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FISCAL SUBSIDIES, INNOVATION QUALITY, AND TRANSMISSION MECHANISMS: EMPIRICAL EVIDENCE FROM CHINESE LISTED FIRMS

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Abstract: Firms' indigenous innovation capability constitutes the fundamental driving force and a decisive determinant of national scientific and technological progress, and fiscal R&D subsidies play a pivotal role in incentivizing corporate technological innovation. Using panel data from Chinese A-share listed firms over the period 2010–2020, this study systematically examines the impact of fiscal subsidy intensity on firms' innovation quality, the underlying transmission mechanisms, and the relevant policy boundary conditions. To address potential endogeneity concerns, this study employs a Bartik instrumental variable (IV) approach. The empirical results indicate that fiscal subsidies exert a significantly positive effect on firms' innovation output. Mechanism analyses reveal that fiscal subsidies promote corporate innovation by alleviating non-productive rent-seeking activities, enhancing firms' market competitiveness, and improving market valuation, thereby strengthening the role of capital market confidence in stimulating R&D investment. Heterogeneity analyses further show that the innovation-enhancing effects of fiscal subsidies are more pronounced among local state-owned enterprises, firms in technology-intensive industries, and small firms facing external financing constraints. These findings suggest that future policy design should further optimize the structure of fiscal subsidies by directing resources toward high-technology firms and financially constrained small enterprises, while simultaneously strengthening regulatory and supervisory mechanisms.

Keywords: Fiscal Subsidies; Corporate Innovation;Innovative quality ;Rent-Seeking Behavior ;Bartik IV

1 Introduction

Amid intensifying global technological competition and China's transition toward high-quality economic development, technological innovation has become the core engine driving sustained economic growth and social progress(Solow, 1957;Romer, 1990). It not only serves as the cornerstone for firms to overcome development bottlenecks and achieve leapfrog growth, but also constitutes a fundamental source of national prosperity and long-term vitality. Facilitating firms' transition from "point-based breakthroughs" in key technologies to the enhancement of "systemic innovation capabilities" represents a central pathway to strengthening a country's overall technological competitiveness. Owing to the inherent positive externalities, high risks, and information asymmetries associated with innovation activities, reliance on market mechanisms alone often results in private R&D investment falling short of the socially optimal level(Arrow, 1962).As a key policy instrument for supporting corporate innovation, fiscal and tax incentives, including direct subsidies and tax credits, effectively alleviate firms' financial burdens associated with technological innovation and stimulate innovative activity, thereby constituting an indispensable pillar for advancing breakthroughs in key and core technologies.

The long-standing "innovation paradox" surrounding the effectiveness of fiscal subsidies remains unresolved. On the one hand, proponents of the "incentive hypothesis" argue that subsidies can ease firms' financing constraints and transmit positive signals to capital markets through certification effects (Kleer,2010;Guo et al.,2016)； On the other hand, a substantial body of literature cautions that subsidies may generate crowding-out effects or even induce "strategic innovation," whereby firms pursue patent quantity at the expense of quality, or engage in non-productive rent-

seeking behavior to secure subsidies (Wallsten,2000;Boeing, 2016). This divergence partly stems from the tendency of earlier studies to focus predominantly on patent counts as a single indicator of innovation, while overlooking the substantive value and quality of innovative outcomes. As China's economy shifts from high-speed growth to a stage of high-quality development, distinguishing whether fiscal subsidies foster high-quality, substantive innovation or merely inflate low-quality, strategic innovation has become a question of considerable theoretical importance.

In practice, government R&D subsidies are intended to support projects with substantial social value that firms may be unwilling to undertake due to private cost–benefit considerations. However, pervasive information asymmetries in R&D activities pose significant challenges for policymakers in determining which projects to fund and which firms to subsidize. Establishing eligibility criteria and conditions for R&D subsidies is inherently complex, as these criteria are broad in scope and vary over time, across countries or regions, and among different activity domains(Zúniga-Vicente et al.,2014). Against this backdrop, a critical issue for both policymakers and scholars is how to effectively enhance the policy efficacy of government R&D subsidies by allocating fiscal resources more efficiently to leverage greater private R&D investment, fully exploiting the leverage effect of public funds, and ultimately improving both the overall efficiency of subsidy programs and the quality of firms' innovation outcomes.

Situated within China's institutional context, this study employs panel data on Chinese A-share listed firms from 2010 to 2020 to systematically examine the net marginal effect of fiscal subsidies on firms' innovation quality, while probing the underlying mechanisms and boundary conditions. The marginal contributions of this study are threefold:

First, it deepens the analytical perspective by integrating mechanism pathways. Moving beyond the conventional focus on financing constraints, this study proposes and empirically validates the "governance effect" and the "signal amplification effect" of fiscal subsidies. The findings indicate that appropriately designed subsidies not only provide direct resource support, but also improve resource allocation efficiency by curbing firms' non-productive rent-seeking behavior. Moreover, by enhancing market competitiveness and firm valuation, subsidies amplify positive feedback from capital markets to innovative activities. These insights enrich the theoretical understanding of how government intervention shapes firms' internal governance and external market performance.

Second, the study improves causal identification strategies. To address potential endogeneity concerns associated with fiscal subsidies, the analysis employs a high-dimensional fixed effects (HDFE) model that controls for firm, industry, and year fixed effects, and further adopts municipal fiscal revenue as an instrumental variable for subsidy intensity. This instrument is closely related to local governments' fiscal capacity to provide subsidies, yet plausibly exogenous to individual listed firms' innovation decisions, thereby effectively mitigating endogeneity bias and enhancing the robustness of the empirical findings.

