Innovations and (Shocks to) Industry-Academia Collaboration

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Abstract

We examine how failures of academic integrity impact industry-university collaborations. Using university paper retractions as a shock to the credibility of upstream scientific knowledge, we show that retractions meaningfully weaken the innovative performance of connected firms. Firms linked to retracting universities experience decreases in both the quantity and quality of subsequent innovation, alongside a deterioration in the effectiveness of transformation of their R&D efforts into successful innovations. Capital markets respond negatively to retraction announcements, indicating that investors view these shocks as impairing firms' innovation prospects. In addition, retractions disrupt ongoing collaborations and sharply reduce the formation of new industry-university partnerships. Overall, our findings reveal that scientific misconduct and related disruptions extend beyond academia: they hinder corporate innovation productivity and reshape firms' strategies for accessing external knowledge. The results highlight scientific integrity as a foundational determinant of the functioning and resilience of collaborative innovation systems.

Keywords: Patents, retractions, innovation, R&D, integrity

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1. Introduction

Collaboration between industry and universities plays a central role in the modern innovation ecosystem. A large literature documents that academic partnerships expand firms' technological opportunity sets, grant access to frontier science, and facilitate translation of scientific advances into commercial technologies (Fabrizio, 2009; Cohen, Nelson, and Walsh, 2002; Branstetter et al., 2015). Firms engaged in such partnerships tend to generate patents of higher quality, greater originality, and stronger citation impact, particularly in science-intensive industries where university research constitutes a critical upstream input (Belderbos, Carree, and Lokshin, 2004). University collaborations also support exploratory R&D, accelerate commercialization, and facilitate the transfer of tacit knowledge and scientific expertise that firms struggle to produce internally (Mansfield, 1995). In this paper we extend the literature on industry-university collaboration by focusing on the vulnerabilities of partnerships between academia and industry.

In particular, we investigate how shocks to academic credibility—specifically, the retraction of scientific publications—affect corporate innovation outcomes and the structure of industry-university collaboration networks. Scientific retractions have become increasingly common in recent decades, frequently resulting from research misconduct, data fabrication, or severe methodological flaws (Fanelli, 2009; Fang, Steen, and Casadevall, 2012).

Retractions impose substantial penalties on the visibility and impact of scientific work: citations decline sharply, knowledge flows contract, and related fields experience persistent slowdowns in follow-on discovery (Furman, Jensen, and Murray, 2012; Lu et al., 2013; Azoulay et al., 2015; Thorp, 2022; Else, 2024). Such events also carry reputational consequences, affecting prior collaborators (Hussinger and Pellens, 2019) and reshaping scientific incentives within institutions. At the university level, misconduct-related retractions depress patenting output and hinder innovation capacity (Li, Wu, and Wang, 2025). These patterns suggest that retractions are not isolated academic corrections, but rather meaningful disruptions to scientific credibility with potentially far-reaching implications.

Despite this growing evidence, little is known about whether these disruptions propagate beyond academia and affect firms that rely on universities for knowledge, talent, and research partnerships. If paper retractions undermine confidence in a partner institution or in a scientific domain, firms may respond by adjusting their external knowledge sourcing, altering their collaboration portfolios, or reallocating effort away from university-linked research. Firms re-optimize collaboration strategies in response to shifts in partner productivity and knowledge spillovers (Cassiman and Veugelers, 2002; Belderbos, Carree, and Lokshin, 2004), suggesting that academic credibility shocks may have significant implications for the trajectory of firms' innovation activities.

Paper retractions can operate through two main channels. First, retractions may diminish the value of firms' current innovative capital by undermining the validity of the scientific foundations of ongoing projects. Because retracted articles experience large and persistent citation collapses, and because patents building on retracted science suffer weakened technological impact (Lu et al., 2013), retractions effectively reduce the reliability of upstream knowledge inputs. Second, retractions can act as forward-looking signals, altering firms' beliefs about the expected productivity of university engagement. If retractions signal lower quality or integrity of university research—either generally or at specific institutions—firms may scale back future collaborations, alter the structure of their collaboration portfolios, or shift toward internal research.

To perform our empirical investigation of the effects of paper retractions on related firms, we construct a dataset that links academic paper retractions, firm-university collaborations, stock returns, and firm innovation outcomes. Information on retracted publications is obtained from the Retraction Watch database (`RetractionWatch.com`) and used to build university-year measures of retraction activity. Firm-university linkages are identified using patent application data from the China National Intellectual Property Administration (CNIPA), based on joint patent filings between firms and universities. These linkages allow us to identify firms that are exposed to university-affiliated paper retractions. The baseline sample consists of all non-financial A-share firms listed in Shanghai and Shenzhen during 2009-2022, excluding firms under Special Treatment (ST) or Particular Treatment (PT). In addition to the firm-year sample of real innovation outcomes, we also construct a firm-day event sample to examine stock market reactions and a firm-university-year sample to study firm-university collaboration dynamics.

We begin by examining how capital markets respond to university paper retractions. For firms that rely on academic institutions for upstream scientific inputs, a retraction represents a negative information shock to the credibility of these inputs: firms linked to retracting universities experience statistically and economically significant negative abnormal returns around retraction announcements. For example, when firms are exposed to more than three retractions announced on the same day, negative abnormal returns over a 7-day window are around 30 basis points on average. The valuation impact is significantly amplified for firms with more intensive prior university collaboration, indicating that the market prices the degree of academic visibility. Overall, these market reactions suggest that investors view retractions as economically meaningful shocks to firms' innovation.

We next examine the real effects of retractions on firms' subsequent innovation output. Following exposure to retractions at partner universities, firms exhibit persistent and economically large declines in future patenting activity. A one-standard-deviation increase in retraction exposure is associated with a 7.6-9.2 percent reduction in total patent output over the subsequent one to three years. The effects are even stronger for patents involving direct university collaboration. For patent co-authored by firms and universities, the corresponding decline ranges from approximately 34 to over 50 percent relative to the sample mean, reflecting high sensitivity of collaborative innovation to academic disruptions. Overall, retractions materially depress firms' innovation activity, particularly those that rely most heavily on academic research.

Retractions are also accompanied by significant declines in the quality of firms' innovation. Measured by forward citations, a one-standard-deviation increase in retraction exposure is associated with a 2-13 percent reduction in average citations to future firm patents. For university-collaborative patents, the quality effects are substantially larger: citations to patents fall by 14-83 percent. Even among innovative (high-quality) patents, forward citations decline by 2-12 percent, while citations to university-linked innovative patents exhibit even steeper declines. These results imply that retractions not only reduce the amount of innovation but also meaningfully weaken the technological and economic significance of the innovations that do occur.

We then examine whether retractions affect the productivity with which firms convert R&D inputs into innovation outputs. We find clear evidence of a decline in innovation efficiency. A one-standard-deviation increase in retraction exposure leads to about 6 percent decline in total patent output per unit of R&D over the subsequent two years. For university-linked patent efficiency, the declines are economically striking, ranging from approximately 30 to 60 percent relative to the sample mean. Citation-based efficiency shows a similar pattern: quality-adjusted citation productivity falls by roughly 13 percent in the short run at the firm level and by as much as 30-80 percent for university-collaborative innovation.

In contrast, firms' overall R&D intensity does not exhibit a broad or persistent decline following retractions. Only when retractions are accompanied by negative stock market reactions do we observe a short-run, modest reduction in R&D spending, which quickly dissipates. This divergence between stable R&D input and sharply declining R&D productivity indicates that retractions primarily operate through a knowledge-productivity channel: firms continue to invest in R&D, but the effectiveness of these investments deteriorates as upstream academic knowledge becomes less reliable.

Retractions also affect firms' collaboration strategies. At the firm-university level, higher retraction activity at a partner university increases the probability that a firm-university pair actively collaborates in subsequent years by 5-6 percent. Exposure to retractions also leads to a sizable reduction in the formation of new university partnerships. In the short run, the number of newly established university collaborators declines by 26-85 percent, reflecting a substantial pullback in exploratory academic engagement. These results indicate that firms respond actively to retraction shocks by restructuring their external knowledge-sourcing strategies rather than passively absorbing the shock.

Our paper contributes to three related strands of literature. First, we contribute to the literature on industry-university collaboration (IUC) by uncovering a previously unexplored source of fragility in collaborative innovation. A large body of work shows that university partnerships enhance firms' innovation quantity, quality, and commercialization performance by providing access to frontier scientific knowledge, specialized human capital, and complementary research assets (Jaffe, 1989; Mansfield, 1995; Zucker, Darby, and Brewer, 1998; Jensen and Thursby, 2001; Cohen, Nelson, and Walsh, 2002; Belderbos, Carree, and Lokshin, 2004; Fabrizio, 2009; Perkmann et al., 2013; Che and Zhang, 2018). Related studies further emphasize the roles of absorptive capacity and prior collaboration experience in shaping firms' ability to benefit from academic science (Cohen and Levinthal, 1990; Cassiman and Veugelers, 2006; Fabrizio and Di Minin, 2008; Bruneel, d'Este, and Salter, 2010). More recent work further shows that the impact of IUC is highly context-dependent: for example, alliance network structure and technological diversity impact the innovative returns to collaboration in science-based industries such as biotechnology and pharmaceuticals (Ahuja, 2000; Rothaermel and Deeds, 2006; Azoulay, Graff Zivin, and Sampat, 2011). We show that these well-documented benefits are vulnerable to shocks in academic credibility: university paper retractions significantly reduce firms' subsequent patenting activity, innovation quality, and innovation efficiency, and lead to systematic termination and contraction of firm-university collaborations. Our findings therefore identify scientific integrity as a critical, but previously underappreciated, condition for the sustainability of IUC.

