The Impact of Government Bailout Policies on Corporate Innovation: Evidence from Listed Companies

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Abstract. In recent years, government bailout policies have become an important tool for stabilizing market participants, and their impact on corporate innovation has become a focal point for both academic research and policy makers. This paper uses data from listed companies between 2014 and 2019 to empirically analyze, via a difference-in-differences (DID) model, the effect of a significant local government bailout policy on corporate innovation. The findings reveal that the bailout policy significantly promotes innovative output, as evidenced by increases in the number of invention patents and utility model patent applications. Robustness checks-including alternative measures of variables, changes in the regression model, adjustments to the sample period, and the use of propensity score matching (PSM)-confirm the validity of this conclusion. Mechanism analysis indicates that the policy works by alleviating firms' financing constraints and reducing agency costs. Furthermore, heterogeneity tests show that the policy effect is more pronounced in companies located in eastern regions and those with strong profitability. This study provides a new perspective on the interaction between government intervention and corporate innovation and offers important insights for optimizing bailout policy design.

Keywords: Government bailout policies, corporate innovation, Agency costs, Financing constraints.

1. Introduction

China's economy is shifting from high-speed growth to high-quality development, with innovation-driven strategies becoming the core support of national strategy. General Secretary Xi Jinping has repeatedly emphasized that "innovation is the primary driving force for development." As the micro-entities responsible for technological breakthroughs and industrial upgrades, companies' R&D intensity and efficiency in converting innovations into practical outcomes directly affect national competitiveness. However, in 2018, a concentrated outbreak of equity pledge risks among private enterprises occurred, with over 68% of Shenzhen Stock Exchange-listed companies facing equity pledge ratios exceeding 50%. This risk event not only threatened the stability of the capital market but also imposed institutional constraints on companies' sustained innovation investments. In this context, local governments intervened in the market by establishing bailout funds and offering credit support with the aim of resolving systemic risks and sustaining the innovative momentum of enterprises. It is noteworthy, however, that the emergency nature of bailout policies may be inherently at odds with the long-cycle characteristics of innovation, making it imperative to empirically examine their actual impact on corporate innovation.

The existing literature on the economic effects of bailout policies has converted into two main viewpoints. Proponents argue that such policies can positively incentivize corporate innovation by alleviating financing constraints and restoring market confidence (Guo Yue, 2018; Wang Ganggang and Xie Fuzhi, 2017). In contrast, critics suggest that government intervention might induce resource misallocation and rent-seeking behaviors, thereby undermining the quality of innovation (An Tongliang, 2009; Mao Qilin and Xu Jiayun, 2015). Recent studies have further expanded the analytical dimensions. For instance, Xie Qiaoxin et al. (2021) found that bailout policies and certain unexpected public events exert similar influences on corporate innovation shifts; Zhang Qing et al. (2020) demonstrated that bailout policies can effectively mitigate equity pledge difficulties for many listed companies; Zhou Zejiang et al. (2022) approached the issue from the perspective of information constraints in corporate innovation, showing that the government can provide relief for intellectual

property protection and thereby enhance innovation activities; while Mao Jie et al. (2022) pointed out that although the policy can increase firm value by curbing the expropriation of interests by controlling shareholders, its effect on innovation remains ambiguous. Most prior studies have focused on short-term financial performance, lacking systematic investigations into the dynamic mechanisms affecting innovation activities. Building on previous research, this paper delves into the causal effects of government bailout policies on corporate innovation behavior and their transmission channels.

Theoretical mechanisms suggest that companies affected by bailout policies may promote innovation through a dual mechanism of alleviating financing constraints and reducing agency costs. Xie Deren et al. (2016) note that equity pledges expose controlling shareholders to the risk of control transfer due to stock price declines, which in turn compels them to take measures to maintain firm value. Thus, policy intervention generates an innovation-promoting effect by easing financing constraints and lowering agency costs. The risk associated with equity pledges motivates controlling shareholders to reduce fund misappropriation (Zheng Guojian et al., 2014). Furthermore, Luo Danglun et al. (2021) confirm that a reduction in tax avoidance among pledged firms indicates that shareholders are more inclined to boost stock prices through compliant operations. These behaviors enhance innovation via two channels: first, by reducing agency costs, firms have increased discretionary resources to invest in R&D (Wang Ganggang and Xie Fuzhi, 2017); second, the stabilization of control reduces financing costs, thereby expanding the scale of debt financing (Guo Feng and Xiong Ruixiang, 2017). Aghion et al. (2005) show that the synergy between improved governance and financing can raise innovation outputs. Consequently, the risk constraint mechanism induced by equity pledges may serve as an accelerator for innovation.

However, bailout policies might also suppress corporate innovation through channels of information manipulation. Wang Xiongyuan et al. (2018) reveal that an increase in tax avoidance among pledged firms can lead to a decline in the quality of financial information, which may mislead the market's assessment of corporate risk. Hao Xiangchao and Liang Qi (2009) argue that reduced information transparency increases financing costs and widens bond issuance spreads. Hall's (2010) cross-national study indicates that the failure rate of innovation projects can be as high as 65%, necessitating continuous and stable funding support; rising financing costs, therefore, may reduce R&D investments (Ju Xiaosheng et al., 2013). Given that corporate innovation is a high-risk, capital-intensive activity, stable and continuous funding is crucial. Hence, if bailout policies lead to resource misallocation, they may ultimately exacerbate financing constraints through diminished transparency, thereby inhibiting innovation.