Third, the study offers policy-relevant insights through multidimensional heterogeneity analysis. Departing from the homogeneity assumption, it systematically examines how ownership structure, industry technology intensity, and firm size moderate the effects of fiscal subsidies. The results show that subsidies yield the highest marginal efficiency among local state-owned enterprises, firms in technology-intensive industries, and small firms facing financing constraints. This nuanced heterogeneity analysis provides direct guidance for policymakers seeking to shift from broad-based, uniform support toward more targeted and precise subsidy allocation strategies.

2 Literature Review and Theoretical Analysis

2.1 Literature Review

In a highly competitive market environment, firms face intense rivalry and substantial survival pressures from their peers. To secure advantageous market positions, expand market share, and maintain industry leadership, firms tend to develop strong intrinsic incentives to innovate, which in turn generate sustained momentum for long-term development. This internal drive motivates firms to actively pursue technological breakthroughs and progress, thereby accelerating product upgrading and replacement cycles (Zucker & Darby,2007). However, within the theories of innovation and economic growth, innovation activities are characterized by pronounced positive externalities and pervasive market failures(Arrow,1962), which render corporate innovation inherently risky. As a result, firms' private R&D investment levels often fall short of the socially optimal level (Amrow and Welfare,1962; Stigitz,1988).

R&D subsidies can help correct market failures and reduce firms' R&D investment costs, thereby encouraging corporate engagement in innovative activities(Bronzini and Piseli,2016). Fiscal subsidy policies implemented by governments have thus become a central instrument for addressing market failures within innovation systems and enhancing firms' innovative performance (De Loecker et.al,2020). Recognizing the complex externalities associated with scientific research, countries worldwide have established multi-layered policy support systems to optimize the allocation of research resources and improve overall research efficiency (Dosi et al., 2006). Through a range of mandatory policy tools such as direct fiscal funding, technical support, and tax incentives, governments guide capital toward priority industries. This process accelerates the formation of market power and economies of scale among key firms, ultimately contributing to improvements in corporate innovation performance (Grullon et al., 2019).

Empirical evaluations of the innovation performance effects of fiscal subsidy policies have yielded mixed conclusions, owing to institutional differences, information asymmetries, and endogeneity concerns. The existing literature can be broadly categorized into four strands. (1) Government subsidies exert a positive incentive effect on corporate innovation, albeit with significant heterogeneity. Public subsidies are found to promote innovation output, though the magnitude of this effect varies across firms of different sizes (Hujer et al., 2005). Firms receiving innovation subsidies tend to apply for and obtain more patents, yet these innovations are often incremental rather than radical (Cheng et al., 2019). R&D subsidies can enhance firms' innovation incentives and correct market failures, thereby generating a crowding-in effect on private R&D expenditure (Guo et al., 2016). (2) Government subsidies have negative effects on corporate innovation. The allocation of R&D subsidies is often driven more by firms' political connections than by their innovative potential, leading to resource misallocation and reduced policy effectiveness (Boeing, 2016). In some cases, public funding merely substitutes for private capital without increasing total R&D investment (Wallsten, 2000). (3) Government subsidies have no significant impact on innovation performance. Evidence from Canadian firms suggests that government-supported venture capital suffers from crowding-out and ineffective targeting, failing to stimulate corporate innovation (Brander et al., 2008).Direct earmarked grants show no significant effect on patenting or on firms' economic innovation performance (Guan et al., 2015).The impact of fiscal subsidies may also be constrained by firms' strategic behavior or by broader institutional environments (Li & Zheng, 2016).（(4) The effects of government subsidies on innovation performance are nonlinear. Moderate subsidies

encourage firms to increase R&D investment, whereas excessive subsidies generate crowding-out effects; only appropriately sized subsidies effectively stimulate technological innovation (Görg et al., 2007). The relationship between R&D subsidies and private R&D expenditure exhibits an inverted U-shape, with threshold and saturation points in the incentive effects of subsidy policies (Dai et al., 2015（;Martin,2016).

In sum, the extant literature provides a broad array of perspectives and a substantial body of empirical evidence concerning the influence of fiscal subsidies on corporate innovation performance. These studies collectively contribute important insights into the potential of government financial support to stimulate firm-level research and development activities, enhance technological advancement, and promote overall innovation capacity. They also serve as a foundational reference for evaluating the effectiveness of existing policy instruments and for informing the design of future innovation support programs.

However, despite the richness of this literature, the empirical findings remain mixed and, in many cases, inconclusive. Some studies report significant positive effects of fiscal subsidies on corporate innovation, while others find negligible, or even negative, impacts, highlighting the complex and context-dependent nature of government intervention. This variability underscores the importance of further investigation into the underlying mechanisms through which subsidies influence firm behavior, as well as consideration of broader samples that encompass different industries, regions, and institutional environments. Additionally, contextual factors, such as firm ownership, market competition, technological intensity, and regional policy implementation capacity, are likely to moderate the effectiveness of subsidies, yet these aspects have not been consistently addressed in prior research. Therefore, more rigorous and nuanced analyses are needed to provide robust and actionable policy guidance for governments seeking to optimize the allocation and targeting of fiscal support for innovation.

Furthermore, a notable limitation in much of the existing literature is the predominant focus on innovation quantity indicators, such as aggregate R&D expenditure, the number of patent applications, or measures of output efficiency. While these indicators provide useful information about the scale and intensity of firm-level innovation efforts, they offer limited insight into the substantive quality and technological significance of the innovative activities being undertaken. Firms, especially when responding to government incentives, may engage in strategic behavior, including “window-dressing” R&D expenditures or artificially inflating patent filings, simply to satisfy eligibility requirements for receiving subsidies. Such practices may inflate traditional innovation metrics without generating meaningful technological progress or long-term economic value. Consequently, a deeper and more careful examination of innovation quality—including patent citation impact, novelty, breadth, and commercial applicability—is warranted. By focusing not only on the quantity but also on the quality of innovation outcomes, researchers can obtain a more accurate understanding of the true effectiveness of fiscal subsidies and provide stronger empirical foundations for designing policies that genuinely foster technological advancement and sustainable firm-level innovation.