Second, we contribute to the literature on the determinants of corporate innovation by identifying upstream scientific reliability as a novel external driver of firm innovation outcomes. Existing work highlights the importance of managerial incentives and exploration-exploitation trade-offs (Manso, 2011; Acharya and Subramanian, 2009; Bernstein, 2015), corporate governance and information environments (Aghion, Van Reenen, and Zingales, 2013; Cohen, Diether, and Malloy, 2013; Hirshleifer, Hsu, and Li, 2013; He and Tian, 2018, 2020), financial constraints and capital market access (Hall and Lerner, 2010; Brown, Martinsson, and Petersen, 2012; Hsu, Tian, and Xu, 2014), and product-market competition (Aghion et al., 2005) in shaping firms' innovation behavior. We complement this literature by showing that exogenous disruptions to the credibility of affiliated universities generate economically large declines in firms' innovation output and R&D productivity, even while R&D spending itself remains largely unchanged. These findings align with a growing strand of research emphasizing the role of corporate engagement with science in shaping innovation outcomes. For example, firms that publish more scientific research or maintain stronger links to academic science exhibit different innovation strategies and patent characteristics (Azoulay, Graff Zivin, and Sampat, 2011; Belenzon and Patacconi, 2014). Our results show that when the reliability of the scientific collaboration between academia and industry is disrupted, firm innovation performance deteriorates in both quantity and efficiency. Thus, we identify scientific integrity as a novel external determinant of firm-level innovative performance.

Third, our paper contributes to the growing literature on scientific misconduct and research retractions. Prior studies document that retractions lead to sharp and persistent declines in citations to affected articles and depress knowledge production in related scientific fields (Furman, Jensen, and Murray, 2012; Lu et al., 2013; Azoulay et al., 2015; Azoulay, Bonatti, and Krieger, 2017; Else, 2024). A parallel strand of work shows that scientific misconduct and retractions have become increasingly prevalent and are closely linked to incentive distortions in academic research (Fanelli, 2009; Lacetera and Zirulia, 2011; Fang, Steen, and Casadevall, 2012; Biagioli et al., 2019). Recent evidence further shows that academic misconduct reduces innovation output at the university level (Li, Wu, and Wang, 2025). We extend this literature by providing first large-scale evidence on the firm-level spillover effects of university retractions, linking academic integrity directly to corporate innovation, market valuation, and collaboration behavior. Our results demonstrate that the economic consequences of scientific misconduct extend beyond academia and propagate into real corporate innovation activity.

Taken together, our findings reveal that the integrity of scientific research is not only a cornerstone of academic progress but also a critical determinant of corporate innovation and the functioning of industry-university networks. Failures of academic integrity present significant externalities to innovation processes, reshaping innovative productivity and altering the structure of collaborative relationships.

The remainder of the paper is organized as follows. Section 2 describes the data sources, sample construction, and key variable definitions. Section 3 presents the empirical strategy and main results. Section 4 concludes.

2. Data

We compile data from multiple sources to construct a panel dataset of Chinese publicly listed firms for the period 2009-2022. The sample begins in 2009, the first year for which paper retraction data are available and consists of all A-share non-financial firms listed on the Shanghai and Shenzhen Stock Exchanges, excluding firm-year observations designated as Special Treatment (ST) or Particular Treatment (PT), as these firms exhibit abnormal financial conditions and are subject to distinct regulatory requirements.[1] The final firm-year panel consists of 33,630 firm-year observations representing 4,392 unique firms.

2.1. Corporate Patents and Firm-University Collaborations

To capture firms' innovation activities and collaborations with universities, we utilize patent application data from the China National Intellectual Property Administration (CNIPA), which provides comprehensive, application-level coverage of all patent filings in China. The data include detailed bibliographic and technical information for each patent, including application numbers, filing dates, International Patent Classification (IPC) codes, applicant names, inventor names, and forward citation counts.

We begin with the universe of patent applications filed by Chinese publicly listed firms, identified by matching firm names in the CNIPA records to the names of listed companies using standardized naming conventions. For each patent, we identify the primary filing firm and record all listed co-applicants. To identify universities as co-applicants, we assemble a comprehensive directory of

[1] In China's stock market, firms are classified as Special Treatment (ST) after reporting negative net profits for two consecutive years, indicating sustained financial distress. If losses persist for a third consecutive year, firms may be designated as Particular Treatment (PT), signaling severe financial deterioration and heightened risk of delisting. Both ST and PT firms are subject to stricter regulatory oversight, enhanced disclosure requirements, tighter daily price limits of 5% (instead of the standard 10%), and potential trading suspension or delisting. These institutional features make their trading behavior and financial reporting systematically different from those of regular firms.

Chinese universities and their corresponding English names from multiple sources.[2] This procedure yields 934 unique universities, among which 301 have jointly filed patents with listed firms.

When a university appears as a co-applicant on a patent filed by a listed firm, we classify the patent as a firm-university joint application, which allows us to identify firm-university collaborations based on patents jointly applied for by a firm and a university. Specifically, when a firm and a university jointly file a patent application in a given year, we treat the firm-university pair as linked for the five-year window surrounding the filing year. This approach accounts for the fact that patent co-applications often capture ongoing collaborative relationships extending beyond the year of filing. To capture a firm's breadth of university collaborations, we define *Collaborated Universities (log)* as the natural logarithm of one plus the total number of universities linked to a firm in a year.

Using the patent information, we construct several measures of firms' innovation outcomes. Patents filed in China fall into three categories: invention patents, utility model patents, and design patents.[3] Invention patents are regarded as more indicative of a firm's innovative capabilities (Zhou, Gao, and Zhao, 2017; Fang, He, and Li, 2020).

First, at the firm-year level, we measure overall patenting activity using *Total Patent (log)*, defined as the natural logarithm of one plus the total number of patents, and *Innovative Patent (log)*, defined as the natural logarithm of one plus the number of invention patents. We similarly construct measures of university-collaborated patenting for each firm-year, *University Total Patent (log)* and *University Innovative Patent (log)*, which capture patenting activity jointly undertaken with universities.

Second, to capture the quality of innovation, we construct citation-based measures. For each

[2]See `https://en.wikipedia.org/wiki/List_of_universities_and_colleges_in_China`; `http://www.moe.gov.cn/jyb_xxgk/s5743/s5744/202506/t20250627_1195683.html`; `https://www.isacteach.com/list-of-universities-in-china/`.

[3]`https://english.cnipa.gov.cn/col/col2995/index.html`. "There are three types of patent applications, namely invention, utility model, and design. If there is a new technical solution relating to a product, a process, or an improvement thereof, an invention may be filed. If there is a new technical solution relating to a product's shape, structure, or a combination thereof, which is fit for practical use, a utility model may be filed. If there is a new design of the shape, pattern, or a combination thereof, as well as a combination of the color, shape and pattern of the entirety or part of a product, which creates an aesthetic feeling and is fit for industrial application, a design may be filed."

patent, quality is measured by the total number of lifetime citations it receives.[4] At the firm-year level we then aggregate these citations across all patents filed and granted in the same year to construct *Average Total Citation (log)* and *Average Innovative Citation (log)*, along with their university-specific counterparts, *Average University Total Citation (log)* and *Average University Innovative Patent Citation (log)*, based on patents jointly filed with universities.

To further capture a firm's innovation inputs and innovation efficiency, we obtain firm-level R&D expenditures from the China Stock Market and Accounting Research (CSMAR) database. Innovation input is measured by *R&D Intensity*, defined as a firm's annual R&D spending scaled by total assets, and innovation efficiency is proxied by several productivity ratios, including *Total Patent / Total R&D*, *University Total Patent / Total R&D*, *Total Citation / Total R&D*, and *University Total Citation / Total R&D*, which measure the productivity of R&D expenditures.

To capture the dynamics of firm-university collaborations, we construct measures of both the establishment of new collaborations and the continuation of existing ones based on co-filed patent records. Using firm-university co-application information, we define *New University Collaboration (log, t+k)* as the natural logarithm of one plus the annual number of university partners that newly appear as co-applicants relative to the firm's pre-existing collaboration network in the subsequent k years following year t. This variable captures the expansion of a firm's collaboration network through newly formed university partnerships. At the firm-university-year level, we further construct *Collaboration (dummy, t+k)*, which equals one if the firm and the university jointly file any patents in the subsequent k years following year t, and zero otherwise. This measure captures the continuation of active collaborative relationships.

2.2. Paper Retractions

Information on academic paper retractions is drawn from the Retraction Watch database (`RetractionWatch.com`), a comprehensive and widely used source that tracks retracted publi-

[4]Citation counts take time to accumulate, which may create a truncation issue for patents granted in the most recent years. However, our sample ends in 2022, providing at least three years for the citations to accumulate and thus largely mitigating this concern. Moreover, our regression analyses compare citation outcomes across firms within the same year, further reducing any remaining truncation effects.

cations across scientific disciplines (Cox, Craig, and Tourish, 2018; Freilich and Kim, 2023). The database provides detailed metadata for each retracted paper, including the publication title, journal, authors, DOI, publication and retraction dates, documented reasons for retraction, subject classification, and the institutional affiliations of the authors.[5] We extract and standardize the institutional affiliations listed for each retracted paper, harmonizing variations in English and Chinese naming conventions to accurately identify universities. This process allows us to assemble a complete census of retractions associated with Chinese universities over the sample period.