Theoretically, the impact of bailout policies on corporate innovation is ambiguous and requires empirical clarification. This study uses data from A-share listed companies between 2014 and 2019 and employs a difference-in-differences (DID) model to empirically test the effect of government bailout policies on corporate innovation. The results indicate that these policies have a significant positive impact on corporate innovation investment. This conclusion remains robust after various tests—including adjustments to the sample period, alternative variable measures, modifications in model specifications, and the application of propensity score matching (PSM). Further analysis shows that the policy effects are more pronounced in eastern regions and in companies with high profitability, and that the underlying mechanisms conform to a dual pathway of "alleviating financing constraints" and "reducing agency costs." The study also finds that the marginal effects of bailout policies on innovation efficiency exhibit a nonlinear pattern—marked by a significant short-term promotion effect but a potential long-term decline in innovation efficiency due to resource misallocation—thus providing new empirical evidence for understanding the dynamic effects of these policies.

The contributions of this paper are threefold. First, it expands the research dimensions on the economic consequences of government bailout policies. Existing studies primarily focus on the short-term financial performance of firms—for instance, improvements in profitability (Guo Lin, 2019), stabilization of stock price fluctuations (Li Zhisheng et al., 2019), or enhancement of market value (Mao Jie and Guan Xinghua, 2022). This paper breaks through the traditional financial perspective by systematically examining the impact of bailout policies on corporate innovation—the core driver

of long-term development—and reveals the nonlinear characteristics of policy effects: while bailout policies significantly promote innovation in the short term by alleviating financing constraints, they may lead to a decline in innovation efficiency over the long run due to resource misallocation. This finding fills a gap in the existing literature concerning the dynamic effects of these policies. Second, it deepens the theoretical explanation of the relationship between government bailout policies and innovation. Previous studies have reached conflicting conclusions regarding policy effects: some emphasize the resource supplementation function of bailout policies (Zhou Xiaohua and Wang Shiyi, 2022), arguing that government credit endorsement attracts social capital (Wang Ganggang and Xie Fuzhi, 2017), while others criticize the administrative intervention drawbacks (Li Wenjing and Zheng Mannie, 2016), suggesting that policy arbitrage may crowd out substantive innovation (An Tongliang, 2009). By testing dual mechanisms, this study reveals the contradictory nature of policy effects: on one hand, bailout policies lower financing costs; on the other hand, administrative resource allocation causes R&D investments to deviate from market demand. This conclusion provides new evidence for reconciling the existing theoretical debates. Third, the empirical model constructed in this paper offers a methodological reference for further comprehensive studies on the impact of bailout policies on economic and social development. By adopting a DID model as the baseline regression, the study provides a reliable method for scientifically evaluating the multifaceted effects of bailout policies.

The remainder of this paper is organized as follows: Section II reviews the literature and traces the evolution of relevant institutional frameworks; Section III presents the research hypotheses and design, including data sources, econometric models, variable definitions, and descriptive statistics; Section IV reports the empirical results, including the baseline regression and robustness tests; Section V further analyzes the heterogeneity of the policy effects; and Section VI concludes the paper.

2. Literature Review

2.1. Government Bailout Policies

Between August 2018 and September 2019, in response to the systemic financial risks triggered by the concentrated exposure of equity pledge risks among private enterprises, the Chinese government established a multi-level risk mitigation mechanism with coordinated actions between the central and local governments. This bailout system exhibits remarkable policy innovation features in three dimensions. First, at the governance structure level, a "central-local division of labor and cooperation" paradigm was formed. Local governments assumed the main execution role by establishing bailout funds totaling over 500 billion RMB, thereby enabling the cross-regional coordination of risk disposal resources (Zhou Xiaohua & Wang Shiyi, 2022). Second, in terms of policy instruments, the selection is characterized by a structured design dominated by debt-type bailout tools (accounting for 72% of the policy implementation plan), implemented through market-based instruments such as the issuance of specialized bailout bonds and targeted convertible bonds to achieve precise intervention. Third, the operational mechanism innovation is manifested in the construction of a mixed governance paradigm. By guiding commercial banks and insurance institutions to participate in specialized asset management plans, a dual governance logic of "government credit enhancement plus market-based pricing" is formed (Guo Lin, 2019).

In terms of policy instrument types, government bailout policies include multiple forms such as fiscal subsidies, tax incentives, and credit support. Fiscal subsidies alleviate firms' financial pressures by directly injecting liquidity (Tang Qingquan & Luo Danglun, 2007); tax incentives enhance firms' disposable resources by reducing their tax burdens (Liu Qiren et al., 2019); and credit support improves the accessibility of financing, thereby optimizing firms' cash flow structures (Guo Feng & Xiong Ruixiang, 2017). The synergistic effect of these three policy tools constitutes the core pillar of the bailout policy package.

Table 1 presents the implementation timeline of bailout policies across provinces on a quarterly basis. In 2018, 21 provincial-level administrative regions—including Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong,

Hubei, Hunan, Guangdong, Guangxi, Sichuan, Shaanxi, and Ningxia—were the first to implement bailout policies. In 2019, six provinces (including Henan, Chongqing, Heilongjiang, and Xinjiang) followed, while only six provinces (Hainan, Guizhou, Yunnan, Gansu, Qinghai, and Tibet) did not launch any specialized bailout policies. This differentiated timeline across regions provides ideal research setting for later identifying the net effect of bailout policies on corporate innovation using a difference-in-differences (DID) approach.