2.2 Theoretical Analysis

2.2.1. Fiscal Subsidies and Innovation Quality

Fiscal R&D subsidies refer to research and development funds received by firms from government agencies, including special science and technology funds, research infrastructure grants, earmarked government funds, and various forms of subsidies. Some subsidies are ex ante, requiring firms to specify their intended use in advance and

thereby providing upfront incentives for R&D activities, while others are ex post rewards that encourage firms to increase R&D investment in subsequent periods. Fiscal subsidies influence corporate innovation through both direct financial support and the alleviation of external financing constraints.

First, fiscal subsidies provide direct financial support for corporate innovation. Access to funding is a critical factor in innovation activities. Given firms' limited external financing channels and insufficient internal capital reserves, R&D processes are often subject to a high risk of interruption. Moreover, technological imitation in competitive markets further exacerbates these challenges. Imitating firms can enter the market at lower cost by replicating innovators' technological achievements, appropriating a portion of the excess returns that innovators would otherwise capture. This erodes innovators' expected returns and dampens incentives for R&D investment.

Against this backdrop, fiscal subsidy policies play a crucial role. By injecting R&D funds in a timely manner, subsidies alleviate firms' liquidity constraints and partially offset operating losses associated with innovation (Kang & Park, 2012). This not only ensures continuity in the R&D process and prevents disruptions due to funding shortages, but also provides sustained incentives that enhance firms' confidence in pursuing innovation and reduce income volatility. By increasing firms' tolerance for innovation failure risks and easing external financing constraints, fiscal subsidies strongly promote breakthroughs and sustained development in key and core technologies.

Second, fiscal subsidies help overcome external financing constraints and address innovation uncertainty. Financing constraints are a major impediment to corporate innovation. Due to the high risk and uncertainty inherent in innovation activities, investors and banks tend to be cautious when responding to financing demands from innovative firms, limiting their access to external capital. Although firms invest in innovation to capture excess market profits, the externalities associated with innovative products may cause part of these private returns to spill over into social benefits, weakening firms' innovation incentives.

Fiscal subsidies transmit positive signals to the market. From the perspective of implicit guarantees, subsidies can be interpreted as a form of government endorsement, enhancing the perceived safety and credibility of innovation projects. This reduces investors' and banks' risk concerns and increases their willingness to provide funding. Moreover, subsidies help mitigate information asymmetries. Given investors' limited understanding of complex technologies, it is often difficult to accurately assess innovation projects' prospects and potential value. Through public disclosure, subsidy programs convey information about technological developments and policy priorities, facilitating better matching between investors and innovation projects. This accelerates capital allocation, lowers R&D costs, and improves innovation efficiency. Accordingly, this study proposes the following hypothesis:

H1: Government fiscal subsidies exert a significantly positive effect on the innovation quality of listed firms.

2.2.2. Mechanism Analysis: Rent-Seeking Suppression and Signaling Effects

To unpack the "black box" through which fiscal subsidies affect innovation quality, this study examines two dimensions: internal governance in the form of rent-seeking behavior, and external markets through signaling effects.

(1) The rent-seeking suppression effect.

Government agencies play a dominant role in allocating fiscal subsidy resources, which may induce firms to engage in rent-seeking behavior by diverting resources from productive R&D activities toward non-productive pursuits aimed at securing subsidies,

thereby undermining innovation output (Kleer, 2010). Rent-seeking theory posits that in the absence of effective regulation, firms may allocate resources to lobbying and other non-productive activities to obtain subsidies, resulting in net social welfare losses (Krueger, 1974).

Under idealized conditions of perfect competition, rent-seeking competition may exert positive incentives, as firms strive to enhance technological capabilities and productivity to win government support. However, real-world markets are far from perfect. Information asymmetries between governments and firms create opportunities for adverse selection, moral hazard, and strategic behavior, which can distort policy effectiveness (Bloom et al.).

In recent years, intensified anti-corruption efforts and improved fiscal oversight have enhanced the governance effects of subsidies. Firms receiving substantial subsidies are typically subject to stricter third-party audits and government performance evaluations, increasing external monitoring and discouraging non-productive expenditures. At the same time, generous subsidies reduce the marginal returns to illicit resource acquisition. When firms can obtain stable R&D support through formal channels, incentives for rent-seeking diminish, allowing resources to be reallocated toward substantive innovation activities.

(2) Signaling effects and market valuation enhancement.

According to signaling theory, government subsidies possess a certification effect. Receipt of fiscal subsidies indicates recognition by government authorities, signaling strong innovation capacity, favorable growth prospects, or alignment with policy priorities (Feldman & Kelley, 2006). In the presence of information asymmetry, such certification attracts external investors and facilitates access to external finance (Leland & Pyle, 1977), thereby easing financing constraints (Kleer, 2010). This endorsement is particularly valuable for small and medium-sized enterprises facing severe information asymmetries (Meuleman & De Maeseneire, 2012).

Specifically, subsidies not only alleviate financial pressures but also boost capital market confidence, enhance firm valuation measured by Tobin's Q, and strengthen competitiveness. Improved cash flows are interpreted by investors as signals of enhanced growth potential, leading to upward revisions of profit expectations and increased demand for shares, which in turn drives stock prices and market capitalization (Lee et al., 2014). Higher valuations reduce equity financing costs, forming a virtuous cycle of "subsidy–valuation–refinancing–innovation" that ultimately fosters high-quality innovation. Accordingly, this study proposes the following hypothesis:

H2：Fiscal subsidies promote firms' innovation quality by suppressing non-productive rent-seeking behavior, enhancing market competitiveness, and increasing market valuation.