To measure a firm's exposure to paper retractions, we construct variables at different levels of aggregation: firm-date, firm-university-year, and firm-year. At the firm-date level, we assign each retraction event to all firms linked to the affected university on the retraction date, allowing us to compute, for each firm on each trading day, the total number of university retractions to which it is exposed. Specifically, we define *Retraction (dummy)* as an indicator that equals one if any of the universities linked to a firm experience at least one paper retraction on that day. To capture the heterogeneity in the severity of retraction events, we further construct two indicators. *High Retraction (dummy)* equals one if a firm is associated with more than three retractions on the same day and *High Concern Retraction (dummy)* equals one if the firm's associated retractions involve more than three stated issues or concerns. To capture a firm's dependence on university collaborations, we define *High University Collaboration (dummy)* as an indicator equaling one if the firm has collaborated with multiple universities prior to the event.

At the firm-university-year level, we aggregate all retractions associated with each university within a calendar year and match these university-year retraction counts to every firm linked to that university during that same year, thereby capturing the intensity of retractions within each specific firm-university relationship. Specifically, *Paired University Retraction (log)* is defined as the natural logarithm of one plus the number of retractions by linked university.

At the firm-year level, we aggregate retractions across all universities linked to a firm to calculate

[5]Retraction reasons in the database include concerns/issues related to data, results, peer review, human subject welfare, and referencing, among others.

the total number of university retractions associated with its academic partners. This measure provides a comprehensive annual indicator of a firm's overall exposure to retractions within its university collaboration network. Specifically, we define *University Paper Retraction (log)* as the natural logarithm of one plus the number of total retractions associated with a firm in a year.

Table 1 depicts time-series variation and distribution of university paper retractions and their links to firms.

Table 1 here

Retractions exhibit substantial year-to-year variation, with pronounced spikes in 2010-2011 (3,033 and 3,181 cases) and again during 2020-2022: annual retractions exceeded 1,000 in 2020 and surpassed 2,300 in both 2021 and 2022. The share and number of publicly listed firms collaborating with retracted universities rise steadily over time, with the average number of retractions per firm increasing markedly after 2019. Overall, the table highlights that scientific retractions are not isolated academic events but increasingly a part of firm-university collaborations, underscoring their potential relevance for corporate innovation outcomes.

2.3. Stock Price Reactions and Firm Characteristics

To study stock price reactions around university paper retraction events, we collect daily stock return data and Fama-French three-factor return data from China Stock Market and Accounting Research (CSMAR). Daily abnormal returns are estimated using both the market model and the Fama-French three-factor model. We employ a rolling estimation window of [-120, -20] trading days prior to the event date to estimate the parameters of the expected return models. Event windows are defined symmetrically around the retraction announcement [-1, +1], [-3, +3], and [-5, +5] trading days—to capture short-term market responses. Cumulative abnormal returns (CARs) for each firm-date observation are then computed by summing the daily abnormal returns over the specified event window.

Other firm-level characteristics are obtained from the CSMAR database, which provides standardized and comprehensive financial statement information for all publicly listed Chinese firms. From CSMAR, we extract annual firm fundamentals including firm size, leverage, profitability, market to book ratio, and cash holdings, which will be used as control variables. Table 2 presents the summary statistics for the main variables. All variables are constructed as described in the preceding subsections, and detailed definitions are provided in Table 1 in the Appendix.

Table 2 here

3. Empirical Analysis and Findings

3.1. Stock Market Reactions around University Paper Retractions

We begin our analysis by examining how capital markets respond to university paper retractions. A retraction resulting from fraud, fabrication, or serious methodological flaws introduces epistemic uncertainty, signaling that prior research may be unreliable and potentially undermining the foundation of innovation activities dependent on it. This degradation of upstream knowledge can prompt investors to reassess a firm's innovation pipeline, potentially leading to valuation losses that reflect concerns about the firm's future technological viability and R&D productivity. Accordingly, we hypothesize that markets may respond negatively to retraction events.

To evaluate the capital market implications of university paper retractions, we conduct a standard event-study analysis of firms' abnormal stock returns around retraction announcement dates. We define treated firms as those linked to universities that experience one or more retractions on a given trading day, and control firms as all other firms not directly affected on the same date. For treated firms, retractions constitute a negative information shock concerning the credibility of their academic partners and the reliability of upstream knowledge inputs, relative to control firms.

We estimate the market response using the following regression specification:

$$CAR_{i,d} = \alpha + \beta Retraction_{i,d} + \gamma \mathbf{X}_{i,t} + F_i + F_d + F_{ind\times year} + F_{province\times year} + \epsilon_{i,d}, \quad (1)$$

where $CAR_{i,d}$ denotes cumulative abnormal returns for firm i around day d using either the market model or the Fama-French three-factor model over various symmetric event windows. $Retraction_{i,d}$ are different measures capturing a firm's exposure to university retraction events on day d. $X_{i,t}$ is a vector of firm-level controls, including *Collaborated Universities (log), Total Patent (log), Firm Size, Leverage, ROA, Market to Book, Cash Holdings, and R&D Intensity.* All specifications include firm fixed effects, which absorb time-invariant firm characteristics, and day fixed effects, which absorb trading-day shocks common to all firms. For robustness, we also present specifications incorporating industry-by-year fixed effects and province-by-year fixed effects to control for time-varying industry-level and region-level factors. Standard errors are clustered at the firm level.

Table 3 presents the baseline event-study estimates of stock market reactions to university paper retractions, using both the market model and Fama-French three-factor model across [-1,+1], [-3,+3] and [-5,+5] event windows.

Table 3 here

For ease of presentation, abnormal returns are multiplied by 100. The two panels correspond to different fixed effects specifications. Panel A includes firm and date fixed effects. The estimated coefficients indicate that firms experience economically meaningful abnormally negative cumulative abnormal returns (CARs) on days when their linked universities face retraction events. The effects range from -3.6 to -5.6 basis points for both the market-model and for the Fama-French three-factor model.

Panel B adds industry-year fixed effects, addressing the possibility that retraction events coincide with industry-specific technological cycles or shocks, as well as province-year fixed effects, capturing local economic shocks, policy changes, and region-specific research conditions that could jointly affect universities and nearby firms. The magnitude of the retraction coefficients becomes slightly more negative and remains statistically significant in most specifications, indicating that the observed price reactions are not driven by unobserved industry-level developments, regional trends or local economic factors. The consistent pattern reinforces the interpretation that retraction events convey negative informational content for firms that rely on the scientific output of affected universities.

Table 4 further explores cross-sectional heterogeneity in market reactions to university retractions.

Table 4 here

We expect that stock price reactions would vary across firms depending on the intensity of their exposure to retractions, as reflected in the severity of the retraction event, the number of retracted publications, and the firm's reliance on university as a knowledge partner.

Panel A investigates whether market reactions are more negative when firms are associated with multiple retractions on the same day. We define *High Retraction (dummy)* as an indicator equaling one if a firm is associated with more than three retractions on a given day, and zero otherwise. We augment the baseline regression in equation (1) with this indicator to capture more severe retraction events. The results show that coefficients on *High Retraction (dummy)* are negative and statistically significant in most specifications, whereas the coefficients on *Retraction (dummy)* are negative but generally statistically insignificant. Moreover, the magnitude of the *High Retraction (dummy)* is typically larger than the average estimates reported for all retraction events in Table 3. For example, the seven-day CAR is around -30 basis points using the market model and -27 basis points using the Fama-French three-factor model, both significant at the 1% level. These results suggest that firms experience significantly more negative stock market reactions when exposed to multiple simultaneous retractions, indicating that more severe retraction events amplify the market's adverse response.

Panel B focuses on the nature of concerns underlying retraction events. We define *High Concern Retraction (dummy)* as an indicator equaling one if the firm's associated retractions involve more than three stated issues or concerns. The results show that retractions involving more concerns lead to significantly more negative abnormal returns, whereas reactions with fewer concerns produce weaker and less statistically significant market reactions. Specifically, the coefficients on *High*

Concern Retraction (dummy) are negative and statistically significant in four of the six models, particularly in the Fama-French three-factor CAR models, where the effects increase in magnitude as the event window widens (e.g., -7.8 basis points over [-1,+1], -12.2 basis points over [-3,+3], and -17.2 basis points over [-5,+5]). These results suggest that investors interpret retractions citing multiple concerns as signals of more serious or systemic issues.

Panel C examines whether the impact of retractions varies with the intensity of firm-university collaboration. Firms with stronger university ties are likely more dependent on academic research inputs and therefore may suffer larger valuation losses following retractions, which signal potential disruptions to future knowledge production, technology transfer, and joint R&D activities. At the same time, firms collaborating with multiple universities may benefit from diversification, potentially mitigating the impact of any single retraction. To assess these competing effects, we define *High University Collaboration (dummy)* that equals one if a firm has collaborated with more than one university prior to the event, and zero otherwise. The interaction term *Retraction (dummy)* $\times$ *High University Collaboration (dummy)* is negative and statistically significant, indicating that retractions have a larger adverse market impact for firms more heavily engaged with universities. The finding suggests that firms' dependence on academic research dominates any potential diversification benefits from broader collaboration networks.

Taken together, the cross-sectional results in this section show that the adverse market reaction to university retractions is not uniform; rather, it is concentrated in cases involving more intense retraction shocks, more serious or multifaceted retraction reasons, and firms that are more deeply embedded in university collaboration networks.

3.2. University Paper Retractions and Corporate Innovation

University research serves as a critical upstream knowledge input for firms, particularly those engaged in science-based innovation. When a university paper is retracted due to fabrication, falsification, or major methodological flaws, it introduces uncertainty regarding the reliability of the affected research domain. Such disruptions can affect firms' innovation processes in multiple ways. Innovation quantity may decline if firms delay, scale back, or discontinue projects that rely on compromised scientific inputs. Innovation quality may also suffer, as retractions raise doubts about the robustness of the underlying knowledge, potentially resulting in patents that are less novel or have weaker technological impact. Additionally, retractions may influence firms' innovation input decisions—such as adjustments in R&D spending—if managers revise expectations about the payoffs of research linked to affected scientific fields. Finally, innovation efficiency may decrease if the productivity of R&D investment falls following a credibility shock to universities that firms depend on for knowledge generation.