Table 1. Timeline for the Implementation of Bailout Policies by Province (by Year)

Implementation Year	Provinces Implementing Bailout Policies
2018	Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia Autonomous Region, Liaoning, Jilin, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Hubei, Hunan, Guangdong, Guangxi Zhuang Autonomous Region, Sichuan, Shaanxi, Ningxia Hui Autonomous Region
2019	Henan, Chongqing, Heilongjiang, Xinjiang Uygur Autonomous Region

Note: The table is compiled by the author based on relevant policy documents released by various local governments. For provinces that implemented bailout policies in the same year, they are listed in order according to their administrative division codes.

Regarding the economic consequences of bailout policies, existing literature adopts a multi-dimensional perspective. At the level of financial performance, studies have shown that fiscal subsidies and tax incentives can significantly enhance firms' profitability and solvency, although short-term bailout funds might crowd out firms' self-initiated R&D investments (Shi Yongdong & Wang Tongtong, 2022). From the perspective of financing constraints, bailout policies reduce firms' financing costs by releasing implicit government guarantee signals, thereby indirectly easing the liquidity constraints faced by innovation activities (Li Xiaowei et al., 2024). Concerning innovation efficiency, government-guided funds drive innovation output by improving asset turnover efficiency; however, administrative intervention might also induce risks of resource misallocation (Mao Jie et al., 2022). These studies reveal the complex mechanisms through which bailout policies balance short-term crisis relief with long-term innovation incentives, providing important theoretical support for this paper's exploration of dynamic policy effects.

2.2. Corporate Innovation

Corporate innovation activities are characterized by high risk, high uncertainty, and longtime horizons. Compared to traditional production activities, the intensity of R&D investments and the difficulty of technology commercialization are much higher (Grupp, 1997). Schumpeter's (1942) theory of "creative destruction" suggests that innovation is essentially a dual adventure of technological iteration and market validation, a process accompanied by an extremely high failure rate and an extended commercialization cycle (Hall, 2010). These inherent characteristics render traditional financing systems inadequate; commercial banks impose stringent collateral requirements for R&D loans (Wu Xiaohui & Guo Xiaodong, 2018), and capital markets exhibit systematic biases in valuing unprofitable innovative firms (Brown et al., 2012). At the same time, agency problems—such as managerial myopia and expropriation of resources by major shareholders—further exacerbate the financing difficulties associated with innovation, creating an institutional contradiction between the high-risk nature of innovation and the low-risk preference of available financing (Manso, 2011).

Financing support plays an irreplaceable role in empowering corporate innovation. Research by Aghion et al. (2012) shows that bank credit, by alleviating liquidity constraints, significantly promotes firms' innovation investments, particularly in technology-intensive industries. Venture capital, through a "technology screening-resource synergy-governance intervention" mechanism, enhances the quality of innovation; Chemmanur et al. (2014) found that listed companies receiving venture capital support tend to produce a higher proportion of high-value patents and effectively shorten the patent conversion cycle. Moreover, government subsidies can lower external financing

costs through signal transmission effects. Howell's (2016) cross-national study confirms that subsidy projects with additional R&D audit clauses can generate a significant leverage effect, spur increased R&D investment and improve patent conversion rates. However, the short-term orientation of capital markets often clashes with the long-term nature of corporate innovation, as market incentive mechanisms may cause systematic differences in innovation quality (Li Weining & Zheng Mannie, 2016). Tax policy designs that incorporate a fault-tolerance mechanism help reduce the sunk cost pressures on innovation investments, thereby demonstrating institutional value in promoting sustained R&D (Yu Minggui et al., 2016).

Agency costs represent a core institutional barrier to effective corporate innovation. The agency theory proposed by Jensen and Meckling (1976) reveals that managerial short-sightedness can distort innovation decisions. Li Wenjing et al. (2016) find that in firms with lower managerial shareholdings, the proportion of utility model patents is significantly higher, reflecting a strategic decline in innovation quality. Additionally, the phenomenon of major shareholders shifting innovation resources via related-party transactions is noteworthy; research by Li Zengquan et al. (2005) indicates that firms with higher equity pledge ratios exhibit significant expropriation of innovation resources. Governance failures further exacerbate these agency conflicts.

Regarding the impact of government bailout policies on innovation activities, existing literature presents significant divergences. Guo Lin (2019) finds, based on the SA index, that debt-type bailout policies effectively alleviate firms' financing constraints through liquidity support, though they may also induce policy dependency. In contrast, a comparative analysis by Zhou Xiaohua and Wang Shiyi (2022) shows that equity-type bailout policies, by improving governance structures, significantly enhance corporate innovation quality, with their mechanisms including the suppression of expropriation by major shareholders and the optimization of decision-making processes. Furthermore, multi-case studies by Shi Yongdong et al. (2022) reveal that a combined policy approach of "debt liquidity support plus equity governance optimization" can generate synergistic effects that substantially improve policy efficacy. Despite these advances, there remains considerable debate over the choice of policy tools and the mechanisms of their implementation, indicating a high level of complexity. Hence, there is a need for more empirical analyses that account for industry differences, dynamic effects, and the interplay of institutional environments to design more tailored policy solutions.

Existing studies have deeply explored both government bailout policies and corporate innovation, yielding abundant findings. However, research on the impact of government bailout policies on corporate innovation remains relatively limited and has certain shortcomings. Most studies focus on the impact of bailout policies on short-term financial indicators and market performance, with insufficient attention paid to corporate innovation—a key driver of long-term development. Moreover, many studies rely primarily on theoretical analyses and case studies, while empirical research is relatively scarce. Therefore, this study will conduct empirical analyses to delve into the impact of government bailout policies on corporate innovation, thereby enriching and refining research in this field and providing theoretical and practical guidance for the formulation of scientifically sound bailout policies and for enhancing corporate innovation capabilities.