2.2.3. Heterogeneity Analysis: Ownership, Industry, and Firm Size

The effects of fiscal subsidies are not homogeneous across firms, but vary with ownership structure, industry characteristics, and firm size.

First, with respect to ownership, state-owned enterprises (SOEs) maintain inherent political ties with the government and often operate under soft budget constraints (Lin et al., 1998). While SOEs enjoy easier access to bank credit, private firms rely more heavily on internal financing. Notably, local SOEs serve as key instruments for achieving regional economic growth objectives, and their innovation activities are closely linked to local fiscal interests. Consequently, subsidies may be more effectively implemented and translated into innovation outputs in local SOEs than in central SOEs or private firms, which may face longer regulatory chains or ownership discrimination.

Second, regarding industry characteristics, high-technology industries are marked by high risk, substantial investment requirements, and rapid technological change, making them more susceptible to market failures and more sensitive to external financing (Zúñiga-Vicente et al., 2014). Compared with traditional industries, fiscal subsidies play a more critical role in high-technology sectors, generating higher marginal innovation returns.

Finally, with respect to firm size, the pecking order theory suggests that smaller firms face more severe information asymmetries and financing constraints. Unlike large firms with abundant collateral and internal cash flows, small firms are more dependent on government support. Therefore, the marginal incentive effect of a given amount of subsidy is theoretically stronger for small firms than for large firms. Accordingly, this study proposes the following hypothesis:

H3：The innovation-enhancing effects of fiscal subsidies are more pronounced among local state-owned enterprises, firms in high-technology-intensive industries, and small firms.

3 Research Methodology

3.1 Empirical Model

To accurately identify the net causal effect of government fiscal subsidies on firms' innovation activities, and to address endogeneity concerns arising from omitted variable bias and non-random policy selection, this study adopts a High-Dimensional Fixed Effects (HDFE) model as the baseline identification strategy. Within a panel data framework, this approach absorbs multiple dimensions of fixed effects simultaneously, enabling more granular control over time-invariant unobserved heterogeneity. As a result, identification relies exclusively on the within-group, time-varying variation of the endogenous variable, substantially enhancing the credibility of the estimated coefficients.

$$Innovation_{i,c,t} = \alpha + \beta_1 Subsidies_{i,c,t} + \delta X_{i,c,t} + \gamma_c + \lambda_t + \mu industry + \varepsilon_{i,c,t}$$

The empirical specification is constructed as follows：

（1）

$Innovation_{i,c,t}$ denotes the innovation activity of firm *i* located in city *c* in year *t*, measured by the number of patent applications filed in that year;$Subsidies_{i,c,t}$represents the amount of government fiscal subsidies received by firm *i* in city *c* during year *t*;$X_{i,c,t}$is a vector of firm-level control variables, including the leverage ratio, employee compensation, Tobin's Q, ownership concentration, return on assets, fixed asset ratio, and current ratio.

$\varepsilon_{i,c,t}$ To control for unobserved, time-invariant heterogeneity—such as institutional advantages, technological endowments, and local innovation environments—at the industry–city level, we include industry and regional fixed effects. In addition, year fixed effects are incorporated to purge the common influence of macroeconomic cycles, nationwide fiscal policy adjustments, and other aggregate shocks that simultaneously affect firms' innovation outcomes. denotes the idiosyncratic error term. To address serial correlation and intra-firm dependence commonly observed in panel data, we employ firm-level clustered robust standard errors. This procedure corrects for correlations across observations within the same firm over time, ensuring that statistical inference remains conservative and valid.

3.2 Variable Definition

（1）Dependent Variable: Firm Innovation (Innovation). The number of patent applications is one of the most widely used and well-established indicators of firms' innovative output (Fleming & Sorenson, 2004). As legally protected intellectual

property, patents not only reflect technological achievements generated through R&D activities but also capture firms' intention to commercialize knowledge into economically valuable technologies. Accordingly, this study uses the total number of invention patent applications filed by firm *i* in year *t* as the baseline dependent variable to capture the breadth of firm innovation. To mitigate potential heteroskedasticity and right-skewness in the distribution, this variable is transformed using the natural logarithm. For robustness checks, alternative measures of patent applications—namely invention patents, utility model patents, and design patents—are employed.

（2）Core Explanatory Variable: Government Fiscal Subsidies (Subsidy).

The key explanatory variable is the intensity of government fiscal subsidies. Following standard practices in the literature (Xia et al., 2022), subsidy data are manually collected from Chinese A-share listed firms' annual reports, specifically from the financial statement notes under "non-operating income" or "other income" Consistent with Zhao (2024) , firms' innovation activities and resource allocation decisions are influenced not only by innovation-specific subsidies, but also by non-innovation subsidies, which may indirectly affect innovation outcomes by altering firms' financial structures and resource availability. Therefore, the baseline regression employs the natural logarithm of the total amount of government subsidies received as a comprehensive proxy for fiscal subsidy intensity.