Taken together, university retractions constitute upstream knowledge disruptions that can reshape the scale and effectiveness of corporate innovation. To formally examine these effects, we estimate the following specification:

$$Y_{i,t+k} = \alpha + \beta\, \textit{University Paper Retraction}_{i,t} + \gamma \mathbf{X}_{i,t} + F_i + F_t + \epsilon_{i,t+k}. \tag{2}$$

where $Y_{i,t+k}$ denotes firm i's innovation outcomes—measured in quantity, quality, input, or efficiency—in years $t+1$, $t+2$, and $t+3$. The key independent variable, $\textit{University Paper Retraction}_{i,t}$, captures the total number of retractions occurring at universities linked to firm i in year t. Control variables include *Collaborated Universities (log), Firm Size, ROA, Leverage, Market to Book, Cash Holding, and R&D Intensity*, and the regressions include firm fixed effects to absorb time-invariant heterogeneity and year fixed effects to capture macroeconomic shocks. Standard errors are clustered at the firm level.

3.2.1. Innovation Quantity

Table 5 presents the relation between university paper retractions and subsequent patenting activities of affiliated firms.

Table 5 here

Panel A examines effects on the quantity of all patent applications, while Panel B focuses on innovative patents, which exclude incremental or utility-model filings and therefore capture higher-quality, knowledge-intensive inventions. For both panels, the outcome variables are observed in years $t+1$, $t+2$, and $t+3$, reflecting the forward-looking nature of firms' innovation responses.

In Panel A, Columns (1)-(3) consider total patent output at horizons t+1, t+2, and t+3, whereas Columns (4)-(6) focus on university-collaborative patents over the same periods. The estimated coefficients on *University Paper Retraction (log)* for total patents range from -0.127 to -0.154 and are all highly significant. A one-standard deviation increase in retraction exposure (0.929) is associated with a decline in total patenting of 7.6-9.2 percent relative to the mean over the subsequent three years. For university-collaborative patents in Columns (4)-(6), the coefficients range from -0.063 to -0.040, again consistently negative and statistically significant. The corresponding declines are highly economically meaningful 34.6-53.9 percent relative to the mean (0.108).

Panel B turns to innovative patents—those representing substantive new inventions rather than incremental follow-on filings. Columns (1)-(3) report innovative patent output at $t+1$, $t+2$, and $t+3$, with coefficients on *University Paper Retraction (log)* ranging from -0.074 to -0.093. A one-standard deviation increase in retraction exposure (0.929) is associated with declines of 6.7-8.5 percent relative to the mean in forward-looking innovative patent output. For university-collaborative innovative patents in Columns (4)-(6), the coefficients range from -0.021 to -0.005, smaller in absolute value but still consistently negative. The corresponding declines are 21.8-83.9 percent relative to the mean (0.023).

3.2.2. Innovation Quality

Table 6 presents the effects of university paper retractions on the quality of firms' subsequent innovation output, measured by forward citations.

Table 6 here

Panel A examines citations received by all patents filed by a firm in a given year, whereas Panel B focuses specifically on citations to innovative patents.

In Panel A, Columns (1)-(3) report average forward citations for patents filed in year $t + 1$, $t + 2$, and $t + 3$, respectively. Columns (4)-(6) restrict the analysis to average forward citations received by university-collaborative patents. Overall, we document a strong negative impact on patent citations for the subsequent two years. For example, the coefficients on *University Paper Retraction (log)* for overall citations are -0.062 and -0.036, for the first and second year, respectively. A one-standard deviation increase in *University Paper Retraction (log)* (0.929) is associated with a decline in average forward citations of 7.4-12.6 percent relative to the sample mean (0.452). For university-collaborative citations in Columns (4)-(6), the coefficients range from -0.012 to -0.074. A one-standard deviation increase in *University Paper Retraction (log)* (0.929) is associated with a decline in average university-collaborative forward citations of 13.7-82.5 percent relative to the sample mean (0.083). Panel B considers innovative patents. Overall, we find a similar pattern as in total patents, with statistically weaker results.

These results indicate that university paper retractions reduce not only the quantity but also the quality of corporate innovation over the subsequent three years, with effects concentrated in the first two years. The adverse effects are evident for both patents developed with university collaborators and those generated independently by firms.

3.2.3. Innovation Efficiency

Next, we examine the impact of university retractions on firm innovation efficiency, measured by innovation output scaled by innovation input. Table 7 investigates whether university retractions affect the efficiency with which firms convert R&D expenditures into patents.

Table 7 here

In Columns (1)-(3), the coefficients on *University Paper Retraction (log)* are negative and statistically significant for the first two years following paper retraction events (-0.0181 and -0.0186). A one-standard-deviation increase in *University Paper Retraction (log)* (0.929) implies declines of 6.5-6.7 percent relative to the sample mean of *Total Patent / Total R&D* (0.260), representing economically meaningful reductions in innovation productivity. Columns (4)-(6) focus on university-related patenting efficiency, where coefficients range from -0.0019 to -0.0010, all statistically significant across all three subsequent years. Given the mean value of 0.003 for *University Total Patent / Total R&D*, a one-standard-deviation increase in retraction exposure implies substantial proportional declines of 31-59 percent relative to the mean in the productivity of university-linked innovation.

Table 8 examines whether university retractions affect the efficiency with which firms convert R&D expenditures into high-quality innovation outputs, measured by patent citations.

Table 8 here

For total citation efficiency in Columns (1)-(3), the coefficient on *University Paper Retraction (log)* is negative and statistically significant at t+1 (-0.0691), whereas the effects dissipate at t+2 and turn weakly positive at $t+3$. A one-standard-deviation increase in retraction exposure (0.929) implies a 12.8 percent decline relative to the sample mean of *Total Citation / Total R&D* (0.501), indicating a sizable short-run deterioration in citation-based innovation efficiency. For university-related citation efficiency in Columns (4)-(6), the coefficients are negative and statistically significant at $t+1$ and $t+2$ (-0.0080 and -0.0029). Given the sample mean of *University Total Citation / Total R&D* (0.009), these estimates imply large proportional declines of 29.9-82.6 percent relative to the mean in citation productivity of university-collaborative innovation.

Taken together, Tables 7 and 8 show that university retractions significantly impair firms' innovation efficiency, with economically large and persistent effects concentrated in university-linked patents, while the efficiency of aggregate firm-level innovation is primarily affected in the short run.

3.2.4. Innovation Inputs

Table 9 investigates whether university paper retractions lead firms to adjust their R&D inputs in the years following a retraction event.

Table 9 here

R&D input is measured by *R&D Intensity*, defined as a firm's annual R&D expenditures scaled by total assets. Columns (1)-(3) report the results at horizons $t+1$, $t+2$, and $t+3$. The coefficients on *University Paper Retraction (log)* are small in magnitude and statistically insignificant across all horizons. These estimates indicate that, in contrast to the pronounced effects on patent quantity and quality documented earlier, firms' R&D spending does not systematically decline following increases in retraction exposure. The absence of detectable changes in R&D intensity suggests that firms do not adjust their overall R&D budgets in response to shocks to the reliability of external scientific knowledge.

We further entertain the possibility that firms' adjustment behavior varies with market perceptions of retraction events. Specifically, we examine whether firms experiencing negative stock market reactions are more likely to reduce their innovation inputs. *Negative Market Reaction* is an indicator equaling one if a firm experiences a negative cumulative abnormal return around paper retractions in year t. We interact this variable with *University Paper Retraction (log)*. Columns (4) to (6) report the results. We find some evidence that firms experiencing negative market reactions reduce their R&D expenditure for the first subsequent year, although the magnitude of the effect is modest and short-lived.

Taken together, university paper retractions do not trigger broad reductions in firms' R&D investment, even though they significantly diminish firms' innovation output and citation performance. These findings support the interpretation that retractions primarily operate through a productivity channel, eroding the effectiveness of R&D rather than altering firms' R&D investment expenditures.

3.3. University Paper Retractions and Collaborative Relations

Retraction-related credibility shocks may also disrupt collaborative relations along multiple dimensions. First, retractions may reduce the likelihood of firm-university pairs co-filing patents in a given year. Paper retractions signal potential issues with a university's research quality or reliability. Firms facing such credibility shocks may perceive higher uncertainty or risk in collaborating with these universities, making joint patenting less attractive in subsequent periods. Second, retractions may affect the formation of new firm-university partnerships. Firms exposed to higher retraction rates among their existing university partners may revise their beliefs about the reliability of academic collaboration more broadly, leading them to be more cautious in initiating relationships with new university partners. In both cases, retractions can disrupt the flow of knowledge from universities to firms by reducing the likelihood of both continuing and new collaborations.

To examine these potential adjustments in collaboration behavior, we conduct two complementary analyses. First, using a firm-university-year panel of all pairs that have ever co-filed a patent, we test whether retractions at a partner university increase the likelihood that previously active collaborations become inactive in subsequent years. Second, using a firm-year sample, we further test whether firms exposed to retractions through existing university partners become less willing to initiate collaborations with new universities.

Table 10 reports results on whether university paper retractions affect the likelihood that a firm-university pair continues collaborating in future years.

Table 10 here

Because we cannot directly observe collaborations between a university and a firm, we use joint patenting as a proxy. Accordingly, the dependent variable is an indicator that equals one if firm i and university u jointly file any patents in the subsequent k years following year t, where $k = 1, 2,$

or 3. Columns (1)-(3) include firm, university, and year fixed effects while Columns (4)-(6) use firm-university and year fixed effects.