3. Research Design

3.1. Research Hypothesis

Government bailout policies possess a dual nature—both reallocating resources and transmitting signals—and serve as an important industrial policy tool. Through measures such as fiscal subsidies, tax relief, and credit support, the government directly intervenes in the allocation of innovation inputs (Guo Yue, 2018). At the macro level, government support and similar bailout policies can, overall, promote corporate innovation. For example, Lichtenberg (1988) points out that the government plays a decisive role in the allocation of research resources and also controls the speed and direction of technological progress. Research by Mahmood and Rufin (2005) further indicates that government

support significantly promotes innovation activities among firms in developing countries. In countries where innovative capacity is relatively weak, the government can effectively stimulate innovation by concentrating the allocation of both economic and political resources, thereby raising the national level of innovation.

Corporate innovation activities, however, are beset by severe financing constraints due to their high risk, uncertain returns, long time horizons (Schumpeter, 1942), and high capital intensity. Hall (2002) argues that the risk characteristics of innovation projects make it difficult to secure funding through traditional debt financing, leading to market failures. Ju Xiaosheng et al. (2013) further demonstrate that financing constraints can suppress the sustainability of corporate innovation, forcing firms to cut back on long-term R&D expenditures. Specifically, government-provided fiscal subsidies and tax incentives can directly increase a firm's internal cash flow, reducing its dependence on high-cost external financing.

Moreover, information asymmetry gives rise to agency problems that severely limit innovation efficiency. Controlling shareholders may divert R&D resources through related-party transactions, causing innovation investments to deviate from optimal levels (An Tongliang, 2009). Bailout policies can mitigate agency costs by optimizing corporate governance structures; government subsidies often include dedicated R&D funding clauses, which constrain short-sighted managerial behavior. Xing Hui et al. (2019) found that the proportion of "strategic innovation" in the R&D expenditure of subsidized firms decreases while the proportion of substantive innovation increases; in addition, the additional clauses associated with debt-type bailouts (such as R&D investment performance agreements) link managerial compensation to patent quality, thereby increasing the proportion of invention patents (Li Weijing & Zheng Mannie, 2016). Through the reduction of agency costs, policy interventions enhance the efficiency of innovation resource allocation.

Based on the above mechanisms, the following hypothesis is proposed:

H1: Government bailout policies significantly promote corporate innovation by alleviating financing constraints and reducing agency costs.

3.2. Empirical Design

To examine whether equity pledging by controlling shareholders suppresses corporate innovation, following the approaches of Mao Jie et al. (2022) and Shi Yongdong et al. (2022), we construct the following regression model:

$$Patent_{i,t+1} = \alpha + \beta_1 Zy_i \times SK_{i,t} + \beta_2 SK_{i,t} + \gamma' Control_{i,t} + \sum Year + \sum Firm + \varepsilon_{i,t}$$

Existing literature primarily employs two paradigms to measure corporate innovation activities: input-oriented and output-oriented indicators. Input-oriented measures, such as R&D expenditures and the proportion of R&D personnel, reflect the scale of resources allocated to innovation but have notable limitations: first, R&D spending may be diverted to non-innovation areas (e.g., capitalization of marketing expenses), leading to measurement bias (Griliches, 1990); second, R&D input data often suffer from systematic truncation issues, with approximately 35% of listed companies not disclosing R&D data (Wu Yanbing, 2006). Therefore, following the studies of Tian Xian et al. (2022) and Li Wenjing et al. (2016), this paper selects the natural logarithm of the number of invention and utility model patent applications plus one (Patent) as a proxy variable for corporate innovation.

To control for potential endogeneity bias, this study adopts common methods used in policy effect evaluation (Zhou Mao et al., 2016; Mao Jie et al., 2022) by constructing an interaction term $Zy_i \times SK_i$.

As the core explanatory variable to quantify the intensity of bailout policy implementation at the regional level. Specifically: Baseline Variable $Zy_{i,t}$ represents the average equity pledge ratio of listed companies in each province in the year prior to the implementation of bailout policies. Sk_i indicates whether a province entered the bailout policy execution period in year t; it equals 1 if impacted in 2018 or 2019, and 0 otherwise.

The interaction term implies that the higher the equity pledge ratio of controlling shareholders in listed companies within a province before the implementation of bailout policies, the greater the

liquidity difficulties and control transfer risks posed by equity pledges, leading to stronger bailout efforts by local governments (Li Changqing et al., 2018; Wang Xiongyuan et al., 2018). This paper primarily focuses on the estimated value of the regression coefficient β; a significantly positive estimate would indicate that government bailout policies significantly promote corporate innovation activities, thereby confirming the hypothesis.

A series of control variables are included, such as company size (*Size*), asset-liability ratio (*Lev*), return on total assets (*ROA*), shareholding ratio of the largest shareholder (*Top1*), Tobin's Q value (*TobinQ*), operating income growth rate (*Growth*), proportion of tangible assets (Fixasset), firm age (*Age*), and working capital turnover rate (*WCT*). Year and Firm represent the control for year and individual fixed effects, respectively. To address potential cross-sectional correlation issues, this study clusters standard errors at the company level in all regressions. Detailed definitions are provided in Table 2.

