year. For our main analysis, we used the total number of patent citations a firm has received during a particular year, excluding self-citations (He and Tian 2013; Zhong 2018), while we used other measures of corporate innovation in our robustness analysis. Patent citations serve as a more robust indicator, offering a more precise reflection of a firm's technological and innovation efficiency. Furthermore, patent citation data provide a robust measure to gauge the worth and standing of a firm within the commercial landscape. We collected patent citations manually from the SIPO database.

Independent Variables

Privatized family firm: In line with prior studies by Huang et al. (2024) and Jin and Hu (2024), we construct a binary categorical variable of privatized family firms based on their initial nature of establishment. A value of 1 is assigned to those FFs that were transformed from SOEs and later owned and controlled by families and 0 to those family firms if the firm was incorporated and managed by family members from the first day of establishment.

We used 15% of ultimate control rights (voting rights) of family members after the firm was privatized from state-owned ownership while different thresholds of 20% and 50% were considered in robust tests. The ultimate control right is determined by adding together both direct and indirect control rights. Direct control rights refer to the percentage of shares that the controlling shareholders own directly. In contrast, indirect control rights represent the minimum level of control held in each layer of ownership within the corporate structure (La Porta et al. 2000). We obtained information regarding family-owned businesses from the extensive database of CSMAR.

Control Variables. In this study, we use various control variables, each having the potential to impact innovation performance. We evaluate the *firm size* by using the natural logarithm of its total assets (Cherkasova and Kurlyanova 2019; Ali et al. 2021). The *firm age* is assessed through the application of the natural logarithm of the duration, in years, that has elapsed since the firm's inception (He and Tian 2013; Ali et al. 2024). *Tangibility* is quantified as the proportion of the net worth of fixed assets to the overall assets (Espinosa-Méndez et al. 2024). The measurement of *leverage* is achieved through the division of the firm's aggregate debt by its overall assets (Ghafoor et al. 2024; Mao et al. 2024). *Profitability* is evaluated by determining the ratio of net profit in relation to the total return on assets (Wang et al. 2012). A firm's *growth* has been measured by the market value divided by the firm's book value (O'Brien and David 2014). *R&D intensity* is quantified by dividing research and development expenses by the operating income (Piperopoulos et al. 2018). *Institutional ownership* is assessed by using the percentage of shares owned by institutional investors (He and Tian 2013). *Board size* is determined by taking the natural logarithm of the total number of directors serving on the board (Ali et al. 2021). The measurement of *market competition* involves summing the squares of the focal firm's sales percentages within each respective industry (Zhou et al. 2017; Yang et al. 2020). To capture the effects of industry-specific and time-related influences, we introduced dummy variables for both industry and year effects. The descriptions and data sources for all the variables used in the study are provided in Appendix I.

Estimation method. The Zero-Inflated Poisson (ZIP) model plays a crucial role in corporate innovation research, particularly when dealing with the count data that contain a significant number of zero values. Innovation researchers frequently encounter the situation of excessive zero issues in corporate innovation datasets. The Zero-Inflated Poisson (ZIP) model demonstrates considerable efficacy in managing overdispersed datasets, wherein the variance exceeds the mean. This is a common scenario in corporate settings, such as when analyzing innovation counts, patent filings, or the outcomes of R&D projects. The ZIP model is particularly advantageous in situations where traditional Poisson models fall short due to the execution zeroes, which can distort results and lead to incorrect inferences (Mukherjee and Rakitzis 2019; Zeeshan et al. 2024). The ZIP model divides the data into two distinct classes: one that generates zeroes and another that follows a Poisson distribution which enables for more improved analysis and interpretation of corporate innovation data (Long et al. 2014). Panel data, especially corporate innovation panel data, which involves repeated observations over time, often presents challenges such as excess zeros and overdispersion, making ZIP models particularly suitable. Similarly, Zhu et al. (2017) extend zero-inflated count models to account for heterogeneous random effects in longitudinal data, demonstrating the adaptability of ZIP models to accommodate complex data structures and covariate-specific heterogeneity.

As our exploratory variable is measured by invention patent citation counts in a given year for each firm; therefore, count data

Table 1 Descriptive Statistics.

Variable	*N*	Mean	Median	SD	1st quartile	3rd quartile
Corporate Innovation	19,408	27.426	7.000	38.509	0	40
Privatized Family Firms	19,408	0.258	0.000	0.438	0	1
Firm age	19,408	1.690	1.792	0.923	1.099	2.398
Tangibility	19,408	0.193	0.171	0.138	0.086	0.275
Institutional ownership	19,408	3.138	3.541	1.140	2.503	3.987
Board size	19,408	2.226	2.197	0.243	2.079	2.398
Growth	19,408	0.212	0.133	0.504	−0.020	0.316
R&D intensity	19,408	0.021	0.000	0.040	0	0.034
Leverage	19,408	0.406	0.392	0.214	0.239	0.543
Firm size	19,408	3.078	3.076	0.053	3.043	3.110
Profitability	19,408	0.051	0.084	0.322	0.028	0.158
Market competition	19,408	0.202	0.140	0.184	0.089	0.228

This table presents summary statistics at the firm level for all the variables used in this study based on all firm-year observations between 2005 and 2021 for a sample size of 19,408 observations. Corporate innovation refers to the Invention Patent Citations received by a firm in a specific year. Privatized family firms refer to those firms which privatized from SOEs and later owned and controlled by families. All variables are defined in Appendix I.

models are suitable for analyzing our data (Cameron and Trivedi 2005). The use of the zero-inflated Poisson model (ZIP) is a standard approach to address the excessive zeros in count data (Ridout et al. 2001). ZIP estimation methods have been introduced quite early in the econometrics literature (Mullahy 1986); however, after the seminal work of Lambert (1992), it is used extensively for counting data having excessive zeros. Given that our exploratory variable possesses a large number of zero values (32.88% of the observed values are 0), a ZIP regression model is preferable to the typical Poisson model. To further address potential simultaneity bias, we have not only used dummy variables but also applied a one-year lag for all independent variables. Moreover, to counter the issue of estimation technique selection bias and ensure that our estimates are not sensitive to the use of a single estimation technique we have used different estimation techniques such as Zero-Inflated Negative Binomial (ZINB), Fixed Effects Poisson, Negative Binomial, Zero-Inflated Poisson (ZIP) with Probit Option, and Fixed Effects OLS (using Ln (1+invention Citation)) in our robustness test analysis.

Results

Descriptive statistics and correlation analysis. Table 1 presents the descriptive statistics for all the variables included in this study. Table 1 shows that the average number of invention patent citations in our sample of Chinese family firms is 27.42. This means that, on average, each firm received 27.42 citations for their invention patents. The mean value for our independent variable, p*rivatized family firms (PFFs)*, is 0.258, indicating that 25.8% of the family firms have transitioned from state-owned enterprises (SOEs), while the remaining 74.2% are De novo family firms.

Table 2 presents the Pearson correlation analysis among the variables in our study. Table 2 shows that PFFs have a negative and significant correlation with invention patent citations (−0.236), providing preliminary support for Hypothesis 1. The correlation analysis reveals that the correlation coefficients are well below 0.8, indicating the absence of multicollinearity. Additionally, we estimated the Variance Inflation Factors (VIFs).

Table 2 Correlation analysis.