In Columns (1)-(3), the coefficient on *Paired University Retraction (log)* is negative and statistically significant for all three horizons, indicating that higher retraction activity at a university reduces the likelihood that a firm-university pair actively collaborates in subsequent years. Using a one-standard-deviation increase in *Paired University Retraction (log)* (1.103), the estimates imply a reduction of 4.8-6.1 percent relative to the mean in the probability of collaboration over the $t+1$ to $t+3$ horizons. Columns (4)-(6) strengthen the specification by comparing the same firm-university pairs over time. Under this more demanding specification, the estimated effects remain negative and statistically significant, with economically similar magnitudes (about 5-6.4 percent of the mean). This finding suggests that within a university-firm pair, an increase in a university's retraction exposure reduces the probability of future collaboration.

Table 11 investigates whether exposure to university paper retractions affects firms' likelihood of forming new collaborations with previously unconnected universities.

Table 11 here

The dependent variable is the log number of new university partners established in the subsequent k years following year t, where $k = 1, 2$, or 3, and the specification includes firm and year fixed effects. In Columns (1)-(2), the coefficient on *University Paper Retraction (log)* is negative and statistically significant (-0.0338 and -0.0213), indicating that firms reduce new collaborative engagements for the subsequent two years following retractions at their existing partner universities. Using a one-standard-deviation increase in retraction exposure (0.929), these estimates imply large proportional declines of 84.8 percent and 25.8 percent relative to the mean values for the first and the second year, respectively. Overall, these results suggest that retractions at current partner universities lower the likelihood that firms initiate new collaborations.

In summary, university paper retractions disrupt both existing and potential firm-university collaborations. Retractions reduce the likelihood that ongoing firm-university pairs continue co-filing patents and lower the probability that firms establish new partnerships with previously unconnected universities. These findings highlight that credibility shocks in academic research not only impair knowledge quality but also weaken the collaborative channels through which firms access and leverage scientific expertise.

4. Conclusions

This paper demonstrates that the reliability of academic research plays an important role in shaping corporate innovation and the structure of industry-university collaboration. Our evidence shows that disruptions to academic credibility have adverse implications for associated firms: weaker innovative output, diminished technological significance of new inventions, and reduced efficiency in converting R&D into successful innovations. Our findings of how university paper retractions impact firms' innovation activity and market valuations underscore that corporate innovation success is intertwined with the integrity of the academic environments they engage with.

Paper retractions reshape firms' strategic behavior, prompting them to pull back from existing academic ties and to scale down the formation of new ones. Even in the absence of substantial changes in R&D expenditure, firms adjust the ways they source external knowledge, revealing that confidence in academic partners is a central determinant of collaboration choices. Financial market reactions to patent retractions also indicate that investors recognize the informational content of retractions and interpret them as signals about firms' future technological potential.

Taken together, our results highlight that scientific integrity is a crucial input to innovation. More broadly, our findings suggest that strengthening the reliability and transparency of scientific production may yield benefits that extend into the corporate sector, increasing the stability and productivity of the innovation economy.

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Table 1: University Paper Retractions

This table summarizes annual counts of academic paper retractions associated with Chinese universities over the sample period. *# Retractions* reports the total number of retracted papers in each year with at least one author affiliated with a Chinese university. *# Retracted Universities* counts the distinct universities that appear in retracted publications in a year. *# Retracted and Co-filer Universities* counts the retracted universities that also co-file patents with Chinese public firms in a year. *# Retractions Related to Firms* counts the number of retractions that are related to the retracted universities that co-file patents with sample firms. *# Sample Firms* counts the total number of sample firms in each year. *# Co-filer Firms* counts the number of firms that co-file patents with universities each year. *# Co-filer Firms with Retracted Universities* reflects the number of publicly listed firms that co-file patents with universities experiencing at least one retraction in a given year. *Average Retractions per Firm* reports the average number of retractions associated with a firm's linked universities in a year.

Year	# Retractions	# Retracted Universities	# Retracted and Co-filer Universities	# Retractions Related to Firms	# Sample Firms Retracted	# Co-filer Firms	# Co-filer Firms with Retracted Universities	Average Retractions per Firm
2009	513	170	39	279	1755	58	49	0.86
2010	3033	353	69	1654	2109	77	74	4.31
2011	3181	389	79	1747	2343	85	84	4.32
2012	204	101	45	145	2473	112	90	0.43
2013	233	104	50	171	2522	121	86	0.49
2014	128	79	35	91	2648	114	75	0.32
2015	314	118	47	189	2864	138	97	0.69
2016	325	147	60	220	3212	175	132	0.74
2017	319	120	57	259	3635	189	132	0.88
2018	341	155	62	262	3758	219	151	1.04
2019	470	182	84	428	4022	308	262	1.77
2020	1018	250	103	896	4478	351	310	3.97
2021	2373	437	143	1779	4901	456	426	7.36
2022	2306	502	162	1683	5169	546	511	5.81

Table 2: Summary Statistics

This table presents summary statistics for key variables across different levels of samples. For firm-event date level sample, dependent variables are cumulative abnormal returns calculated from market model and Fama-French three-factor model over different event windows; independent variables include *Retraction (dummy), High Retraction (dummy), High Concern Retraction (dummy)*, and *High University Collaboration (dummy)*. For firm-year level sample, dependent variables include measures of quantity of innovation (*Total Patent (log), University Total Patent (log), Innovative Patent (log)*, and *University Innovative Patent (log)*), quality of innovation (*Average Total Citation (log), Average University Total Citation (log), Average Innovative Citation (log), and Average University Innovative Patent Citation (log)*), innovation input (*RD Intensity*), innovation efficiency (*Total Patent / Total R&D, University Total Patent / Total R&D, Total Citation / Total R&D*, and *University Total Citation / Total R&D*), and new collaboration (*New University Collaboration (log)*); the independent variable is *University Paper Retraction (log)*. For firm-university-year level sample, we restrict to firm-university pairs that have ever jointly filed a patent. The dependent variable is *Collaboration (dummy)*; the independent variable is *Paired University Retraction (log)*. Control variables for all samples include *Collaborated Universities (log), Firm Size, ROA, Leverage, Market to Book, and Cash Holdings*. Variable definitions are provided in Appendix Table 1.

	# Obs.	Mean	S.D	P25	Median	P75
Event Date Level						
Retraction (dummy)	6,315,497	0.012	0.108	0.000	0.000	0.000
High Retraction (dummy)	6,315,497	0.001	0.024	0.000	0.000	0.000
High Concern Retraction (dummy)	6,315,497	0.006	0.08	0.000	0.000	0.000
High University Collaboration (dummy)	6,315,497	0.117	0.321	0.000	0.000	0.000
CAR MM [-1, +1]	6,315,497	0.042	4.691	-2.292	-0.312	1.905
CAR MM [-3, +3]	6,315,497	0.083	7.144	-3.590	-0.478	3.075
CAR MM [-5, +5]	6,315,497	0.147	8.865	-4.556	-0.593	4.001
CAR FF3 [-1, +1]	6,315,497	0.002	4.583	-2.231	-0.352	1.734
CAR FF3 [-3, +3]	6,315,497	-0.011	6.975	-3.497	-0.569	2.730
CAR FF3 [-5, +5]	6,315,497	-0.015	8.642	-4.454	-0.722	3.517
Firm-Year Level						
University Paper Retraction (log)	33,630	0.339	0.929	0.000	0.000	0.000
Total Patent (log)	33,630	1.554	1.725	0.000	1.099	2.890
University Total Patent (log)	33,630	0.108	0.433	0.000	0.000	0.000
Innovative Patent (log)	33,630	1.02	1.416	0.000	0.000	1.946
University Innovative Patent (log)	33,630	0.023	0.176	0.000	0.000	0.000
Average Total Citation (log)	33,630	0.452	0.616	0.000	0.000	0.841
Average University Total Citation (log)	33,630	0.083	0.388	0.000	0.000	0.000
Average Innovative Citation (log)	33,630	0.243	0.448	0.000	0.000	0.318
Average University Innov. Patent Citation (log)	33,630	0.013	0.134	0.000	0.000	0.000
R&D Intensity	33,630	0.049	0.052	0.018	0.037	0.057
Total Patent / Total R&D	33,630	0.26	0.546	0.000	0.026	0.275
University Total Patent / Total R&D	33,630	0.003	0.016	0.000	0.000	0.000
Total Citation / Total R&D	33,630	0.501	1.398	0.000	0.000	0.294
University Total Citation / Total R&D	33,630	0.009	0.058	0.000	0.000	0.000
New University Collaboration (log, $t+1$)	33,630	0.037	0.175	0.000	0.000	0.000
New University Collaboration (log, $t+2$)	33,630	0.077	0.256	0.000	0.000	0.000
New University Collaboration (log, $t+3$)	33,630	0.112	0.313	0.000	0.000	0.000
Collaborated Universities (log)	33,630	0.156	0.389	0.000	0.000	0.000
Firm Size	33,630	22.118	1.315	21.186	21.909	22.823
ROA	33,630	0.036	0.074	0.014	0.040	0.070
Leverage	33,630	0.406	0.207	0.239	0.393	0.553
Market to Book	33,630	2.068	1.325	1.274	1.650	2.350
Cash Holding	33,630	0.173	0.138	0.075	0.133	0.228
Firm-University-Year Level						
Paired University Retraction (log)	18,565	1.197	1.103	0.000	1.099	1.946
Collaboration (dummy, $t+1$)	18,565	0.131	0.338	0.000	0.000	0.000
Collaboration (dummy, $t+2$)	18,565	0.237	0.425	0.000	0.000	0.000
Collaboration (dummy, $t+3$)	18,565	0.341	0.474	0.000	0.000	1.000