Table 2. Variable Definitions

Variable Symbol	Variable Name	Variable Description
Patent	Corporate Innovation Capability	ln (Number of Invention Patent Applications + Number of Utility Model Patent Applications + 1)
Zy×SK	Intensity of Bailout Policy Implementation	Measured using an interaction term to assess the strength of bailout policy implementation
SK	Implementation of Bailout Policy	Equals 1 if the region has implemented a bailout policy; otherwise, 0
Size	Total Assets	Total assets of the company at the end of the year
Lev	Asset-Liability Ratio	Ratio of total liabilities to total assets
ROA	Return on Assets	Net profit divided by total assets
Top1	Shareholding Ratio of the Largest Shareholder	Number of shares held by the largest shareholder divided by total share capital
TobinQ	Tobin's Q Ratio	(Market value of equity + book value of liabilities) divided by book value of total assets
Growth	Operating Revenue Growth Rate	(Current year's operating revenue - Previous year's operating revenue) divided by previous year's operating revenue
Age	Company Age	Number of years the company has been in existence
WCT	Working Capital Turnover Ratio	Net sales revenue divided by average working capital
Fixasset	Proportion of Tangible Assets	Ratio of tangible assets to total assets

3.3. Data Sources

The data primarily originate from the China Stock Market & Accounting Research (CSMAR) database, Wind database, East Money Information (Choice database), and corporate annual reports. Considering that the phenomenon of stock pledges by listed companies has been prevalent since 2014, and to exclude potential interferences from the COVID-19 pandemic and its multifaceted impacts on the empirical results, this study utilizes annual data from Chinese A-share listed companies spanning 2014 to 2019 as the sample for baseline regression analysis.

To ensure data quality, the following treatments were applied to the sample data prior to empirical analysis: excluding financial industry firms due to their distinct operational models and regulatory environments compared to other industries; removing companies designated as ST or *ST, as their abnormal financial conditions could compromise the accuracy of the research findings; and applying a two-sided 1% winsorization to all continuous variables to mitigate the influence of outliers.

3.4. Descriptive Statistics

Table 3. Descriptive Statistics

VARIABLES	(1)	(2)	(3)	(4)	(5)
	N	mean	sd	min	max
Patent	12907	3.166	1.816	0.000	9.610
Zy×SK	12907	0.790	1.047	0.000	3.190
SK	12907	0.388	0.487	0.000	1.000
Size	12907	22.144	1.213	19.997	26.040
Lev	12907	0.384	0.189	0.057	0.848
ROA	12907	0.047	0.059	-0.214	0.218
Top1	12907	33.958	14.430	8.570	72.110
Fixasset	12907	0.179	0.131	0.002	0.579
TobinQ	12907	2.187	1.367	0.881	8.751
Growth	12907	0.432	1.022	-0.672	7.165
Age	12907	2.906	0.298	2.079	3.497
WCT	12907	5.326	12.291	0.205	96.020

Table 3 shows that *Patent* is 3.166 with a standard deviation of 1.816, indicating significant differences in innovation capabilities among firms; some companies may have patent application volumes far exceeding the mean, while others fall well below it. This distribution characteristic reflects the uneven innovation abilities among the sampled firms. The mean of *Zy×SK* is 0.790 with a relatively large standard deviation of 1.047, suggesting notable differences in the intensity of bailout efforts among firms. *Size* has a mean of 22.14, representing the average firm size, with a standard deviation of 1.213, indicating variability in firm sizes. *ROA* has a mean of 0.0467, measuring average profitability, and a standard deviation of 0.0588, showing differences in firms' profitability. Overall, most variables exhibit large standard deviations, such as *Top1*, *Fixasset*, and *TobinQ*, implying significant disparities among firms in aspects like innovation capability, ownership structure, asset composition, and firm value, reflecting the heterogeneity among the sampled firms.

4. Empirical Results and Analysis

4.1. Analysis of Baseline Regression Results

Table 4. Regression Results

VARIABLES	(1)	(2)
	Patent	*Patent*
Zy×SK	0.242***	0.243***
	(5.747)	(5.761)
SK	0.383***	0.381***
	(3.119)	(3.081)
Size		0.237***
		(5.143)
Lev		-0.202
		(-1.322)
ROA		0.931***
		(3.291)
Top1		0.002
		(0.845)
Fixasset		-0.011
		(-0.047)
TobinQ		0.019
		(1.460)
Growth		-0.014
		(-0.955)
Age		-1.111***
		(-3.030)
WCT		-0.001
		(-0.777)
Constant	2.275**	-0.002
	(2.242)	(-0.001)
Observations	12907	12907
R-squared	0.315	0.322
FirmFE	YES	YES
YearFE	YES	YES

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The same applies hereafter.

Using the number of invention patent applications (Patent) as the dependent variable, regression estimation is conducted based on Equation (1), and the results are presented in Table 4. Column (1) of Table 4 controls only for firm and year fixed effects, without considering other control variables. The regression coefficient of the core explanatory variable, bailout intensity (Zy×SK), is significantly positive. Column (2) offers a more comprehensive analysis by including additional control variables and controlling for both firm and year effects. In this specification, the regression coefficient of bailout intensity remains significantly positive and passes the robustness check. Given that Column (2) accounts more fully for clustered residuals, it is used as the baseline regression result in this paper. The above findings suggest that bailout policies significantly enhance innovation output among listed firms, thus providing support for Research Hypothesis 1. The regression results for control variables are consistent with existing literature.