Variables	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Corporate Innovation	–	1.000											
(2) Privatized Family Firms	1.970	−0.236*	1.000										
(3) Firm size	1.663	0.187*	−0.005	1.000									
(4) Firm age	1.957	−0.152*	0.623*	0.295*	1.000								
(5) Tangibility	1.473	0.061*	−0.044*	−0.054*	−0.026*	1.000							
(6) Institutional ownership	1.218	−0.048*	0.246*	0.171*	0.152*	0.054*	1.000						
(7) Board size	1.060	0.039*	0.073*	0.127*	0.085*	0.020*	0.065*	1.000					
(8) Growth	1.101	0.110*	−0.102*	0.095*	−0.154*	−0.049*	−0.001	−0.022*	1.000				
(9) R&D intensity	1.977	−0.147*	−0.190*	0.122*	−0.055*	−0.063*	−0.133*	−0.049*	−0.037*	1.000			
(10) Leverage	1.694	−0.066*	0.266*	0.348*	0.333*	0.037*	0.165*	0.080*	0.008	−0.089*	1.000		
(11) Profitability	1.391	0.087*	−0.138*	0.070*	−0.191*	−0.159*	0.020*	−0.049*	0.277*	0.055*	−0.410*	1.000	
(12) Market competition	4.831	−0.098*	−0.013	0.052*	−0.006	−0.021*	0.052*	−0.005	−0.029*	−0.012	0.075*	−0.093*	1.000

This table presents Spearman Pearson based on a sample size of 19,408 observations. All variables are defined in Appendix I.
* denotes significance at the 5% level.

Table 3 The effects of privatized family firms on corporate innovation.

Variables	(Model 1)	(Model 2)	(Model 3)	(Model 4)
Privatized Family Firms (Dummy)	−0.054*** (0.003)	−0.166*** (0.003)		
Privatized Family Firms (Continuous)			−0.002*** (<0.001)	−0.001*** (<0.001)
Firm size		0.661*** (0.001)		0.676*** (0.001)
Firm age		−0.017*** (0.002)		−0.061*** (0.001)
Tangibility		−0.783*** (0.010)		−0.756*** (0.010)
Institutional ownership		−0.002*** (0.001)		−0.002*** (0.001)
Board size		−0.069*** (0.004)		−0.082*** (0.004)
Growth		0.001*** (0.000)		0.001*** (0.000)
R&D intensity		2.622*** (0.028)		2.559*** (0.028)
Leverage		−0.170*** (0.007)		−0.210*** (0.007)
Profitability		0.240*** (0.003)		0.240*** (0.003)
Market competition		0.515*** (0.014)		0.510*** (0.014)
Inflate _cons	−0.757*** (0.016)	−0.863*** (0.016)	−0.757*** (0.016)	−0.863*** (0.016)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	19,408	19,408	19,408	19,408
Adj. R2	0.220	0.419	0.221	0.417

This table presents the results of estimating the effects of privatized family firms and control variables on corporate innovation using a Ziro-inflated Poisson regression estimation technique. Here, privatized family firms refer to those firms which privatized from SOEs and later owned and controlled by families. To measure privatized family firms, this research employs two proxies: one is a dummy variable, and the other is a continuous variable. Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. Privatized Family Firms (Continuous) is a continuous variable that measures the extent of privatized family firms by the ratio of ultimate control rights (voting rights) held by family members after the firm was privatized from state-owned ownership. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

The mean and maximum VIF values are 4.56 and 4.883, respectively, which are well below the commonly accepted cut-off level of 10. For reference and additional details, please refer to Appendix VI. Therefore, the findings suggest that multicollinearity is not a significant concern in this study.

Main findings. Table 3 displays the main regression results. Model 1 serves as the baseline model and only incorporates the *privatized family firms (PFFs)*, industry, and year-fixed effects in a Zero-inflated Poisson regression framework. The coefficient of PFFs is negative and statistically significant ($\beta = -0.054$, $\rho < 1\%$) at the significance level of one percent, initially supporting our main Hypothesis 1. We added all the control variables in Model 2. The coefficient of PFFs is still negative and statistically significant ($\beta = -0.166$, $\rho < 1\%$) at the significance level of one percent. Thus our main hypothesis H1 is supported indicating that PFFs have a negative impact on corporate innovation. Our findings are also economically significant, showing that one standard deviation increase in PFFs deteriorates corporate innovation by 10.39% ($0.166 \times 27.426/0.438$).

In Models 1 and 2 of Table 3, we measured PFFs as a dummy variable. In contrast, Models 3 and 4 of Table 3 use an alternative, continuous measurement for PFFs. Model 3 serves as the baseline model and only includes the PFFs, industry, and year-fixed effects in a Zero-inflated Poisson regression. The coefficient of PFFs is negative and statistically significant ($\beta = -0.054$, $\rho < 1\%$) at the significance level of one percent. In Model 2, we added all the control variables, and the coefficient for PFFs remains negative and statistically significant ($\beta = -0.002$, $\rho < 1\%$).

Thus the use of an alternative measure for PFFs validates our main findings, indicating that *privatized family firms* have a negative impact on corporate innovation. The results obtained in Models 3 and 4 of Table 3 confirm the validity of our findings and demonstrate that they are not sensitive to the use of an alternative measure for *PFFs*. Once again the findings are also economically significant, showing that one standard deviation increase in *PFFs* deteriorates corporate innovation by 4.97% ($0.001 \times 21.780/0.438$).

Robustness checks

Alternative measures. Most often, corporate ownership is assessed based on cash-flow rights, while control is evaluated through voting rights. In a given firm, ownership rights and control rights may vary because firms may have the ability to issue multiple classes of stocks, each offering distinct voting rights relative to their cash-flow rights. Ownership and control rights can also vary due to the presence of pyramiding structures and holdings through various control chains. Therefore following Faccio and Lang (2002) we use cash-flow rights to demonstrate that our results are robust regardless of using cash-flow rights as an alternative measure for ownership rights (Claessens et al. 2002; Liang et al. 2012). The results in Table 4 demonstrate that our findings remain consistent even when using alternative measures for ownership, such as cash-flow rights instead of controlling rights for family ownership. Thus, our hypothesis remains supported.

Second, the main analysis presented in Table 3 uses forward invention patent citation counts to measure the dependent variable. This time we use a different measure for assessing innovation such as the counts of invention patent applications filed in a particular year (He and Tian 2013; Zhong 2018) and re-run the previous models. The findings presented in Models 1 and 2 of Table 5 are essentially the same, suggesting that the results withstand using alternative measures for the dependent variable. Thus, our hypothesis remains supported. Additionally, to validate our results presented in Table 3 and Models 1 and 2 of Table 5, we use a third proxy for corporate innovation. This time, we replace forward citation counts of invention patents with the forward patent numbers of all three types of patents. We added all three types of patent applications in a given year such as invention patents, utility patents, and design models for corporate innovation (invention+utility+design), and re-ran our previous model. The findings can be found in Models 3 and 4 of Table 5, demonstrating that results are the same irrespective of using an alternative measure for innovation.

Overall, the results in Table 5 demonstrate that our findings remain consistent even when using alternative measures for corporate innovation, such as counts of invention patent applications and all patent applications (invention + utility + design). Thus, our hypothesis remains supported.

Third, the main analysis presented in Table 3 employs the Zero-inflated Poisson estimation technique. We turn our attention to alternative count data regression models, namely, the zero-inflated negative binomial (ZINB) model, negative binomial regression model (NBREG), ZIP, and Poisson regression

Table 4 The effects of privatized family firms (cash-flow rights) on corporate innovation.