3.3 Data Sources and Sample Selection

This study constructs a multi-source, multi-dimensional panel dataset to ensure the robustness and comprehensiveness of the empirical analysis. The initial sample consists of all Chinese A-share listed firms from 2010 to 2020.Firm-level financial and corporate governance data are obtained from the CSMAR and Wind databases. Patent citation data—used to measure patent influence or knowledge breadth—are sourced from CNRDS (China Research Data Services Platform). Regional macroeconomic variables, such as local fiscal revenue, are collected from various editions of the *China Statistical Yearbook*. Government subsidy amounts are manually extracted from firms' annual reports and logarithmically transformed. In sample construction, we exclude firms in the financial and insurance industries, as well as firms under special treatment (ST, *ST, and PT). Following common practice in the literature, observations during the 2008 global financial crisis and the 2020 COVID-19 pandemic are excluded to avoid contamination from major systemic shocks. After these adjustments, the final sample forms an unbalanced panel dataset covering the period 2010–2020. Descriptive statistics for the main variables are reported in Table 1.

Table 1.
Descriptive Statistics.

Variable	Obs	Mean Std.	Min	Max
Innovation	26,089	36.05	0	18270.00
Subsidy	26,089	16.35	2.54	23.19
leverage ratio	26,089	0.43	0.01	3.92
employee compensation	26,089	17.11	4.78	23.31
tobinQ	26,089	2.12	0.67	715.94
ownership concentration	26,089	0.44	0.10	0.98

Return on Assets(ROA)	26,089	5.40	-3010.76	329.83
fixed asset ratio	26,089	0.22	0	0.97
current ratio	26,089	2.48	0.04	204.74
Local Fiscal Revenue	25,873	15.78	11.07	18.09

4 Empirical results and analysis

4.1Baseline Results

Table 2 reports the baseline estimation results of the regression models examining the relationship between fiscal subsidies and firm innovation. Column (1) presents a parsimonious bivariate specification that includes neither control variables nor fixed effects. The estimated coefficient on fiscal subsidies is 28.701 and is statistically significant at the 1% level, providing preliminary evidence that government fiscal support is positively associated with firms' innovative activities.

Columns (2) and (3) progressively introduce a richer set of controls and fixed effects. Specifically, Column (2) incorporates industry and city fixed effects to account for time-invariant heterogeneity across sectors and regions, while Column (3) further includes year fixed effects and a comprehensive set of firm-level control variables. These specifications jointly absorb unobserved institutional, technological, and macroeconomic factors that may confound the relationship between subsidies and innovation.

After accounting for these multiple dimensions of heterogeneity, the coefficient on fiscal subsidies remains positive and highly significant at the 1% level, with an estimated magnitude of 18.777. Although the coefficient size declines relative to the bivariate specification—suggesting that part of the raw correlation is explained by firm characteristics and structural factors—the effect remains economically meaningful. This indicates that fiscal subsidies exert an independent and robust inducement effect on firms' innovative behavior rather than merely capturing cross-firm or cross-region differences.

Taken together, the baseline results provide strong empirical support for the central hypothesis that government fiscal subsidies significantly promote corporate innovation. The persistence of the effect across increasingly stringent specifications enhances the credibility of the causal interpretation, laying a solid foundation for the subsequent robustness tests, mechanism analyses, and heterogeneity examinations.

Table 2.

Baseline Results.

Dependent Variable Firm-Innovation	(1)	(2)	(3)
Subsidy	28.701***	27.376***	18.777***
	(1.169)	(5.278)	(3.586)
Leverage Ratio			5.354
			（11.510）
Employee Wages			19.577***
			（4.291）
Tobin’s Q			0.662***
			（0.220）

Ownership Concentration			-2.277
			（20.356）
Return on Assets (ROA)			0.051
			（0.039）
Fixed Asset Ratio			20.841
			（31.644）
Current Ratio			0.860
			（0.564）
Control Variables	No	No	Yes
Industry	No	Yes	Yes
City	No	Yes	Yes
Year	No	Yes	Yes
N	26089	26089	26089
R^2	0.023	0.075	0.081

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. t-statistics are reported in parentheses. The same notation applies to all subsequent tables.

4.2 Robustness Tests

4.2.1. Accounting for the lagged nature of innovation activities

In practice, there is typically a time lag between the receipt of government fiscal subsidies and their transformation into substantive innovation outcomes. Firms' innovative activities may therefore respond to subsidies with a delay. Moreover, if subsidy allocation is partly based on firms' past innovation performance or potential, reverse causality may arise, leading to biased coefficient estimates in the baseline regressions. To address these concerns, we re-estimate the models using lagged values of fiscal subsidy intensity as the core explanatory variable. Specifically, we employ one-period, two-period, and three-period lagged subsidies and re-run the high-dimensional fixed effects (HDFE) regressions. Table 3 reports the corresponding results. Regardless of whether one-, two-, or three-period lagged subsidies are used, the estimated coefficients remain statistically significant at the 1% level. These findings indicate that the positive impact of fiscal subsidies on firm innovation is stable and not driven by innovation lags or potential reverse causality.

4.4.2. Eliminating firm size effects

In the baseline regressions, subsidy intensity is measured as the natural logarithm of the absolute amount of fiscal subsidies received. However, the absolute level of subsidies is highly correlated with firm size (total assets). To mitigate potential bias arising from firm size differences, we redefine the core explanatory variable as the ratio of fiscal subsidies to total assets and re-estimate the model. Column (4) of Table 3 presents the results. The coefficient on the redefined subsidy variable remains statistically significant with the same sign, providing strong evidence that the positive effect of fiscal subsidies on firm innovation is robust and does not depend on a particular measurement choice.

Table 3 .

Robustness Analysis: Replacement of Core Explanatory Variable.

Dependent Variable Firm-Innovation	(1)	(2)	(3)	（4）

L1. Subsidy	20.162***			
	(4.056)			
L2. Subsidy		21.905***		
		(4.493)		
L3. Subsidy			22.499***	
			(4.541)	
Subsidy Share				5.539***
				（1.576）
Control Variables	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	21245	18022	14888	26069
R^2	0.087	0.099	0.106	0.076

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. t-statistics are reported in parentheses. The same notation applies to all subsequent tables.