4.2. Robustness Checks

The baseline regression above may be affected by issues such as differential trends and omitted variables, which could distort the empirical results. Therefore, robustness checks are conducted from

multiple perspectives, including testing for parallel trends, altering the sample, modifying the specification of the core variable, and changing the model.

4.3. Parallel Trends Test

Following the approach of Jacobson et al. (1993), this paper uses an event study method to conduct the parallel trends test. The event date is defined as the time when a local government first announced a bailout policy (e.g., a certain province implemented the policy in 2018). The event window includes three years before the policy implementation and the period thereafter, capturing both policy expectations and shocks.

Figure 1 shows that the estimated coefficients for the three years prior to policy implementation are not significant, while the coefficients become significantly positive after implementation. This indicates that the impact of the bailout policy on the innovation output of listed firms materializes only after the policy is implemented (horizontal axis k = after). These results confirm that the Difference-in-Differences model used in this paper satisfies the parallel trends assumption.
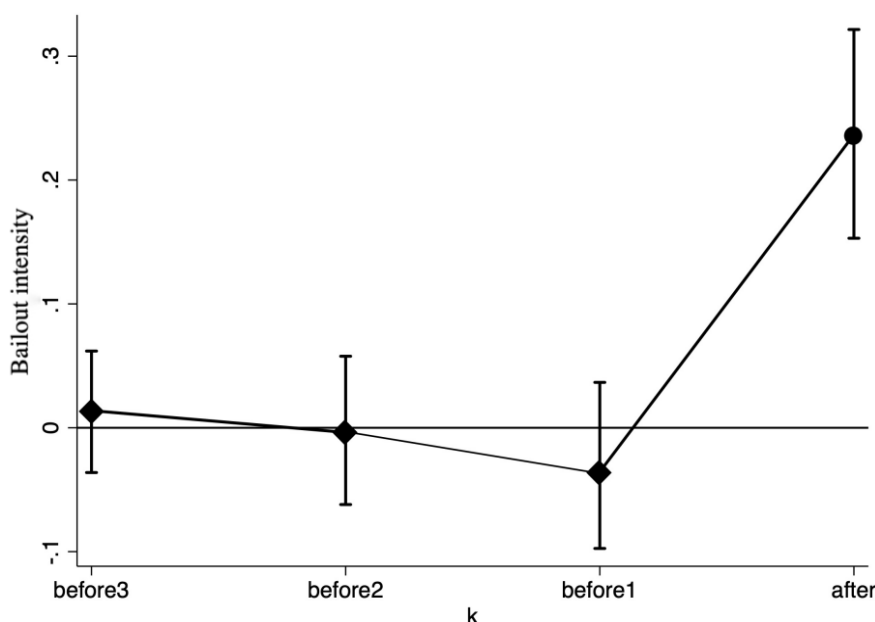

Figure 1. Parallel Trends Test

Note: The horizontal axis "k" represents dummy variables for year intervals, including before3 (three years before bailout policy implementation), before2 (two years before), and before1 (one year before). The vertical axis shows the regression coefficients of the core explanatory variable, bailout intensity.

4.4. Other Robustness Checks

Table 5. Robustness Check

VARIABLES	(1) Patent PSM	(2) Patent Alternative Tobit Model	(3) Patent Alternative Sample Period	(4) Patent Alternative Explanatory Variable
$Zy{\times}SK$	0.243***	0.144***	0.258***	
	(5.761)	(3.546)	(5.941)	
$Robust\_Zy{\times}SK$				0.327***
				(4.389)
SK	0.381***	0.724***	0.358***	0.352**
	(3.081)	(5.606)	(2.841)	(2.358)
Size	0.237***	0.673***	0.047	0.235***
	(5.143)	(28.477)	(0.574)	(5.075)
Lev	-0.202	0.078	0.073	-0.197
	(-1.322)	(0.570)	(0.328)	(-1.298)
ROA	0.931***	2.007***	0.996***	0.986***
	(3.291)	(6.829)	(2.869)	(3.520)
Top1	0.002	-0.001	0.004	0.002
	(0.845)	(-0.619)	(0.915)	(0.856)
Fixasset	-0.011	0.112	-0.328	-0.069
	(-0.047)	(0.601)	(-1.019)	(-0.297)
TobinQ	0.019	0.030*	0.008	0.016
	(1.460)	(1.938)	(0.414)	(1.240)
Growth	-0.014	-0.013	-0.001	-0.014
	(-0.955)	(-0.788)	(-0.031)	(-0.973)
Age	-1.111***	-0.183***	-1.515**	-1.094***
	(-3.030)	(-2.576)	(-2.497)	(-2.963)
WCT	-0.001	0.000	-0.002	-0.001
	(-0.777)	(0.316)	(-1.352)	(-0.777)
Constant	-0.002	-12.908***	4.466*	0.001
	(-0.001)	(-21.696)	(1.859)	(0.000)
Observations	12907	12929	9516	12929
R-squared	0.322	0.174	0.290	0.319
FirmFE	YES	YES	YES	YES
YearFE	YES	YES	YES	YES

(1) Propensity Score Matching (PSM)

To address potential sample selection bias, the propensity score matching (PSM) method is employed to match the treatment and control groups. The treatment variable is defined as whether a firm is subject to bailout policy intervention ($Treat = Zy{\times}SK$), and a Logit model is constructed using nine covariates—such as firm size (*Size*) and leverage (*Lev*)—that reflect firm characteristics, to estimate the propensity scores for entering the treatment group. Column (1) presents the regression results using PSM for robustness testing. The regression coefficient of the core explanatory variable remains significantly positive, indicating that even after correcting for sample selection bias, the positive effect of bailout policy intensity on firm innovation (*Patent*) still holds.