Table 3: Event Studies on Retractions: Baseline

This table reports estimates from event-study regressions examining stock market reactions to university paper retractions. The dependent variables are cumulative abnormal returns (CARs) computed using either the market model (MM) or the Fama-French three-factor model (FF3) over event windows of [1, +1], [3, +3], and [5, +5] trading days around the retraction date. *Retraction (dummy)* is an indicator equal to one on days when any university connected to a firm experiences at least one paper retraction. All control variables are measured at the firm-year level. Panel A includes firm and date fixed effects. Panel B adds industry-year fixed effects and province-year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Firm and Date FEs

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR MM [-1, +1]	CAR MM [-3, +3]	CAR MM [-5, +5]	CAR FF3 [-1, +1]	CAR FF3 [-3, +3]	CAR FF3 [-5, +5]
Retraction (dummy)	-0.0359**	-0.0557*	-0.0388	-0.0158	-0.0547**	-0.0593*
	(0.047)	(0.057)	(0.303)	(0.365)	(0.048)	(0.085)
Collab. Universities (log)	-0.0499***	-0.1018***	-0.1356***	-0.0414***	-0.0947***	-0.1356***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Total Patent (log)	0.0223***	0.0464***	0.0710***	0.0084***	0.0172***	0.0359***
	(0.000)	(0.000)	(0.000)	(0.009)	(0.009)	(0.000)
Firm Size	-0.0038	0.0049	0.0528*	0.0294***	0.0502***	0.1000***
	(0.705)	(0.813)	(0.098)	(0.001)	(0.009)	(0.001)
ROA	1.4315***	3.0135***	4.7008***	1.3007***	2.8448***	4.4382***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	0.2114***	0.5247***	0.6803***	0.1612***	0.4780***	0.6790***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market to Book	0.1715***	0.4103***	0.6596***	0.1577***	0.3592***	0.5677***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash Holding	-0.0503	-0.1204	-0.1689	-0.0838**	-0.2247***	-0.3754***
	(0.250)	(0.172)	(0.203)	(0.046)	(0.008)	(0.004)
R&D Intensity	-0.5314***	-1.2828***	-1.9995***	-0.3900**	-0.9919***	-1.5618***
	(0.002)	(0.000)	(0.000)	(0.019)	(0.005)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784
Adjusted R^2	0.056	0.067	0.074	0.007	0.011	0.015

Table 3: Event Studies on Retractions: Baseline – continued

Panel B. Firm, Date, Industry-Year, and Province-Year FEs

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR MM [-1, +1]	CAR MM [-3, +3]	CAR MM [-5, +5]	CAR FF3 [-1, +1]	CAR FF3 [-3, +3]	CAR FF3 [-5, +5]
Retraction (dummy)	-0.0429**	-0.0659**	-0.0548	-0.0206	-0.0633**	-0.0737**
	(0.019)	(0.025)	(0.142)	(0.241)	(0.022)	(0.033)
Collab. Universities (log)	-0.0480***	-0.1018***	-0.1287***	-0.0367***	-0.0899***	-0.1230***
	(0.001)	(0.000)	(0.002)	(0.005)	(0.001)	(0.002)
Total Patent (log)	0.0109***	0.0269***	0.0347***	-0.0005	-0.0003	0.0031
	(0.001)	(0.000)	(0.001)	(0.890)	(0.969)	(0.765)
Firm Size	0.0118	0.0428**	0.1063***	0.0457***	0.0931***	0.1688***
	(0.238)	(0.037)	(0.001)	(0.000)	(0.000)	(0.000)
ROA	1.3673***	2.9427***	4.6146***	1.2653***	2.8153***	4.4141***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	0.1791***	0.4548***	0.6273***	0.1364***	0.4170***	0.6104***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market to Book	0.1724***	0.4098***	0.6526***	0.1637***	0.3749***	0.5918***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash Holding	-0.0456	-0.1220	-0.1506	-0.0619	-0.1768**	-0.2668**
	(0.295)	(0.160)	(0.249)	(0.148)	(0.039)	(0.040)
R&D Intensity	-0.5734***	-1.2205***	-1.8911***	-0.4728***	-1.0225***	-1.6746***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.002)	(0.001)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784
Adjusted R^2	0.057	0.069	0.077	0.008	0.012	0.018

Table 4: Event Studies on Retractions: Cross-Sectional Results

This table reports estimates from event-study regressions examining cross-sectional heterogeneity in stock market reactions to university paper retractions. The dependent variables are cumulative abnormal returns (CARs) calculated using either the market model (MM) or the Fama-French three-factor model (FF3) over event windows of [1, +1], [3, +3], and [5, +5] trading days around the retraction date. In Panel A, *High Retraction (dummy)* is an indicator that a firm experiences more than three retractions on a given day. In Panel B, *High Concern Retraction (dummy)* equals one if a firm is linked to retractions with more than three concerns. In Panel C, *High University Collaboration (dummy)* equals one if a firm has collaborated with more than one university prior to the event. All regressions include firm and date fixed effects, and all specifications control for standard firm characteristics measured at the firm-year level. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively.

Panel A. High Retraction

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR MM [-1, +1]	CAR MM [-3, +3]	CAR MM [-5, +5]	CAR FF3 [-1, +1]	CAR FF3 [-3, +3]	CAR FF3 [-5, +5]
High Retraction (dummy)	-0.1546**	-0.2976***	-0.2570*	-0.0954	-0.2650***	-0.3330**
	(0.033)	(0.004)	(0.059)	(0.168)	(0.009)	(0.011)
Retraction (dummy)	-0.0288	-0.0421	-0.0271	-0.0115	-0.0426	-0.0441
	(0.120)	(0.155)	(0.472)	(0.524)	(0.129)	(0.203)
Collab. Universities (log)	-0.0498***	-0.1017***	-0.1355***	-0.0413***	-0.0946***	-0.1355***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Total Patent (log)	0.0223***	0.0465***	0.0710***	0.0084***	0.0173***	0.0360***
	(0.000)	(0.000)	(0.000)	(0.008)	(0.009)	(0.000)
Firm Size	-0.0037	0.0050	0.0528*	0.0294***	0.0503***	0.1000***
	(0.707)	(0.811)	(0.098)	(0.001)	(0.008)	(0.001)
ROA	1.4314***	3.0133***	4.7006***	1.3006***	2.8446***	4.4380***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	0.2113***	0.5246***	0.6803***	0.1612***	0.4779***	0.6789***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market to Book	0.1715***	0.4103***	0.6596***	0.1577***	0.3592***	0.5677***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash Holding	-0.0504	-0.1205	-0.1690	-0.0838**	-0.2247***	-0.3755***
	(0.249)	(0.171)	(0.203)	(0.046)	(0.008)	(0.004)
R&D Intensity	-0.5319***	-1.2837***	-2.0002***	-0.3903**	-0.9926***	-1.5627***
	(0.002)	(0.000)	(0.000)	(0.019)	(0.005)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784
Adjusted R^2	0.056	0.067	0.074	0.007	0.011	0.015

Table 4: Event Studies on Retractions: Cross-Sectional Results – continued

Panel B. High Concern Retraction

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR MM	CAR MM	CAR MM	CAR FF3	CAR FF3	CAR FF3
	[-1, +1]	[-3, +3]	[-5, +5]	[-1, +1]	[-3, +3]	[-5, +5]
High Concern Retraction (dummy)	-0.1073***	-0.0865	-0.0899	-0.0783**	-0.1222**	-0.1722**
	(0.003)	(0.102)	(0.185)	(0.028)	(0.024)	(0.010)
Retraction (dummy)	0.0230	-0.0082	0.0105	0.0271	0.0123	0.0351
	(0.373)	(0.832)	(0.832)	(0.290)	(0.752)	(0.473)
Collab. Universities (log)	-0.0498***	-0.1017***	-0.1355***	-0.0413***	-0.0945***	-0.1354***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Total Patent (log)	0.0222***	0.0463***	0.0709***	0.0083***	0.0171***	0.0358***
	(0.000)	(0.000)	(0.000)	(0.009)	(0.009)	(0.000)
Firm Size	-0.0038	0.0049	0.0528*	0.0294***	0.0502***	0.1000***
	(0.704)	(0.813)	(0.098)	(0.001)	(0.009)	(0.001)
ROA	1.4317***	3.0137***	4.7010***	1.3008***	2.8450***	4.4386***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	0.2114***	0.5247***	0.6803***	0.1612***	0.4780***	0.6790***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market to Book	0.1715***	0.4103***	0.6596***	0.1577***	0.3592***	0.5677***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash Holding	-0.0502	-0.1203	-0.1687	-0.0836**	-0.2245***	-0.3751***
	(0.252)	(0.172)	(0.203)	(0.047)	(0.008)	(0.004)
R&D Intensity	-0.5312***	-1.2826***	-1.9992***	-0.3898**	-0.9916***	-1.5614***
	(0.002)	(0.000)	(0.000)	(0.019)	(0.005)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784
Adjusted R^2	0.056	0.067	0.074	0.007	0.011	0.015