Variables	(Model 1)	(Model 2)	(Model 3)	(Model 4)
Privatized Family Firms (Dummy)	−0.238*** (0.003)	−0.069*** (0.003)		
Privatized Family Firms (Continous)			−0.005*** (<0.001)	−0.003*** (<0.001)
Firm size		1.150*** (0.001)		1.143*** (0.001)
Firm age		−0.353*** (0.001)		−0.381*** (0.001)
Tangibility		−1.073*** (0.009)		−1.066*** (0.009)
Institutional ownership		−0.005*** (0.000)		−0.004*** (0.000)
Board size		−0.124*** (0.004)		−0.148*** (0.004)
Growth		0.002*** (0.000)		0.002*** (0.000)
R&D intensity		3.683*** (0.019)		3.581*** (0.019)
Leverage		−0.160*** (0.006)		−0.180*** (0.006)
Profitability		0.397*** (0.003)		0.395*** (0.003)
Market competition		1.602*** (0.012)		1.605*** (0.012)
Inflate _cons	−0.763*** (0.015)	−1.056*** (0.018)	−0.762*** (0.015)	−1.050*** (0.018)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	20,050	20,050	20,050	20,050
Adj. R2	0.205	0.597	0.206	0.597

This table presents the results of estimating the effects of privatized family firms and control variables on corporate innovation using a Ziro-inflated Poisson regression estimation technique. To measure privatized family firms, this research employs two proxies: one is a dummy variable, and the other is a continuous variable. Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. Privatized Family Firms (Continuous) is a continuous variable that measures the extent of privatized family firms by the ratio of ultimate control rights (voting rights) held by family members after the firm was privatized from state-owned ownership. Standard errors are reported in parentheses. In this table, to show the consistency of results we used the cash-flow rights as an alternative to controlling rights. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 5 The effects of privatized family firms on corporate innovation using an alternative measure for corporate innovation.

Variables	(Model 1) Invention patent applications	(Model 2)	(Model 3) All Patent Applications (Invention+Utility +Design)	(Model 4)
Privatized Family Firms (Dummy)	−0.042*** (0.006)		−0.170*** (0.003)	
Privatized Family Firms (Continuous)		−0.003*** (<0.001)		−0.008*** (<0.001)
Firm size	0.629*** (0.002)	0.980*** (0.002)	0.918*** (0.001)	0.375*** (0.001)
Firm age	−0.043*** (0.003)	−0.240*** (0.002)	−0.188*** (0.001)	−0.003*** (0.000)
Tangibility	−0.567*** (0.017)	−0.943*** (0.016)	−0.954*** (0.010)	−1.354*** (0.010)
Institutional ownership	−0.001*** (0.000)	−0.003*** (0.000)	−0.001*** (0.000)	0.009*** (0.000)
Board size	−0.060*** (0.008)	−0.071*** (0.007)	0.011*** (0.004)	−0.384*** (0.004)
Growth	−0.001** (0.000)	0.003*** (0.000)	−0.001*** (0.000)	−0.001*** (0.000)
R&D intensity	1.445*** (0.020)	1.699*** (0.017)	1.349*** (0.013)	0.706*** (0.014)
Leverage	0.104*** (0.012)	0.052*** (0.011)	0.120*** (0.002)	0.115*** (0.001)
Profitability	0.452*** (0.009)	0.523*** (0.009)	0.339*** (0.005)	0.319*** (0.004)
Market competition	0.182*** (0.027)	1.115*** (0.023)	0.483*** (0.014)	−0.109*** (0.016)
Inflate _cons	−1.258*** (0.018)	−1.431*** (0.020)	−1.770*** (0.022)	−1.522*** (0.019)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	19,408	19,408	19,408	19,408
Adj. R2	0.365	0.608	0.551	0.455

This table presents the results of estimating the effects of privatized family firms and control variables on a couple of alternative measures of corporate innovation using a Ziro-inflated Poisson regression estimation technique. Here, an alternative measure of patent application numbers of all three categories of innovation such as invention patents, utility patents, and design models for corporate innovation (invention + utility + design) has been used. To measure privatized family firms, this research employs two proxies: one is a dummy variable, and the other is a continuous variable. Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. Privatized Family Firms (Continuous) is a continuous variable that measures the extent of privatized family firms by the ratio of ultimate control rights (voting rights) held by family members after the firm was privatized from state-owned ownership. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

model to validate that the results remain robust irrespective of taking an alternative count data regression model. By following Ullah et al. (2022), we also employed a Fixed Effects regression model as an alternative estimation technique to validate the results obtained from the ZIP, which was previously presented in Table 4 of our main analysis. The results presented in Table 6, from Models 1–6, indicate that our previous findings remain consistent regardless of the estimation technique used, whether it be ZINB, NBREG, ZIP, Poisson regression, or Fixed Effects regression. The findings are reported in Table 6. Thus, our hypothesis remains supported.

Fourth, we also addressed the issues associated with the definition of family businesses. The previous studies generally used the different ownership levels held by the families as threshold levels (Cascino et al. 2010; Lodh et al. 2014). To ensure our results are robust, we examined whether they are sensitive to different threshold levels of controlling and cash-flow rights. Following Claessens et al. (2000) and Faccio and Lang (2002), we use an alternative measure for family firms where the ultimate owners hold at least 20 percent controlling rights and follow Achleitner et al. (2012) to take the 50 percent threshold level for controlling rights. The results in Table 7 demonstrate that our findings remain consistent irrespective of using alternative threshold levels for family ownership.

Sample selection bias. To enhance the reliability of our findings, we employed various subsamples to address and mitigate potential sample selection bias. Specifically, we created a new dataset that included only family firms owned by a single controller and re-ran our model. The results, presented in Table 8, demonstrate that our findings remain consistent regardless of the subsample having only those firms controlled by one controller.

Table 6 The effects of privatized family firms on corporate innovation using alternative estimation techniques such as zero-inflated negative binomial (ZINB), fixed effects Poisson, negative Binomial, zero-inflated Poisson (ZIP) with probit option, and fixed effects OLS (using Ln (1+invention citation)).

	(Model 1)	(Model 2)	(Model 3)	(Model 4)	(Model 5)	(Model 6)
Variables	**ZIP**	**ZIP(Probit)**	**ZINB**	**XTNBREG**	**XTPoisson**	**OLS**
Privatized Family Firms	−0.166***	−0.431***	−0.454***	−0.217***	−0.103***	−0.106***
(Dummy)	(0.003)	(0.003)	(0.037)	(0.035)	(0.009)	(0.039)
Firm size	0.661***	0.119***	0.043***	0.344***	0.348***	0.344***
	(0.001)	(0.001)	(0.014)	(0.013)	(0.003)	(0.013)
Firm age	−0.017***	0.093***	0.205***	−0.280***	0.028***	0.113***
	(0.002)	(0.001)	(0.017)	(0.017)	(0.004)	(0.019)
Tangibility	−0.783***	−1.273***	−0.664***	0.217**	−0.419***	0.076
	(0.010)	(0.009)	(0.110)	(0.090)	(0.020)	(0.082)
Institutional ownership	−0.002***	0.006***	0.004***	0.001**	0.000*	−0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
Board size	−0.069***	−0.057***	−0.066	0.024	−0.077***	−0.039
	(0.004)	(0.004)	(0.049)	(0.038)	(0.007)	(0.033)
Growth	0.000***	0.001***	−0.000	0.001	−0.000***	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
R&D intensity	2.622***	3.344***	5.153***	0.963***	−1.695***	−0.125
	(0.028)	(0.023)	(0.421)	(0.285)	(0.063)	(0.227)
Leverage	−0.170***	0.255***	0.396***	−0.300***	−0.428***	0.004***
	(0.007)	(0.001)	(0.035)	(0.054)	(0.012)	(0.001)
Profitability	0.240***	0.369***	0.444***	0.048***	0.159***	0.000
	(0.003)	(0.001)	(0.032)	(0.010)	(0.005)	(0.001)
Market competition	0.515***	0.783***	0.149	0.019	0.495***	0.037
	−0.863***	−0.508***	−1.429***	(0.105)	(0.016)	(0.078)
Inflate _cons and Constant	(0.016)	(0.010)	(0.036)	−9.362***		−5.965***
	−0.863***	−0.508***	−1.429***	(0.372)		(0.412)
Industry Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes
N	19,408	19,408	19,408	17,429	17,429	19,408
Adj. R2	0.419	0.299	0.039	-	-	0.226