(2) Changing the Regression Model

Given the potential left-censoring characteristic of the dependent variable *Patent* (i.e., some firms report zero innovation output), the original Difference-in-Differences (DID) model is replaced with a Tobit model, which is suitable for truncated data. The core explanatory variable $Zy{\times}SK$ and control variables remain the same, with industry and year fixed effects controlled. Firm-level clustered robust

standard errors are used to re-estimate the parameters with the Tobit model. Column (2) reports the regression results using the Tobit specification, showing that the conclusion that bailout policies promote firm innovation remains robust to model replacement.

(3) Changing the Sample Period

To test whether the conclusions are sensitive to the sample period, the original sample period (2014-2019) is shortened to 2016-2019. In Column (3) of Table 5, the coefficient of the core explanatory variable is 0.258 and is significantly positive at the 1% level. This indicates that the promotion effect of bailout policies on firm innovation persists even within the adjusted time frame, confirming the temporal robustness of the results.

(4) Changing the Explanatory Variable

The robustness of the empirical results is not affected by changes in the specification of the core explanatory variable. In the baseline regression, the intensity of bailout policy is measured using the average equity pledge ratio of controlling shareholders in each province in 2017, which may be influenced by random effects. To address this, the robustness check replaces it with *Robust_Zy×SK*— the average equity pledge ratio in each province in 2018. Column (4) shows the regression results using the revised explanatory variable, and the core regression coefficient remains significantly positive at the 1% level. This indicates that even when the measurement of the explanatory variable is adjusted, the conclusion that bailout policies positively affect firm innovation still holds.

5. Further Analysis

5.1. Mechanism Analysis

The theoretical framework outlined earlier suggests that government bailout policies promote corporate innovation through two main channels: alleviating financing constraints and reducing agency costs. The former involves direct financial support via subsidies or credit access to fill innovation funding gaps. The latter enhances corporate governance to curb short-sighted behavior by controlling shareholders or management.

5.1.1. Financing Constraints

Following the method proposed by Hadlock and Pierce (2010), this study uses the SA index (SAindex) to measure financing constraints. A higher SA index indicates more severe financing constraints (i.e., higher financing costs and greater difficulty in obtaining credit). If bailout policies facilitate innovation by easing financing constraints, we would expect a significant decrease in the SA index following policy implementation.

Column (1) shows that the regression coefficient of the bailout policy on the SA index is -0.003, which is significantly negative at the 10% level. This result is consistent with the findings of Guo Feng and Xiong Ruixiang (2017), who argued that government credit endorsement through bailout policies lowers external financing costs, thereby easing liquidity constraints essential for innovation.

5.1.2. Agency Costs

Building on the theoretical framework of Jensen and Meckling (1976), this study uses the ratio of administrative expenses to operating revenue and funds appropriated by controlling shareholders (other receivables/total assets) as core agency cost indicators. A higher ratio of administrative expenses suggests greater managerial opportunism or on-the-job consumption. Similarly, a higher proportion of funds appropriated by controlling shareholders reflects stronger tendencies for resource expropriation via related-party transactions, indicating more intense agency conflicts.

Table 6 Column (2) shows that the effect of the bailout policy on agency costs is significantly negative at the 1% level. This suggests that the policy, possibly accompanied by governance-enhancing provisions, effectively reduces agency costs. It confirms that the policy curbs "strategic innovation" or resource diversion, steering innovation toward higher quality. This finding is consistent with Anton liang (2009), who concluded that policy-attached governance terms (e.g., R&D

performance contracts, earmarked funds) help optimize incentive alignment, thereby mitigating both types of agency conflicts: between shareholders and management, and between controlling and minority shareholders.

Table 6. Mechanism Analysis

VARIABLES	(1) SAindex	(2) Receiv
Zy×SK	-0.003*	-0.004***
	(-1.898)	(-6.684)
SK	0.007	0.005**
	(1.508)	(1.972)
Size	-0.004	-0.003***
	(-0.662)	(-2.940)
Lev	-0.029***	0.020***
	(-2.734)	(4.792)
ROA	-0.040***	-0.027***
	(-3.892)	(-4.125)
Top1	0.001**	-0.000
	(2.318)	(-0.496)
Fixasset	0.058***	-0.017***
	(4.167)	(-3.405)
TobinQ	0.009***	0.000
	(12.369)	(1.403)
Growth	-0.001	0.000
	(-0.778)	(0.466)
Age	-0.180***	0.008
	(-6.995)	(1.142)
WCT	0.000	-0.000
	(0.989)	(-1.298)
Constant	-3.172***	0.091***
	(-26.447)	(3.159)
Observations	12907	12907
R-squared	0.823	0.043
Numberofstkcd	3033	3033
FirmFE	YES	YES
YearFE	YES	YES

5.2. Heterogeneity Analysis

5.2.1. Regional Differences

Following the methodology of Mao Jie et al. (2022), this study divides the sample based on the registered location of listed companies into eastern and western regions. Table 7 Column (1) of the table represents firms in the eastern region, while Column (2) represents those in the western region.

The results show that in the eastern region, the regression coefficient for bailout intensity is significantly positive, indicating a strong positive impact of the policy on innovation output. In contrast, the coefficient is not significant in the western region, suggesting that the bailout policy has a weaker or negligible effect on the innovation performance of listed companies in less-developed western areas.