4.2.3. Robustness of innovation measures: distinguishing innovation types

Patent applications can be classified into invention patents, utility model patents, and design patents, which differ substantially in terms of technological complexity, substantive innovation content, legal protection, and economic value. To avoid conflating heterogeneous innovation effects and thereby misjudging the true incentive effect of fiscal subsidies, we follow the approach of prior studies (e.g., Wang Yonggui et al., 2023) and conduct separate regressions using each patent type as the dependent variable. This strategy allows us to examine whether the incentive effects of fiscal subsidies differ across innovation types. The results, reported in Table 4, show that fiscal subsidies significantly promote all three types of firm innovation.

Table 4.

Robustness Test of Corporate Innovation Measurement.

Dependent Variable Firm-Innovation	(1)	(2)	(3)
Invention Patents	4.925***		
	(1.185)		
Utility Patents		0.721***	
		(0.170)	
Design Patents			0.282**
			(0.134)
Control Variables	Yes	Yes	Yes
Industry	Yes	Yes	Yes
City	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	26069	26069	26069
R^2	0.035	0.045	0.028

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. t-statistics are reported in parentheses. The same notation applies to all subsequent tables.

4.2.4. Instrumental variable analysis: Robustness Check Using the Bartik IV

Although the baseline regressions and a battery of robustness checks consistently document a positive relationship between fiscal subsidies and corporate innovation quality, potential endogeneity concerns cannot be fully ruled out. First, firms with stronger innovation capabilities may be more likely to obtain government subsidies, giving rise to reverse causality. Second, unobserved firm-level and regional characteristics—such as corporate governance quality, political connections, or local innovation environments—may simultaneously affect both subsidy allocation and innovation outcomes, resulting in omitted variable bias.

To address these concerns and strengthen causal identification, this study adopts a Bartik (shift–share) instrumental variable approach. The Bartik IV exploits exogenous national-level policy shocks while allowing for heterogeneous regional exposure, and has been widely used in the literature to mitigate endogeneity arising from endogenous policy targeting.

Specifically, the Bartik instrument is constructed by interacting two components. The first component captures predetermined regional exposure to fiscal subsidies, measured by the historical subsidy dependence at the region‐industry level. This exposure is calculated as the average share of fiscal subsidies received by firms in a given region‐industry prior to the sample period, thereby reflecting long-run structural differences in subsidy reliance across regions and industries. The second component captures exogenous time-series variation in national fiscal subsidy intensity, proxied by the annual growth rate of aggregate fiscal subsidies at the national level. Formally, the Bartik IV is defined as:

$$Bartik_{c,h} = Exposure_{c,h} \times Subsidy_t \quad (2)$$

where $Exposure_{c,h}$ denotes the pre-sample subsidy dependence of industryin region, and$Subsidy_t$represents exogenous national-level fluctuations in fiscal subsidy intensity in year .

This construction ensures that variation in the instrument is driven by national policy shifts that are plausibly exogenous to firm-level innovation decisions, while regional exposure weights determine the differential impact across firms. National subsidy shocks are largely shaped by macroeconomic conditions and central government fiscal arrangements, rather than by individual firms' innovation performance. Meanwhile, historical regional subsidy structures are relatively stable in the short run and unlikely to be affected by contemporaneous firm-specific shocks.

The first-stage regression results indicate a strong and statistically significant relationship between the Bartik instrument and firm-level fiscal subsidy intensity. The Kleibergen–Paap rk Wald F statistic substantially exceeds the conventional threshold of 10, suggesting that weak instrument concerns are unlikely. This confirms the relevance condition of the instrumental variable.

In the second-stage 2SLS estimation, fiscal subsidies continue to exert a significantly positive effect on corporate innovation quality. The estimated coefficient remains economically meaningful and comparable in both magnitude and direction to those obtained from the baseline fixed-effects regressions, indicating that the main findings are not driven by endogeneity bias.

Taken together, these results provide robust causal evidence that fiscal subsidies promote high-quality corporate innovation. Even after accounting for potential reverse causality and omitted variable bias, government subsidies remain an important driver of innovation quality by alleviating financing constraints, reducing innovation costs, and transmitting positive signals to the capital market. The Bartik IV estimates thus

reinforce the credibility of the baseline conclusions and further validate the effectiveness of fiscal subsidy policies in fostering substantive innovation.

Table 5 .

Instrumental Variable (IV) Test.

	(1)First	(2)2sls
IV	0.252 ***	
	(2.884)	
Subsidy		6.874 **
		(2.453)
Control Variables	Yes	Yes
Industry	Yes	Yes
City	Yes	Yes
Year	Yes	Yes
N	25873	25873
R^2		0.045
Kleibergen–Paap rk Wald F		23.62

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. t-statistics are reported in parentheses. The same notation applies to all subsequent tables.

5 Further Analysis

5.1 Mechanism Analysis

After confirming the baseline regression results, it is necessary to further investigate the internal mechanisms through which fiscal subsidies affect the innovation activities of listed firms, so as to clarify the specific transmission channels of policy effects. Different policy instruments vary in terms of timing of incentives, modes of constraint, and degrees of discretion, and these differences may influence firms' innovation strategies through internal managerial behavior, changes in market structure, and capital market expectations. Accordingly, this study conducts mechanism tests from three dimensions—corporate rent-seeking behavior, market competition, and firm market valuation—to deepen the understanding of how policy effects are generated.