Table 4: Event Studies on Retractions: Cross-Sectional Results – continued

Panel C. High University Collaboration

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR MM [-1, +1]	CAR MM [-3, +3]	CAR MM [-5, +5]	CAR FF3 [-1, +1]	CAR FF3 [-3, +3]	CAR FF3 [-5, +5]
Retraction (dummy) ×	-0.0578	-0.1295**	-0.0014*	-0.0606	-0.1275**	-0.1275
High University Collab. (dummy)	(0.138)	(0.043)	(0.078)	(0.110)	(0.038)	(0.111)
High University Collaboration (dummy)	0.0162	0.0418	0.0005	0.0193	0.0360	0.0392
	(0.402)	(0.284)	(0.382)	(0.284)	(0.340)	(0.495)
Retraction (dummy)	0.0048	0.0354	0.0006	0.0268	0.0350	0.0304
	(0.886)	(0.514)	(0.379)	(0.409)	(0.505)	(0.651)
Collab. Universities (log)	-0.0542***	-0.1130***	-0.0012***	-0.0466***	-0.1044***	-0.1462***
	(0.001)	(0.000)	(0.007)	(0.001)	(0.000)	(0.001)
Total Patent (log)	0.0224***	0.0469***	0.0007***	0.0086***	0.0176***	0.0363***
	(0.000)	(0.000)	(0.000)	(0.007)	(0.008)	(0.000)
Firm Size	-0.0038	0.0048	0.0002	0.0294***	0.0501***	0.0999***
	(0.702)	(0.817)	(0.528)	(0.001)	(0.009)	(0.001)
ROA	1.4313***	3.0129***	0.0432***	1.3004***	2.8443***	4.4377***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	0.2113***	0.5246***	0.0071***	0.1612***	0.4780***	0.6789***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market to Book	0.1715***	0.4102***	0.0059***	0.1577***	0.3591***	0.5676***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash Holding	-0.0506	-0.1210	-0.0004	-0.0840**	-0.2251***	-0.3759***
	(0.248)	(0.169)	(0.758)	(0.046)	(0.008)	(0.003)
R&D Intensity	-0.5334***	-1.2879***	-0.0188***	-0.3923**	-0.9962***	-1.5666***
	(0.002)	(0.000)	(0.000)	(0.018)	(0.005)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Date FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784	6,251,784
Adjusted R^2	0.056	0.067	0.079	0.007	0.011	0.015

Table 5: University Paper Retractions and Firm Patent Quantity

This table reports regression estimates examining how university paper retractions affect firms' subsequent patenting quantity. The dependent variables are the logarithms of patent counts observed in years $t+1$, $t+2$, and $t+3$. Panel A considers all patent applications (*Total Patent (log)*) in columns (1) to (3) and patents jointly filed with universities (*University Total Patent (log)*) in columns (4) to (6). Panel B restricts the analysis to innovative patents—patents that represent substantive new inventions rather than incremental filings—and their university-collaborative counterparts. The key independent variable, *University Paper Retraction (log)*, measures annual retraction exposure originating from universities linked to each firm. All control variables are measured at the firm-year level. Regressions include firm and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively. The values in brackets indicate economic significance of the main independent variable, computed as the product of the coefficient estimate and the independent variable's standard deviation divided by the dependent variable's standard deviation.

Panel A. All Patents

	(1)	(2)	(3)	(4)	(5)	(6)
	Total Patent (log) $(t+1)$	Total Patent (log) $(t+2)$	Total Patent (log) $(t+3)$	University Total Patent (log) $(t+1)$	University Total Patent (log) $(t+2)$	University Total Patent (log) $(t+3)$
University Retraction (log)	-0.1333***	-0.1544***	-0.1278***	-0.0626***	-0.0519***	-0.0403***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
	[-0.0797]	[-0.0923]	[-0.0764]	[-0.5389]	[-0.4463]	[-0.3464]
Collab. Universities (log)	0.7123***	0.3759***	0.1006*	0.7547***	0.0810**	-0.0634*
	(0.000)	(0.000)	(0.094)	(0.000)	(0.013)	(0.056)
Firm Size	0.1369***	0.0677***	0.0023	0.0049	0.0145**	0.0067
	(0.000)	(0.005)	(0.929)	(0.194)	(0.015)	(0.300)
ROA	0.7602***	0.8240***	0.2857**	0.0118	0.0505	0.0647*
	(0.000)	(0.000)	(0.044)	(0.662)	(0.118)	(0.069)
Leverage	-0.0451	-0.0018	-0.0120	-0.0026	0.0066	0.0015
	(0.592)	(0.984)	(0.897)	(0.869)	(0.769)	(0.953)
Market to Book	0.0215***	-0.0134	-0.0458***	0.0034*	0.0043	-0.0019
	(0.008)	(0.107)	(0.000)	(0.091)	(0.141)	(0.441)
Cash Holding	0.0155	-0.0205	-0.0678	0.0179	0.0550**	0.0258
	(0.849)	(0.820)	(0.473)	(0.318)	(0.021)	(0.332)
R&D Intensity	0.1940	0.4908	0.6173	0.0376	-0.0289	-0.0669
	(0.556)	(0.177)	(0.140)	(0.586)	(0.731)	(0.436)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	33,630	28,876	24,675	33,630	28,876	24,675
Adjusted R^2	0.697	0.696	0.699	0.495	0.386	0.391

Table 5: University Paper Retractions and Firm Patent Quantity – continued

Panel B. Innovative Patents

	(1)	(2)	(3)	(4)	(5)	(6)
	Innov Patent (log) $(t+1)$	Innov Patent (log) $(t+2)$	Innov Patent (log) $(t+3)$	University Innov Patent (log) $(t+1)$	University Innov Patent (log) $(t+2)$	University Innov Patent (log) $(t+3)$
University Retraction (log)	-0.0735***	-0.0932***	-0.0764***	-0.0208***	-0.0112***	-0.0054
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.290)
	[0.0669]	[0.0849]	[0.0695]	[0.8391]	[0.4524]	[0.2178]
Collab. Universities (log)	0.4119***	0.2551***	0.0403	0.1716***	0.0276**	-0.0188
	(0.000)	(0.000)	(0.456)	(0.000)	(0.038)	(0.176)
Firm Size	0.0979***	0.0464**	0.0064	0.0010	0.0026	0.0046**
	(0.000)	(0.013)	(0.748)	(0.608)	(0.209)	(0.036)
ROA	0.4938***	0.6931***	0.2001*	0.0039	0.0115	-0.0107
	(0.000)	(0.000)	(0.067)	(0.727)	(0.351)	(0.456)
Leverage	-0.0607	-0.0268	-0.0732	-0.0015	-0.0031	-0.0081
	(0.376)	(0.711)	(0.329)	(0.851)	(0.717)	(0.433)
Market to Book	0.0202***	-0.0062	-0.0197***	0.0002	0.0017*	0.0013
	(0.002)	(0.349)	(0.010)	(0.855)	(0.086)	(0.143)
Cash Holding	-0.0305	-0.0664	-0.1098	0.0059	-0.0073	-0.0005
	(0.653)	(0.357)	(0.139)	(0.496)	(0.444)	(0.963)
R&D Intensity	0.1554	0.2900	0.2111	-0.0092	0.0219	-0.0180
	(0.493)	(0.226)	(0.427)	(0.749)	(0.469)	(0.532)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	33,630	28,876	24,675	33,630	28,876	24,675
Adjusted R^2	0.667	0.668	0.671	0.325	0.297	0.298

Table 6: University Paper Retractions and Firm Patent Citations

This table reports regression estimates assessing how university paper retractions influence the forward-looking citation impact of firms' patents. The dependent variables are the logarithms of average citations received in years $t+1$, $t+2$, and $t+3$. Panel A examines citation counts for all firm patents (*Total Citation (log)*) and the subset jointly filed with universities (*University Total Citation (log)*). Panel B restricts the analysis to innovative patents—patents that represent substantive new inventions rather than incremental filings—and their university-collaborative counterparts. The main independent variable, *University Paper Retraction (log)*, captures annual retraction exposure arising from universities connected to each firm. All regressions control for firm-year characteristics and include firm and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively. The values in brackets indicate economic significance of the main independent variable, computed as the product of the coefficient estimate and the independent variable's standard deviation divided by the dependent variable's standard deviation.

Panel A. All Patents

	(1)	(2)	(3)	(4)	(5)	(6)
	Total Cit (log) $(t+1)$	Total Cit (log) $(t+2)$	Total Cit (log) $(t+3)$	University Total Cit (log) $(t+1)$	University Total Cit (log) $(t+2)$	University Total Cit (log) $(t+3)$
University Retraction (log)	-0.0615***	-0.0359***	-0.0075	-0.0737***	-0.0386***	-0.0123
	(0.000)	(0.000)	(0.395)	(0.000)	(0.000)	(0.315)
	[-0.1263]	[-0.0739]	[-0.0154]	[-0.8253]	[-0.4325]	[-0.1373]
Collab. Universities (log)	0.1700***	-0.0134	-0.1077***	0.5850***	-0.0558**	-0.2058***
	(0.000)	(0.582)	(0.000)	(0.000)	(0.031)	(0.000)
Firm Size	0.0509***	0.0385***	0.0328***	0.0142***	0.0223***	0.0172**
	(0.000)	(0.001)	(0.006)	(0.009)	(0.001)	(0.015)
ROA	0.0050	-0.0512	-0.1704***	-0.0405	-0.0099	-0.0196
	(0.930)	(0.371)	(0.004)	(0.178)	(0.768)	(0.583)
Leverage	-0.0311	-0.0711	-0.1015**	0.0015	-0.0001	-0.0182
	(0.465)	(0.101)	(0.022)	(0.940)	(0.997)	(0.490)
Market to Book	-0.0001	-0.0092**	-0.0086**	0.0064***	0.0046*	-0.0019
	(0.985)	(0.019)	(0.036)	(0.004)	(0.060)	(0.401)
Cash Holding	0.1325***	0.0730	0.1061**	-0.0373*	0.0015	-0.0321
	(0.002)	(0.123)	(0.025)	(0.079)	(0.958)	(0.247)
R&D Intensity	-0.0830	-0.1349	0.0906	0.0281	-0.0963	-0.0780
	(0.644)	(0.474)	(0.645)	(0.754)	(0.339)	(0.463)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	33,630	28,876	24,675	33,630	28,876	24,675
Adjusted R^2	0.502	0.503	0.505	0.272	0.212	0.221