These heterogeneity findings carry important policy implications: Bailout policies should be tailored to regional endowments. In regions with a higher degree of marketization and well-developed industrial foundations, policy incentives can be more effectively channeled through market mechanisms to stimulate innovation. However, in regions with weaker institutional environments,

accompanying improvements in financial ecosystems and governance mechanisms are necessary to prevent the dissipation of policy resources.

Table 7. Heterogeneity Analysis (by region)

VARIABLES	(1)	(2)
	Patent	*Patent*
	Eastern Region	Western Region
$Zy \times SK$	0.163***	0.014
	(2.901)	(0.103)
SK	0.130	0.869***
	(0.425)	(2.795)
Size	0.195***	0.510***
	(3.580)	(2.904)
Lev	-0.257	-0.356
	(-1.446)	(-0.785)
ROA	0.915***	0.295
	(2.795)	(0.326)
Top1	0.004	-0.016*
	(1.239)	(-1.795)
Fixasset	0.116	-0.869
	(0.417)	(-1.549)
TobinQ	0.014	0.061
	(0.929)	(1.422)
Growth	-0.039**	0.147***
	(-2.337)	(3.251)
Age	-1.004**	-2.659*
	(-2.451)	(-1.856)
WCT	-0.002	0.001
	(-1.465)	(0.489)
Constant	0.287	1.082
	(0.147)	(0.195)
Observations	9518	1502
R-squared	0.334	0.318
Numberofstkcd	2249	364
FirmFE	YES	YES
YearFE	YES	YES

5.2.2. Profitability of Listed Companies

Drawing on the method of Li Ke and Xu Longbing (2011), this study uses Return on Equity (ROE) to measure the profitability of listed companies. Based on whether a company's ROE prior to the implementation of the bailout policy is above the sample median, firms are divided into high-profitability and low-profitability groups.

The empirical results Table 8 show that the regression coefficient of the explanatory variable in the high-profitability group is 0.189, while in the low-profitability group it is 0.325. This indicates that bailout policies have a more pronounced effect on enhancing innovation output in companies with lower profitability—firms that may have greater potential for development.

These findings imply that bailout policies are more effective when targeted at underperforming yet promising firms, suggesting a need for more nuanced policy design based on firm-level characteristics.

Table 8. Heterogeneity Analysis (by Profitability)

VARIABLES	(1)	(2)
	Patent	*Patent*
	High Profitability	Low Profitability
Zy×SK	0.189***	0.325***
	(3.012)	(5.166)
SK	0.392**	0.166
	(2.042)	(0.926)
Size	0.201***	0.294***
	(2.705)	(4.128)
Lev	0.117	-0.507**
	(0.472)	(-2.174)
ROA	1.735***	0.643
	(3.077)	(1.540)
Top1	0.004	0.003
	(0.794)	(0.639)
Fixasset	0.532	-0.355
	(1.623)	(-1.027)
TobinQ	0.009	0.016
	(0.485)	(0.728)
Growth	-0.021	0.002
	(-0.909)	(0.123)
Age	-1.145**	-0.718
	(-2.190)	(-1.223)
WCT	-0.002	0.001
	(-1.224)	(0.442)
Constant	2.891	-3.768
	(1.292)	(-1.604)
Observations	6542	6365
R-squared	0.336	0.306
Numberofstkcd	2253	2018
FirmFE	YES	YES
YearFE	YES	YES

6. Summary

Against the backdrop of a profound global economic transformation and China's structural transition toward high-quality development, resolving the financing bottleneck for corporate innovation has become a critical challenge. This study focuses on the impact and mechanism of local government bailout policies on corporate innovation. Based on panel data of A-share listed companies from 2014 to 2019, we conduct an empirical analysis using a multi-period difference-in-differences (DID) model. The main findings are as follows:

First, bailout policies significantly enhance corporate innovation output. This effect remains robust after a series of tests, including propensity score matching (PSM), Tobit model substitution, and sample period adjustments.

Second, the policy effects exhibit notable heterogeneity. Firms located in eastern regions show a stronger innovation response, and companies with higher profitability demonstrate greater sensitivity to bailout interventions.

Third, mechanism tests reveal a dual-channel transmission logic: bailout policies stimulate innovation by both alleviating financing constraints and reducing agency costs. These two mechanisms constitute the core pathways through which the policy exerts its effect.

Fourth, caution must be exercised regarding potential resource misallocation. In regions with a lower degree of marketization, some bailout funds may flow into inefficient firms, undermining R&D investments in strategic emerging industries and potentially offsetting the intended policy benefits.

This study offers a fresh perspective on the interplay between government intervention and corporate innovation and provides valuable insights for refining the design of bailout policies.

From a policy-making standpoint, the government should continue to strengthen support for enterprise innovation, particularly by intensifying policy implementation in the eastern regions and among high-profitability firms. At the same time, to ensure maximum policy effectiveness, precise targeting of bailout funds is crucial to prevent misallocation of resources. Furthermore, the government should enhance guidance and incentives for corporate innovation by optimizing the innovation ecosystem and improving the innovation service infrastructure, thereby further boosting firms' innovation capabilities and market competitiveness.

These policy recommendations are of great significance for advancing China's high-quality economic development and achieving the goals of an innovation-driven development strategy. Future research could further explore the long-term effects of bailout policies on innovation quality, as well as the optimization of policy transmission mechanisms in the context of digital transformation.

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