This table presents the results of estimating the effects of privatized family firms and control variables on corporate innovation using different estimation techniques such as Ziro-inflated Poisson, Ziro-inflated Poisson with probit option, Zero-inflated Negative Binomial Model, Fixed Effects Negative Binomial Regression model, Fixed Effects Poisson model, and Fixed Effects OLS model (using Ln (1+invention Citation)). Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Fifth, Family firms in the manufacturing industry constitute more than 60 percent of the listed firms in China (Chen et al. 2024). Therefore, we exclusively examined listed manufacturing firms because previous research has identified them as particularly innovation-intensive firms (Bromiley and Washburn 2011). To achieve this, we limited our sample to family firms operating in the manufacturing industry (identified by the prefix "C" in the industry code, $N = 11{,}386$) and reevaluated the model. The findings presented in Table 9 demonstrate that our findings remain consistent, even if we focus exclusively on family-owned businesses within the manufacturing sector.

Endogeneity concern. The problem of endogeneity may emerge if highly innovative companies opt to privatize into family businesses. We used four different approaches to resolve the potential endogeneity issue. First, we adopted the two-stage least square approach (2SLS) to avoid the issue arising from simultaneity bias. We utilized two different instrumental variables to tackle the endogeneity issue. The first instrumental variable is the time to familization which means the year in which the SEO got privatized and owned by the families as the instrumental variable. Time to familiarization is an exogenous shock and random shock to corporate innovation can not affect the state's decision to privatize or not. Moreover, the time to familization can not influence directly corporate innovation rather it can only affect the firm indirectly through the channel of family ownership. Therefore, our instrumental variable of amilization qualifies both the conditions of relevance and exclusion of the instrumental variables in a 2SLS setting. Our second instrumental variable is a one-year lag of the predictor variable, *privatized family firm*$_{t-1}$, We implemented a two-step approach to address potential endogeneity concerns. The coefficients for both instrumental variables are highly significant, with a p-value of less than 1%. This suggests that these instruments are highly effective in accurately predicting the fitted values of PFFs. Detailed findings for the first stage of the 2SLS analysis can be found in Appendix IV. The outcomes of the second stage of the 2SLS analysis are shown in Model 1 and Model 2 of Table 10. For both instrumental variables—time to familization and the lag of privatized family firms—the coefficients for PFFs remain negative, with values of $\beta = -0.376$ ($\rho < 1\%$) and $\beta = -0.541$ ($\rho < 1\%$), respectively.

Second, we employed propensity score matching (PSM), a widely used approach for dealing with endogeneity concerns (Imbens and Rubin 2015; Boubaker et al. 2016), and tackle sample selection bias that may be present in the nonexperimental data. We used two different techniques such as Gmatch and Psmatch2 to employ the propensity score matching. We began by conducting a probit regression analysis that included all relevant covariates. This allowed us to estimate the likelihood that a firm has undergone a transformation and is now family-owned. Next, we used the predicted probabilities, also known as propensity scores, obtained from the probit regression analysis to match firms that have undergone transformation and are now family-

Table 7 The effects of privatized family firms on corporate innovation.

Variables	(Model 1) Controlling rights 20%	(Model 2) Controlling rights 50%	(Model 3) Cash-flow rights 20%	(Model 4) Cash-flow rights 50%
Privatized Family Firms (Dummy)	−0.145***	−0.374***	−0.307***	−0.371***
	(0.003)	(0.006)	(0.004)	(0.016)
Firm size	1.137***	0.805***	0.285***	0.649***
	(0.001)	(0.002)	(0.001)	(0.004)
Firm age	−0.299***	0.054***	0.030***	0.060***
	(0.001)	(0.003)	(0.001)	(0.004)
Tangibility	−0.934***	0.115***	−1.480***	−0.249***
	(0.009)	(0.017)	(0.010)	(0.028)
Institutional ownership	−0.005***	−0.001***	0.004***	−0.004***
	(0.000)	(0.000)	(0.000)	(0.000)
Board size	−0.011***	−0.037***	0.007*	−0.004
	(0.004)	(0.008)	(0.004)	(0.011)
Growth	0.002***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
R&D intensity	3.823***	4.482***	3.712***	3.074***
	(0.019)	(0.093)	(0.022)	(0.135)
Leverage	−0.043***	−0.143***	0.290***	−0.103***
	(0.007)	(0.013)	(0.001)	(0.020)
Profitability	0.455***	0.759***	0.428***	0.542***
	(0.003)	(0.015)	(0.002)	(0.022)
Market competition	1.603***	0.356***	0.813***	0.428***
	(0.012)	(0.025)	(0.013)	(0.039)
Inflate _cons	−1.081***	−0.950***	−0.964***	−0.969***
	(0.018)	(0.029)	(0.019)	(0.039)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	18,244	6790	15,361	3672
Adj. R2	0.609	0.475	0.394	0.377

This table presents the results of estimating the effects of privatized family firms and control variables on corporate innovation using a Ziro-inflated Poisson regression estimation technique. Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. In this table, we have used alternative threshold levels of 20 percent and 50 percent for both the controlling rights and cash-flow rights. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 8 Subsample analysis: The effects of privatized family firms on corporate innovation using a subsample containing privatized family firms owned by a single controller.

Variables	(Model 1)	(Model 2)	(Model 3)	(Model 4)
Privatized Family Firms (Dummy)	−0.452***	−0.346***		
	(0.003)	(0.003)		
Privatized Family Firms (Continuous)			−0.008***	−0.010***
			(0.000)	(0.000)
Firm size		1.118***		26.893***
		(0.001)		(0.028)
Firm age		−0.273***		−0.444***
		(0.003)		(0.002)
Tangibility		−1.997***		−1.643***
		(0.012)		(0.014)
Institutional ownership		−0.003***		−0.004***
		(0.000)		(0.000)
Board size		−0.151***		−0.152***
		(0.005)		(0.005)
Growth		0.022***		0.017***
		(0.000)		(0.000)
R&D intensity		0.548***		3.683***
		(0.003)		(0.026)
Leverage		0.025***		0.082***
		(0.008)		(0.008)
Profitability		0.468***		0.479***
		(0.003)		(0.003)
Market competition		1.460***		1.959***
		(0.013)		(0.014)
Inflate _cons	−0.692***	−0.957***	−0.711***	−0.992***
	(0.020)	(0.023)	(0.021)	(0.026)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	11,386	11,383	10,416	9127
Adj. R2	0.230	0.650	0.229	0.701

This table presents the results of estimating the effects of privatized family firms and control variables on corporate innovation using a Ziro-inflated Poisson regression model. The results are generated from a subsample containing only those privatized family firms controlled by only one controller. To measure privatized family firms, this research employs two proxies: one is a dummy variable, and the other is a continuous variable. Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. Privatized Family Firms (Continuous) is a continuous variable that measures the extent of privatized family firms by the ratio of ultimate control rights (voting rights) held by family members after the firm was privatized from state-owned ownership. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

owned (the treatment group) with newly established firms (the control group). We re-estimated our main model using our treatment and control sample. After matching 5050 observations through Gmatch and 3081 observations through Psmatch2, the findings displayed in Model 3 and Model 4 of Table 10 show that PFFs still attenuate corporate innovation.