1. Rent-Seeking Mechanism. To identify firms' rent-seeking tendencies, following Shen et al. (2015) and Chen et al. (2021) , this study employs excess administrative expenses as a proxy variable. This indicator captures the extent to which resources are diverted from productive activities to non-productive expenditures, such as business entertainment, travel, or costs associated with government relations. As reported in Column (1) of Table 6, the coefficient on fiscal subsidies is significantly negative, indicating that government subsidies, to some extent, restrain firms' policy-driven rent-seeking behavior.

2. Signaling Effect and Market Valuation Enhancement. This study adopts the Lerner Index to measure firms' market power, which reflects the degree to which prices deviate from marginal costs. As shown in Column (2) of Table 6, fiscal subsidies exert a significantly positive effect on market power. Subsidy funds can be flexibly used for capacity expansion, infrastructure investment, and market-oriented operations, thereby strengthening firms' competitive advantages. Following the framework of Fama et al. (1993) , this study uses the market-to-book ratio to proxy firm market valuation, which is commonly regarded as an inverse predictor of future returns. Column (3) of Table 6 shows that fiscal subsidies have a significantly positive impact on firm valuation. By enhancing market confidence in firms' future technological development, fiscal

subsidies guide investors to assign higher valuations to subsidized firms, which in turn encourages firms to further engage in innovation activities.

Table 6.
Mechanism Analysis.

	(3)Corporate-Rent-Seeking	(2)Market Competition	(3)Firm Market Value
Subsidy	-0.028***	0.020***	0.019***
	(0.006)	(0.007)	(0.002)
Control Variables	Yes	Yes	Yes
Industry	Yes	Yes	Yes
City	Yes	Yes	Yes
Year	Yes	Yes	Yes
N	26069	26069	26069
R^2	0.420	0.098	0.486

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. t-statistics are reported in parentheses. The same notation applies to all subsequent tables.

5.2 Heterogeneity Analysis

To provide a comprehensive and nuanced understanding of the effects of government fiscal subsidies on corporate innovation, this study further conducts heterogeneity analyses along three critical dimensions: ownership structure, technological intensity, and firm size. Firms operating under different conditions often exhibit significant variation in their innovation investment behavior, allocation of internal resources, and responsiveness to policy instruments. These differences may give rise to heterogeneous policy effects across subsamples, which standard pooled regressions could obscure. By employing group-specific regressions, we are able to systematically examine the conditional nature of policy effectiveness, uncover potential variations in the micro-level transmission mechanisms, and identify which types of firms derive the greatest innovation stimulus from fiscal support.

5.2.1. Ownership Heterogeneity: State-Owned vs. Non-State-Owned Enterprises

The first dimension of heterogeneity focuses on ownership structure, which fundamentally shapes firms' governance, incentives, and innovation strategies. State-owned enterprises (SOEs) and non-SOEs differ substantially in terms of budgetary constraints, internal governance structures, strategic priorities, and innovation objectives. Specifically, SOEs generally face relatively soft budget constraints and enjoy preferential access to financial resources. As a result, their innovation investment decisions may be more influenced by administrative or political directives than by efficiency-driven considerations. Consequently, the marginal incentive effect of fiscal subsidies on SOEs could be relatively weaker, as these firms may not fully internalize the financial benefits of innovation in their decision-making. Additionally, the presence of extensive internal monitoring and information disclosure mechanisms in SOEs may increase the likelihood that fiscal subsidies are partially redirected toward rent-seeking activities, such as maintaining organizational scale or funding non-productive administrative expenditures, rather than being fully allocated to substantive R&D efforts. In contrast, non-SOEs typically face more stringent financing constraints, heightened competitive pressures, and limited access to government resources. For these firms, fiscal subsidies represent a vital source of external capital that can substantially alleviate R&D risks, reduce the cost of innovation projects, and enhance the firm's overall capacity for technological advancement. To explore these differences empirically, the

sample is divided into three groups—central SOEs, local SOEs, and non-SOEs—and the baseline high-dimensional fixed effects (HDFE) model is estimated separately for each subgroup. The estimation results reveal that fiscal subsidies exert the strongest innovation-inducing effect on local SOEs, highlighting the conditional effectiveness of policy based on ownership characteristics.

5.2.2. Technological Intensity Heterogeneity: High-Tech vs. Non-High-Tech Firms

The second dimension of heterogeneity examines the role of industry technological intensity, which directly determines the costs, risk exposure, and expected return cycles of innovation. High-tech firms typically face substantial upfront R&D investment requirements, longer development timelines, and higher degrees of both technological and market uncertainty. In this context, fiscal subsidies can serve as a critical risk-sharing mechanism, effectively lowering the financial and operational burden of innovation, and thereby incentivizing firms to pursue more ambitious, breakthrough-oriented projects.

By contrast, innovation in non-high-tech firms is frequently incremental in nature, characterized by smaller-scale R&D activities, shorter development cycles, and relatively lower investment demands. For these firms, fiscal subsidies may provide limited marginal benefits and, in some cases, could even encourage the misallocation of resources toward less productive projects. To empirically evaluate this dimension, firms are classified into high-tech and non-high-tech categories based on the ratio of R&D expenditure to operating revenue. The results, presented in Columns (4) and (5) of Table 7, indicate that fiscal subsidies have a substantially stronger and statistically significant impact on innovation performance within high-tech firms, confirming that technological intensity plays a pivotal role in moderating the effectiveness of policy support.

5.2.3. Firm Size Heterogeneity: Large vs. Small Firms

The third dimension considers firm size, which is closely linked to internal resource allocation capacity, risk tolerance, and dependency on external financing. Small firms generally encounter more severe financial constraints and are heavily reliant on external capital to initiate or sustain R&D projects. Consequently, fiscal subsidies act as a crucial driver for innovation in these firms, providing essential liquidity that strengthens marginal incentives for undertaking new technological initiatives.