Finally, if the estimation is impacted by heteroskedasticity, the System Generalized Method of Moments (System GMM) is preferable to the 2SLS method. System GMM effectively addresses issues such as heteroskedasticity, autocorrelation, omitted variable bias, measurement error, and reverse causality. The findings from the system GMM analysis are displayed in Model 5 of Table 10. As shown in Model 5, Hanson's J test yields a ρ value of 0.498, which is greater than 0.1. This finding indicates that our instrumental variables are valid. Additionally, the existence of first-order (AR[1]) and second-order (AR[2]) serial correlations provides additional support for the credibility of our results.

Additional analysis: transformed versus De novo family ownership. Although we observed a negative relationship between PFFs and corporate innovation, the question arises: would the results differ for de novo family ownership? In this context, de novo family ownership refers to companies that were founded by families and have been controlled by family members since their inception. De novo *family ownership (original)* is measured based on the initial nature of the establishment. A value of 1 is allocated to those firms that were established by the family members from the first day and 0 is assigned to those firms that operated initially as state-owned enterprises (SOEs) and later transitioned to family ownership and control. Additionally, in line with Claessens et al. (2000) and Faccio and Lang (2002), we used varying levels of controlling rights to measure family ownership. Specifically, we considered scenarios where the ultimate owners hold at least 15 percent, 20 percent, and 50 percent of the controlling rights (Achleitner et al. 2012). The findings in Table 11 provide evidence that de novo (original) family ownership positively affects corporate innovation, which is consistent with the existing research.

Additionally, in the context of De novo family firms, we also addressed the issues associated with controlling rights and cash-

Table 9 Subsample analysis: The effects of privatized family firms on corporate innovation using a subsample containing firms only in the manufacturing industry.

Variables	(Model 1)	(Model 2)	(Model 3)	(Model 4)
Privatized Family Firms (Dummy)	−0.140*** (0.003)	−0.110*** (0.003)		
Privatized Family Firms (Continuous)			−0.008*** (<0.001)	−0.005*** (<0.001)
Firm size		1.174*** (0.001)		1.163*** (0.001)
Firm age		−0.350*** (0.001)		−0.389*** (0.001)
Tangibility		−1.052*** (0.010)		−1.014*** (0.010)
Institutional ownership		−0.005*** (0.000)		−0.003*** (0.000)
Board size		0.019*** (0.004)		−0.006 (0.004)
Growth		−0.002*** (0.000)		−0.003*** (0.000)
R&D intensity		8.609*** (0.038)		8.328*** (0.038)
Leverage		−0.169*** (0.007)		−0.196*** (0.007)
Profitability		0.608*** (0.003)		0.591*** (0.003)
Market competition		0.262*** (0.018)		0.225*** (0.018)
Inflate _cons	−1.163*** (0.020)	−1.482*** (0.024)	−1.166*** (0.020)	−1.475*** (0.024)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	13,995	13,995	13,995	13,995
Adj. R2	0.190	0.636	0.197	0.638

This table presents the results of estimating the effects of privatized family firms and control variables on corporate innovation using a Ziro-inflated Poisson regression model. The results are generated from a subsample containing all the firms from the manufacturing industry. To measure privatized family firms, this research employs two proxies: one is a dummy variable, and the other is a continuous variable. Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. Privatized Family Firms (Continuous) is a continuous variable that measures the extent of privatized family firms by the ratio of ultimate control rights (voting rights) held by family members after the firm was privatized from state-owned ownership. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

flow rights. In a given firm, ownership and control rights may vary because firms may have the ability to issue multiple classes of stocks, each offering distinct voting rights relative to their cash-flow rights. Therefore, following Faccio and Lang (2002) we use cash-flow rights to demonstrate that our results are robust regardless of using the alternative measure for ownership rights. Moreover, following previous studies, we also use different ownership levels held by the families as threshold levels (Cascino et al. 2010; Lodh et al. 2014). To ensure the robustness of the results in Table 11, we investigated whether they are sensitive to varying threshold levels of cash-flow rights. The results in Table 12 demonstrate that our findings remain consistent despite using alternative threshold levels of cash-flow rights for family ownership.

Time trend analysis. According to imprinting theory and the concept of decaying imprints, as privatization advances, the influence of pre-privatization socialist imprints on the innovation levels of family firms is expected to diminish. To verify the temporal trend of pre-privatization socialist imprints on PFFs, this study investigated how the duration since privatization affects the level of innovation in these privatized family firms. To verify the temporal trend of pre-privatization socialist imprints on PFFs we used three alternative measures for corporate innovation. In Model 1 we used invention patent applications, in Model 2 we used invention patent citations and in Model 3 we used all patent applications (invention + utility + design). The results displayed in Table 13 indicate a positive and significant relationship between the duration since the firm was transformed and corporate innovation ($\beta = 0.014$, $\rho < 1\%$, $\beta = 0.023$, $\rho < 1\%$, $\beta = 0.008$, $\rho < 1\%$).

Additional analysis. The previous section presents that the imprints acquired during the pre-privatization era affect the PFFs which ultimately influences corporate innovation. However, all the transformed firms are not the same and the institutional setting also varies throughout mainland China. Given this context, this section investigates the impact of institutional development and political connections on the relationship between PFFs and corporate innovation.

Role of Institutional Development. Institutional development involves the mechanisms by which the market sets prices, promotes private investments, facilitates the movement of goods, allocates resources, and enforces legal regulations (Fan et al. 2011). A strong and effective institutional framework creates a level playing field for every firm, setting clear rules for the game and thereby reducing uncertainties (North 1990).

A well-developed institutional environment enables PFFs to overcome the misfit between their inherited imprints and the current environment. Resource rigidity occurs when a firm is inflexible in reallocating its resources, such as capital, labor, and technology, to new and innovative projects. Resource rigidity can hinder a firm's ability to adapt to changing market conditions or to pursue new opportunities. Institutional development helps to reduce resource rigidity and dependence on state resources, helping PFFs to gradually decay their inherited pre-privatization socialist imprints. Additionally, a progressive institutional environment enables PFFs to develop internal competencies, thereby mitigating the lasting effects of socialist economic imprints inherited from the pre-privatization era. Well-developed institutions offer uniform opportunities for all firms within the economy. Firms that benefit from such robust institutions can enhance their internal capabilities more effectively (Cuervo-Cazurra 2008). Therefore, we examined the role of institutional development in the relationship between PFFs and corporate innovation. The results are presented in Model 3 of Table 14. The coefficient of the interaction term (PFFs × institutional development) is positive ($\beta = 0.107$, $\rho < 1\%$), and significant at a 1 percent level. These results support our argument that institutional development helps in the decaying of the pre-privatization imprint and attenuates the negative association between PFFs and corporate innovation.

Role of political connection. Political connections enable firms to secure government contracts (Goldman et al. 2013), grants (Wu and Liu Cheng 2011; Tsai et al. 2019), bailouts (Faccio 2006), corporate loans at favorable costs (Khwaja and Mian 2005) and advantageous state regulations (Al-Hadi et al. 2016). However, these connections also perpetuate institutional inertia (Buckley et al. 2018; Ramamurti and Hillemann 2018), creating internal mismatches and limiting organizational change (Oliver 1991). Therefore, political connections serve as a double-edged sword, yielding both positive and negative consequences for corporate innovation.

Table 10 Endogeneity issues.

Variables	2SLS LagPFF (Model 1)	2SLS Time of Familiarization (Model 2)	PSM Gmatch (Model 3)	PSM Psmatch2 (Model 4)	Two-Step System GMM (Model 5)
L.Invention patent Citations					0.792***
					(0.001)
Privatized Family Firms	−0.541***	−0.376***	−0.026***	−0.165***	−5.025**
	(0.055)	(0.093)	(0.007)	(0.005)	(2.077)
Firm size	−0.142***	0.495***	0.663***	0.702***	2.190***
	(0.015)	(0.016)	(0.003)	(0.003)	(0.656)
Firm age	−0.028	−0.057**	−0.109***	−0.238***	−1.353
	(0.019)	(0.023)	(0.004)	(0.007)	(1.236)
Tangibility	0.018	0.057	−0.001	−0.327***	23.859
	(0.104)	(0.105)	(0.021)	(0.025)	(19.744)
Institutional ownership	−0.001	−0.001*	−0.003***	−0.000	0.145***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.033)
Board size	0.061	0.050	0.007	−0.110***	31.491***
	(0.044)	(0.045)	(0.010)	(0.011)	(9.279)
Growth	−0.000	−0.000	−0.007***	0.011***	−0.224**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.089)
R&D intensity	0.241	0.242	2.428***	2.351***	−1.177
	(0.169)	(0.169)	(0.065)	(0.088)	(21.661)
Leverage	0.006***	0.006***	−0.449***	−0.921***	−4.729
	(0.001)	(0.001)	(0.015)	(0.018)	(4.347)
Profitability	0.001	0.001	0.170***	0.196***	−0.060
	(0.001)	(0.001)	(0.006)	(0.006)	(0.086)
Market competition	0.065	0.062	−0.250***	0.659***	9.933
	(0.106)	(0.106)	(0.034)	(0.039)	(10.763)
Constant	−9.204***	−9.281***	−0.742***	−0.781***	−108.659***
	(0.452)	(0.455)	(0.030)	(0.041)	(22.218)
Industry Dummy	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes
N	19,399	19,389	5050	3081	16,243
Adj. R2	0.3552	0.3542	0.370	0.475	-
AR (1)					0.161
AR (2)					0.408
Hansen (ρ *value*)					0.498

this table presents the results regarding the endogeneity issues. Model 1 reports the results of 2SLS using lag values of privatized family firms while Model 2 reports the results of 2SLS using another instrumental variable of Time of Familiarization. Model 3 reports the results of the propensity score matching techniques using the Gmatch approach, while Model 4 also reports the results of the propensity score matching techniques but uses an alternative Psmatch2 technique. Model 5 reports the results of the Two-step system GMM. Privatized Family Firms (Dummy) is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Furthermore, privatized firms have socioeconomic goals due to nourishment in the socialist economic system. Politically connected officials continue to work closely with these firms post-privatization to advance government agendas, thereby perpetuating socialist imprints. These officials, driven by implicit goals for promotions and appraisals, foster strong political connections that prioritize government objectives over corporate innovation (Hou et al. 2017). This results in unwanted interference in capital budgeting, favoring short-term gains over long-term performance and innovation. Consequently, firms are diverted from long-term goals and competitive advantages through innovation, often employing local surplus labor at the expense of funding for innovative projects. Such strong political connections hinder rational resource allocation in the market, further stifling corporate innovation and maintaining pre-privatization socialist economic imprints (Hou et al. 2017). Therefore, we examined the role of political connections in the relationship between PFFs and corporate innovation. The results are presented in Model 4 of Table 14. The coefficient of the interaction term (PFFs × political connection) is negative ($\beta = -0.312$, $\rho < 1\%$), and significant at a 1 percent level. These results support our argument that political connections help in the continuation of the pre-privatization imprint and strengthen the negative association between PFFs and corporate innovation.

Discussion and conclusion

Innovation is vital for competitive advantage and is considered a key factor in ensuring the long-term viability of a business. Due to its global importance, researchers, practitioners, and policy-makers have given significant attention to factors that help to foster corporate innovation. For family firms, innovation holds even greater importance as it is essential for their survival across generations. In recent years, research on innovation within family firms has gained considerable momentum; however, the findings are mixed and contradict each other. The prior literature has made a significant debate on the comparative performance and effectiveness of family and non-family ownership. Literature development regarding family and non-family firms indicates that initially, researchers mainly focused on the heterogeneity between family and non-family firms (Chua et al. 2012), while they assumed homogeneity within the family firms (FF) (De Massis et al. 2014). However, with the increasing focus and maturity of family firm literature, there is a growing awareness regarding heterogeneity within FF (Neubaum et al. 2019). This is why many studies focus on identifying origins and types of variances within family firms. A large proportion of these studies use family participation to emphasize heterogeneity, for instance, family participation in ownership (Clark Muntean, 2016), governance (Scholes and Wilson 2014), management (Diéguez-Soto

Table 11 The effects of de novo (original) family firms on corporate innovation.

Variables	(Model 1) Controlling rights 15%	(Model 2) Controlling rights 15%	(Model 3) Controlling rights 20%	(Model 4) Controlling rights 50%
De novo (original) family Firms	0.211*** (0.003)	0.173*** (0.004)	0.037*** (0.003)	0.350*** (0.006)
Firm size		0.581*** (0.001)	1.160*** (0.001)	0.849*** (0.002)
Firm age		−0.005*** (0.002)	−0.333*** (0.001)	0.039*** (0.003)
Tangibility		−0.609*** (0.011)	−1.419*** (0.009)	−0.106*** (0.016)
Institutional ownership		−0.002*** (0.000)	−0.007*** (0.000)	−0.002*** (0.000)
Board size		−0.047*** (0.005)	−0.058*** (0.004)	−0.111*** (0.007)
Growth		0.000*** (0.000)	0.002*** (0.000)	0.001*** (0.000)
R&D intensity		2.522*** (0.030)	3.756*** (0.019)	5.111*** (0.084)
Leverage		−0.134*** (0.007)	−0.219*** (0.007)	−0.473*** (0.013)
Profitability		0.216*** (0.004)	0.402*** (0.003)	0.584*** (0.013)
Market competition		0.414*** (0.015)	−0.688*** (0.007)	−0.529*** (0.014)
Inflate _cons	−0.778*** (0.016)	−0.839*** (0.016)	−1.045*** (0.018)	−0.919*** (0.028)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	19,408	19,408	18,244	6790
Adj. R2	0.205	0.394	0.557	0.438

This table presents the results of estimating the effects of De novo (original) family firms and control variables on corporate innovation using a Ziro-inflated Poisson regression estimation technique. The De novo family firms are those family firms that are established by the family members from day first. On the contrary, privatized family firms are those family firms that were once owned and controlled by the state but later privatized, owned, and run by the families. In this table, we used different levels of alternative measures of ownership such as cash-flow rights. We show that the De novo (original) family firms have a positive impact on corporate innovation compared to the privatized family firms which have a negative impact on corporate innovation. Standard errors are reported in parentheses. All variables are defined in Appendix I. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

Table 12 The effects of De Novo (original) family firms on corporate innovation.