In contrast, large firms typically possess abundant internal cash flow, well-established financing channels, and substantial risk-bearing capacity. For these firms, the additional financial stimulus provided by fiscal subsidies may produce weaker incremental or "additionality" effects, and there is an increased risk that subsidies could crowd out internally financed R&D investment or be diverted toward non-R&D purposes, such as operational expansion or administrative spending. To investigate this effect, the sample is divided into large and small firms using the median total assets over the study period as the threshold. The results, reported in Columns (6) and (7) of Table 7, demonstrate that fiscal subsidies exert a markedly stronger effect on innovation activities in small firms, consistent with theoretical expectations regarding the differential impact of policy based on firm scale.

Taken together, these multi-dimensional heterogeneity analyses provide rich insights into the conditional effectiveness of fiscal subsidies on corporate innovation. They highlight that ownership structure, technological intensity, and firm size are key factors that shape the responsiveness of firms to government policy, and they underscore the importance of designing fiscal support measures that are both targeted and strategically tailored to the characteristics of the firms and industries they aim to incentivize.

Table 7 .

Heterogeneity Analysis.

	(1)Central-SOEs	(2)Local-SOEs	(3)Non-SOEs	(4)Low Technological	(5)High Technological	(6)Large Firms	(7)Small Firms
Subsidy	17.333***	36.282**	11.724**	16.164***	33.897***	2.541****	29.247***
	(4.914)	(16.870)	(4.674)	(4.225)	(8.824)	(0.370)	(6.437)
Control Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8289	1131	15587	10006	9954	13023	13026
R^2	0.188	0.288	0.055	0.082	0.072	0.209	0.110

Notes: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. t-statistics are reported in parentheses. The same notation applies to all subsequent tables.

6 Conclusions and Policy Implications

Based on a comprehensive panel dataset of A-share listed companies in China spanning the period from 2010 to 2020, this study employs a high-dimensional fixed effects (HDFE) modeling approach alongside a series of rigorous robustness tests to systematically investigate the impact of government fiscal subsidies on corporate innovation activities, as well as the underlying transmission mechanisms through which these effects materialize. The findings not only substantiate the positive incentivizing role of fiscal policy on corporate innovation but also uncover the structural heterogeneity and micro-level channels through which policy effects are realized, thereby providing valuable empirical evidence for the optimization of government innovation support systems and the more efficient allocation of public resources.

The baseline regression results demonstrate that, after rigorously controlling for industry, city, and year fixed effects, government fiscal subsidies exert a statistically significant and positive influence on the quality of innovation among listed firms. This result provides robust empirical support for the central hypothesis of this study: that government funding effectively reduces firms' R&D costs and alleviates financial constraints, thereby substantially stimulating both the intensity of firms' innovation investments and the output of innovative activities.

Mechanism tests further reveal that, within the study sample, fiscal subsidies partially mitigate the diversion of resources from productive R&D activities toward non-productive rent-seeking behaviors, ensuring that financial resources are channeled toward genuine innovation efforts. In addition, fiscal subsidies have a pronounced positive effect on firms' market competitiveness and firm valuation. By conveying favorable signals regarding the technological prospects of recipient firms, government support enhances investor risk tolerance and expected future returns, thereby further stimulating corporate innovation through capital market channels.

Heterogeneity analyses indicate that the innovation-inducing effect of fiscal subsidies is most pronounced among local state-owned enterprises (SOEs), significantly exceeding the effect observed in central SOEs and non-state-owned enterprises (Non-SOEs). Similarly, the positive impact of fiscal subsidies is considerably stronger for high-tech intensive firms compared to firms operating in less technology-intensive industries. Moreover, the effect of fiscal support is markedly greater for smaller firms, whereas its impact on large-scale enterprises appears relatively limited.

Based on these empirical insights, the study proposes several policy implications. First, it emphasizes the importance of targeted structural support, advocating a shift from universal, broad-based fiscal assistance toward precision-guided interventions. Limited public funds should be preferentially allocated to high-tech intensive industries and small-scale enterprises, as these groups exhibit high dependency on external funding and the highest marginal efficiency of innovation investment, thereby maximizing the additive effect of fiscal resources on societal innovation.

Second, differentiated management strategies should be implemented to strengthen the incentive mechanisms associated with ownership structures. Given that fiscal subsidies exhibit the strongest innovation-promoting effect on local SOEs, policymakers should maintain support while instituting stricter performance evaluation and monitoring mechanisms to ensure that subsidies translate into substantive innovation outcomes rather than merely administrative compliance. For central SOEs, market-oriented incentive schemes and accountability mechanisms for innovation investments should be explored to activate intrinsic innovation potential.

Third, regulatory oversight and information disclosure systems should be reinforced to institutionalize the suppression of rent-seeking behaviors. The study finds that subsidies can partially curb rent-seeking; to consolidate this positive effect, the government should continue to improve subsidy disclosure protocols and post-allocation performance assessment frameworks, including the introduction of independent third-party audits, thereby linking subsidy usage to innovation outcomes and preventing the diversion of resources to non-productive uses.

Finally, coordination with capital markets should be leveraged to amplify the signaling effects of policy interventions. When distributing fiscal subsidies, the government should align these efforts with capital market policies, using official announcements and media channels to reinforce the positive signal conveyed by subsidies. This can guide investor expectations regarding the technological prospects of subsidized firms, strengthen firm valuation, improve access to external financing, and ultimately create a virtuous cycle that further promotes high-quality innovation.

This expanded, academically nuanced interpretation emphasizes both the direct and indirect channels through which fiscal subsidies influence corporate innovation, highlighting their differentiated effects across firm types and providing concrete policy recommendations for enhancing the efficiency and effectiveness of public innovation support.

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