Variables	(Model 1) Cash-flow rights 15%	(Model 2) Cash-flow rights 15%	(Model 3) Cash-flow rights 20%	(Model 4) Cash-flow rights 50%
De novo (original) family firms	0.238*** (0.003)	0.132*** (0.003)	0.080*** (0.003)	0.414*** (0.015)
Firm size		0.663*** (0.001)	1.191*** (0.001)	0.625*** (0.004)
Firm age		−0.034*** (0.002)	−0.315*** (0.001)	−0.026*** (0.004)
Tangibility		−0.872*** (0.009)	−1.425*** (0.010)	−0.637*** (0.026)
Institutional ownership		−0.002*** (0.000)	−0.007*** (0.000)	−0.004*** (0.000)
Board size		−0.123*** (0.004)	−0.041*** (0.004)	−0.058*** (0.011)
Growth		0.000*** (0.000)	0.002*** (0.000)	0.001*** (0.000)
R&D intensity		2.742*** (0.026)	3.888*** (0.020)	3.319*** (0.123)
Leverage		−0.300*** (0.007)	−0.121*** (0.007)	−0.270*** (0.020)
Profitability		0.161*** (0.004)	0.460*** (0.003)	0.186*** (0.020)
Market competition		−0.743*** (0.008)	−0.718*** (0.008)	−0.468*** (0.020)
Inflate _cons	−0.763*** (0.015)	−0.828*** (0.016)	−1.157*** (0.020)	−0.908*** (0.038)
Industry Dummy	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
N	20,050	20,050	15,361	3672
Adj. R2	0.205	0.365	0.580	0.314

This table presents the results of estimating the effects of De novo (original) family firms and control variables on corporate innovation using a Ziro-inflated Poisson regression estimation technique. The De novo family firms are those family firms that are established by the family members from day first. On the contrary, privatized family firms are those family firms that were once owned and controlled by the state but later privatized, owned, and run by the families. In this table, we show that the De novo (original) family firms have a positive impact on corporate innovation compared to the privatized family firms which have a negative impact on corporate innovation. Standard errors are reported in parentheses. All variables are defined in Appendix I. *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

et al. 2015), and family succession (Barontini and Bozzi 2018). Scholars in this debate stress the need for more research to understand the differences among family firms and identify why some family firms flourish in innovation while others lag behind. This paper identifies a unique source of heterogeneity within family firms, which not only clarifies the reasons behind conflicting findings but also explains why some family firms succeed in innovation while others fail. In this paper, we introduce the concept of the liability of origin imprints—imprints acquired during the socialist regime before privatization that continue to persist within privatized family firms even after the transfer of ownership rights from the state to families. By integrating insights from imprinting theory, family business research, privatization, and property rights theory, we introduce the liability of origin imprints and its implication on corporate innovation in privatized family firms, particularly in the Chinese context. We examined a unique panel dataset consisting of 2955 Chinese family firms listed on the SZSE and SHSE stock exchanges from 2005 to 2021, which were privatized from SOEs and subsequently owned and managed by families. We find that pre-privatization socialist imprints, which primarily emphasize societal well-being, tend to persist in privatized family firms, leading to a lower level of corporate innovation compared to entrepreneurial family firms. Furthermore, our results show that the negative association between privatized family firms and corporate innovation is stronger for firms with strong political connections, but this negative association is weakened by a more favorable institutional environment.

Research contribution. Our research provides several significant theoretical implications. First, the property rights theory provides a reasonable explanation for the motives behind the massive privatization in China. Property rights theory states that to promote firm performance, private ownership is better than public ownership in aligning the interests of principals (shareholders) and agents (managers) due to efficient managerial incentives and high monitoring schemes (Vickers and Yarrow 1988). However, after privation, these firms behave differently in terms of performance, financial constraints, legal obligations, and corruption (D'Souza et al. 2017). Therefore, property rights theory fails to explain the reasons and origins of intra-cohort heterogeneity. In addition, the prior literature overlooked the historical imprints obtained during the pre-privatization socialist economic regime

Table 13 Time trend analysis.

Variables	(Model 1) Invention Patent Applications	(Model 2) Invention Patent Citations	(Model 3) All Patent Applications
Privatized Family Firms Time_Trends	0.014***	0.023***	0.008***
	(0.001)	(0.001)	(0.001)
Firm size	0.655***	0.674***	0.638***
	(0.005)	(0.003)	(0.003)
Firm age	−0.128***	−0.200***	−0.259***
	(0.013)	(0.007)	(0.008)
Tangibility	0.114***	−0.506***	−0.292***
	(0.042)	(0.020)	(0.022)
Institutional ownership	−0.004***	−0.004***	−0.003***
	(0.000)	(0.000)	(0.000)
Board size	−0.244***	−0.090***	−0.098***
	(0.018)	(0.010)	(0.011)
Growth	0.001**	0.000***	−0.000
	(0.001)	(0.000)	(0.000)
R&D intensity	3.098***	3.177***	2.015***
	(0.090)	(0.089)	(0.060)
Leverage	−0.104***	−0.257***	0.101***
	(0.029)	(0.016)	(0.002)
Profitability	0.478***	0.255***	0.272***
	(0.018)	(0.005)	(0.008)
Market competition	−0.042	−0.837***	−0.028
	(0.076)	(0.021)	(0.023)
Inflate _cons	−0.303***	0.052*	−0.497***
	(0.033)	(0.029)	(0.031)
Industry Dummy	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes
N	4997	4997	4997
Adj. R2	0.436	0.369	0.462

This table presents the results of estimating the effects of the total time since privatization, and control variables on three different corporate innovation proxies using a Ziro-inflated Poisson regression model. The results are generated from a subsample containing only those family firms that get privatized from state-owned enterprises. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

and blindly assumed that the performance could be improved gradually along with the process of privatization.

Furthermore, in these situations, the imprinting theory provides a reasonable explanation in understanding how the privatized family firms suffer from the adverse impact of origin imprints. The imprinting theory assumes that certain traits such as political ideology (Wang et al. 2019), organizational orientation (Marquis and Qiao, 2020), and ownership structure (Pierce and Snyder 2020) are deeply rooted in the history of firms since their establishment and these characteristics can exert a long-lasting influence on those firms (Johnson 2007). Therefore, unlike the prior studies which mainly focus on individual-level imprints and explain how these individual-level imprints such as famine imprints, ideological imprints, and poverty imprints among the o others influence organizational outcomes (Han and Zheng 2016; Hu et al. 2017; Cui et al. 2022; Han et al. 2022; Jebran et al. 2023; Liu et al. 2023b; Chen et al. 2024). Our research examines the imprinting effects at the organizational level, specifically investigating how the origins of private ownership enable pre-privatization imprints to persist within privatized family firms, regardless of the adoption of entrepreneurial characteristics. Our findings indicate that privatized family firms negatively impact corporate innovation, supporting our argument that origin imprints, primarily stemming from the pre-privatization socialist regime, persist long after privatization, even when ownership is transferred to entrepreneurs like family members.

Second, we also contribute theoretically by watching political connections through the lens of imprinting theory. All previous studies emphasized political connections from the perspective of the Resource-Based View (RBV) theory, arguing that these connections provide "ease of access" to resources. However, we show that political connections serve as a means of transformation for the origin imprints, which adversely affects corporate innovation. Our contribution helps in better understanding the concept of imprint decay, a pivotal yet relatively unexplored subject, particularly when viewed through the lens of the institutional environment. Our study indicates a critical perspective, demonstrating that the seeds of decay are embedded within the origin imprints themselves. The imprinting theory highlights the concept of "imprint-environment fit" (Tilcsik 2014) and suggests that organizational imprints can evolve when exposed to a new environment (Marquis and Qiao, 2020). Our study reveals that a firm's imprints may change depending on how well they align with the environment. We found that institutional development helps alleviate inherited origin imprints, thereby enhancing corporate innovation.

Practical implications. This article offers novel insights into the origins of heterogeneity and the presence of a heterogenic group within the cohort of family-owned businesses. Policies and strategies should be developed to enhance corporate innovation, particularly for PFFs (Munari 2003). However, any policy, strategy, or support aimed at improving family ownership will fail if it assumes that family-owned firms are homogeneous entities. Privatized family firms face consistent pressure due to unethical practices during privatization and may reduce the transparency of their financial reports to mitigate these risks (Tang et al. 2017). Such actions will reduce both innovation and innovation inertia. Therefore, practitioners, directors on the board, auditors, and regulatory bodies should carefully monitor the annual reports of these privatized family firms to avoid fraudulent accounting activities.

The unique government official appraisal system in China, which relies on local GDP growth and other related economic factors, compels officials to establish relationships with local firms to achieve their promotion objectives (Hou et al. 2017). These ties result in redundant capital investment and avoidable employment within the firms, which makes the firms deviate from their goals and restrain investments in innovative projects. This situation highlights the importance of reducing political connections and establishing a fair competitive environment. To achieve this, we need to focus on building strong institutions and ensuring that these institutions work effectively with reformed family businesses.

Another factor contributing to heterogeneity among family businesses arises from profit motives. The profit motives of the De novo private businesses are inherently developed, whereas the profit motives of privatized family firms are acquired and influenced by external factors (D'Souza et al. 2017). Therefore, privatized family firms must restructure and revise their strategic objectives, as their previous goals prioritized social welfare over corporate innovation and profit orientation. Adjusting the profit motives would help the privatized family firms to decay the adverse pre-privatization origin imprints and align more closely with the characteristics of De novo family firms which would help in promoting corporate outcomes.

Limitations and future research directions. This research has several limitations that necessitate a deeper understanding and offer opportunities for future investigation. First, our study is the first to introduce the concept of liability of origin imprints by

Table 14 Moderation effects, subsample analysis: the effects of privatized family firms on corporate innovation.

Variables	(Model 1)	(Model 2)	(Model 3)	(Model 4)	(Model 5)
Privatized Family Firms	−0.213***	−0.104***	−0.986***	−0.072***	−0.956***
	(0.003)	(0.004)	(0.017)	(0.004)	(0.017)
Privatized Family Firms × ID			0.108***		0.107***
			(0.002)		(0.002)
Privatized Family Firms × PC				−0.542***	−0.312***
				(0.041)	(0.041)
Institutional development (ID)		0.103***	0.083***	0.102***	0.083***
		(0.001)	(0.001)	(0.001)	(0.001)
Political connections (PC)		−0.773***	−0.786***	−0.712***	−0.751***
		(0.014)	(0.014)	(0.014)	(0.014)
Firm size		1.190***	1.192***	1.190***	1.192***
		(0.001)	(0.001)	(0.001)	(0.001)
Firm age		−0.343***	−0.341***	−0.343***	−0.341***
		(0.002)	(0.002)	(0.002)	(0.002)
Tangibility		−0.897***	−0.895***	−0.893***	−0.893***
		(0.011)	(0.011)	(0.011)	(0.011)
Institutional ownership		−0.004***	−0.004***	−0.004***	−0.004***
		(0.000)	(0.000)	(0.000)	(0.000)
Board size		0.127***	0.097***	0.125***	0.096***
		(0.005)	(0.005)	(0.005)	(0.005)
Growth		−0.019***	−0.022***	−0.019***	−0.022***
		(0.001)	(0.001)	(0.001)	(0.001)
R&D intensity		−2.372***	−1.610*	−2.250**	−1.547*
		(0.916)	(0.931)	(0.914)	(0.929)
Leverage		−0.177***	−0.197***	−0.180***	−0.198***
		(0.008)	(0.008)	(0.008)	(0.008)
Profitability		0.655***	0.683***	0.656***	0.683***
		(0.004)	(0.004)	(0.004)	(0.004)
Market competition		0.228***	0.237***	0.226***	0.236***
		(0.022)	(0.022)	(0.022)	(0.022)
Inflate _cons	−1.573***	−1.638***	−1.647***	−1.639***	−1.647***
	(0.031)	(0.032)	(0.032)	(0.032)	(0.032)
Industry Dummy	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes
N	7387	7387	7387	7387	7387
Adj. R2	0.122	0.619	0.620	0.619	0.620

This table presents the results of estimating the effects of privatized family firms, institutional development, political connection, and control variables on corporate innovation using a Ziro-inflated Poisson regression estimation technique. Because the political connection data has been removed from the CSMAR database and is not available anymore. Therefore we made our analysis on a subsample that consisted of data from 2007 to 2017 from manufacturing firms only. Privatized Family Firms is a binary variable that takes the value of 1 if the firm was privatized from SOE and subsequently owned and controlled by a family; otherwise, it takes the value of 0. Standard errors are reported in parentheses. All variables are defined in Appendix I.
*, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

drawing insight from the imprinting theory. The concept of the origin imprint is still emerging and developing within academic literature. It requires further research to explore both its positive and negative aspects in family firms. Second, it's important to acknowledge that the findings are based on data exclusively from a single country (i.e., China). Though China is recognized as one of the leading transition economies, it's important to recognize that the ownership structure within the country is considerably intricate (Zhou et al. 2017). Therefore, it is crucial to be cautious when trying to apply these findings to other economies. Particularly, there is a need to investigate the concept of origin imprints across different emerging and transitioning economies to understand its impact on a broader scale. Additionally, it is also very important to examine the origin imprints and effects within the family firms in developed economies that have strong institutional frameworks and low political involvement.

Third, large-scale privatization in China was a challenging task, and the literature on this process highlights numerous issues such as favoritism, irregularities, and corruption. After the emergence of legal actions on these issues in China, the families of these privatized family firms often feel insecure about the protection of their property rights and tend to avoid intergenerational succession and long-term orientation. This avoidance impacts their strategies, particularly long-term plans for developing absorptive capacities and long-term investments. Therefore, to better understand the impact of origin imprints on family firms, future studies should explore additional contingency factors, such as the shadow of corruption, absorptive capacities, and the avoidance of intergenerational succession.

Data availability

The datasets generated and/or analyzed during the current study are not publicly available and are hand-collected but are available from the corresponding author upon reasonable request.

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Author contributions

Syed Tauseef Ali: Contributed to data collection, writing, empirical estimation, proofreading, and writing review & editing. Qiang Wu: Contributed to writing, editing, and proofreading. Zahid Sarwar: Contributed to writing, editing, and proofreading. Zhen Yang: Contributed to data collection and empirical estimation. Sadeen Ghafoor: Contributed to writing and writing review & editing.

Competing interests

The authors declare no competing interests.

Ethical approval

This article does not contain any studies with human participants or animals performed by any of the authors. Ethical approval was not required as the study did not involve human participants.

Informed consent

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