Table 6: University Paper Retractions and Firm Patent Citations – continued

Panel B. Innovative Patents

	(1)	(2)	(3)	(4)	(5)	(6)
	Innov Cit (log) $(t+1)$	Innov Cit (log) $(t+2)$	Innov Cit (log) $(t+3)$	University Innov Cit (log) $(t+1)$	University Innov Cit (log) $(t+2)$	University Innov Cit (log) $(t+3)$
University Retraction (log)	-0.0311***	-0.0135**	0.0060	-0.0191***	-0.0056	0.0037
	(0.000)	(0.047)	(0.437)	(0.000)	(0.139)	(0.468)
	[0.1189]	[0.0519]	[0.0229]	[1.3700]	[0.4000]	[0.2650]
Collab. Universities (log)	0.0464**	-0.0221	-0.1030***	0.1008***	-0.0060	-0.0526***
	(0.031)	(0.272)	(0.000)	(0.000)	(0.595)	(0.000)
Firm Size	0.0323***	0.0301***	0.0290***	0.0008	0.0034*	0.0063***
	(0.000)	(0.001)	(0.001)	(0.675)	(0.075)	(0.007)
ROA	-0.0198	0.0016	-0.0819*	-0.0083	-0.0031	-0.0190
	(0.624)	(0.969)	(0.051)	(0.369)	(0.745)	(0.152)
Leverage	-0.0746**	-0.1140***	-0.1367***	0.0051	-0.0037	-0.0097
	(0.015)	(0.000)	(0.000)	(0.454)	(0.628)	(0.241)
Market to Book	-0.0004	-0.0060**	-0.0044	0.0002	0.0011*	0.0007
	(0.894)	(0.048)	(0.154)	(0.756)	(0.063)	(0.419)
Cash Holding	0.0485	0.0212	0.0509	0.0018	-0.0164**	-0.0159*
	(0.139)	(0.532)	(0.143)	(0.824)	(0.039)	(0.070)
R&D Intensity	0.2596**	0.2032	0.2267	0.0343**	0.0399**	-0.0170
	(0.037)	(0.139)	(0.106)	(0.041)	(0.047)	(0.450)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	33,630	28,876	24,675	33,630	28,876	24,675
Adjusted R^2	0.431	0.427	0.423	0.119	0.102	0.108

Table 7: University Paper Retractions and Efficiency of Quantity

This table reports regression estimates linking university paper retractions to firms' innovation efficiency measured as patent output relative to R&D investment. The dependent variables are the ratios of total patents or university related patents to total R&D expenditures at horizons $t+1$, $t+2$, and $t+3$. *University Paper Retraction (log)* captures retraction exposure from affiliated universities in year t. All control variables are measured at the firm-year level. All regressions include firm and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively. The values in brackets indicate economic significance of the main independent variable, computed as the product of the coefficient estimate and the independent variable's standard deviation divided by the dependent variable's standard deviation.

	(1)	(2)	(3)	(4)	(5)	(6)
	Total Patent/ Total R&D ($t+1$)	Total Patent/ Total R&D ($t+2$)	Total Patent/ Total R&D ($t+3$)	University Total Patent/ Total R&D ($t+1$)	University Total Patent/ Total R&D ($t+2$)	University Total Patent/ Total R&D ($t+3$)
University Retraction (log)	-0.0181**	-0.0186**	-0.0017	-0.0019***	-0.0014***	-0.0010**
	(0.041)	(0.034)	(0.851)	(0.000)	(0.000)	(0.025)
	[-0.0647]	[-0.0665]	[-0.0061]	[-0.5884]	[-0.4335]	[-0.3097]
Collab. Universities (log)	0.0697***	0.0002	-0.0711***	0.0213***	-0.0013	-0.0051***
	(0.008)	(0.993)	(0.004)	(0.000)	(0.204)	(0.000)
Firm Size	-0.0319***	-0.0314***	-0.0227**	-0.0002	0.0001	0.0001
	(0.002)	(0.001)	(0.029)	(0.476)	(0.769)	(0.713)
ROA	-0.0811	-0.0595	-0.1676***	-0.0032**	-0.0013	-0.0010
	(0.125)	(0.277)	(0.003)	(0.043)	(0.408)	(0.495)
Leverage	-0.0946**	-0.0875**	-0.0496	-0.0002	-0.0000	-0.0001
	(0.014)	(0.024)	(0.218)	(0.788)	(0.984)	(0.933)
Market to Book	-0.0029	-0.0048	-0.0049	0.0001	0.0001	-0.0001
	(0.447)	(0.149)	(0.148)	(0.295)	(0.347)	(0.459)
Cash Holding	0.1109***	0.0738*	0.0656*	0.0002	0.0009	-0.0002
	(0.005)	(0.052)	(0.078)	(0.873)	(0.415)	(0.861)
R&D Intensity	-1.6038***	-0.5373***	-0.0153	-0.0147***	-0.0111***	-0.0080**
	(0.000)	(0.000)	(0.899)	(0.000)	(0.002)	(0.035)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	33,630	28,239	24,028	33,630	28,239	24,028
Adjusted R^2	0.419	0.435	0.448	0.283	0.219	0.221

Table 8: University Paper Retractions and Efficiency of Quality

This table reports regression estimates linking university paper retractions to firms' innovation efficiency, measured as patent citations relative to R&D investment. The dependent variables are the ratios of total patent citations or university related patent citations to total R&D expenditure at horizons $t+1$, $t+2$, and $t+3$. *University Paper Retraction (log)* captures retraction exposure from affiliated universities in year t. All control variables are measured at the firm-year level. All regressions include firm and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively. The values in brackets indicate economic significance of the main independent variable, computed as the product of the coefficient estimate and the independent variable's standard deviation divided by the dependent variable's standard deviation.

	(1)	(2)	(3)	(4)	(5)	(6)
	Total Cit/ Total R&D ($t+1$)	Total Cit/ Total R&D ($t+2$)	Total Cit/ Total R&D ($t+3$)	University Total Cit/ Total R&D ($t+1$)	University Total Cit/ Total R&D ($t+2$)	University Total Cit/ Total R&D ($t+3$)
University Retraction (log)	-0.0691***	-0.0193	0.0437*	-0.0080***	-0.0029*	-0.0011
	(0.009)	(0.415)	(0.063)	(0.000)	(0.059)	(0.540)
	[-0.1280]	[-0.0358]	[0.0811]	[-0.8260]	[-0.2990]	[-0.1140]
Collab. Universities (log)	0.1057	-0.1866**	-0.3732***	0.0651***	-0.0131***	-0.0264***
	(0.229)	(0.017)	(0.000)	(0.000)	(0.001)	(0.000)
Firm Size	-0.0316	-0.0274	-0.0206	0.0010	0.0013	0.0014
	(0.334)	(0.393)	(0.535)	(0.287)	(0.195)	(0.157)
ROA	-0.3872***	-0.3255**	-0.4733***	-0.0105*	-0.0075	-0.0069
	(0.008)	(0.020)	(0.002)	(0.051)	(0.168)	(0.177)
Leverage	-0.1824	-0.2204**	-0.1458	-0.0016	-0.0008	-0.0046
	(0.118)	(0.044)	(0.198)	(0.660)	(0.848)	(0.280)
Market to Book	-0.0015	-0.0143	-0.0186**	0.0006	0.0006	-0.0000
	(0.901)	(0.159)	(0.037)	(0.128)	(0.156)	(0.987)
Cash Holding	0.5528***	0.3825***	0.4710***	-0.0043	0.0008	-0.0052
	(0.000)	(0.001)	(0.000)	(0.260)	(0.856)	(0.245)
R&D Intensity	-3.4444***	-1.0184**	0.0729	-0.0413***	-0.0320**	-0.0210
	(0.000)	(0.020)	(0.862)	(0.005)	(0.025)	(0.172)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	33,630	28,239	24,028	33,630	28,239	24,028
Adjusted R^2	0.354	0.357	0.372	0.200	0.164	0.165

Table 9: University Paper Retractions and Firm R&D Inputs

This table reports regression estimates examining the impact of university paper retractions on firms' subsequent R&D inputs. The dependent variable is *R&D Intensity*, observed in years $t+1$, $t+2$, and $t+3$. *University Paper Retraction (log)* captures the log-transformed number of retractions associated with universities connected to each firm. In Columns (4)-(6), we additionally include the interaction between an indicator of *Negative Market Reaction* and *University Paper Retraction (log)*, to study whether market responses moderate firms' R&D adjustments. All control variables are measured at the firm-year level. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively. The values in brackets indicate economic significance of each of the two main independent variables, computed as the product of the coefficient estimate and the independent variable's standard deviation divided by the dependent variable's standard deviation.

	(1)	(2)	(3)	(4)	(5)	(6)
	R&D Intensity $(t+1)$	R&D Intensity $(t+2)$	R&D Intensity $(t+3)$	R&D Intensity $(t+1)$	R&D Intensity $(t+2)$	R&D Intensity $(t+3)$
University Retraction (log)	-0.0004	-0.0004	-0.0001	-0.0001	-0.0004	-0.0001
	(0.270)	(0.308)	(0.867)	(0.691)	(0.305)	(0.880)
	[-0.0076]	[-0.0076]	[-0.0019]	[-0.0019]	[-0.0076]	[-0.0019]
University Retraction (log) ×				-0.0005**	0.0001	-0.0000
Negative Market Reaction				(0.030)	(0.775)	(0.990)
				[-0.0095]	[0.0019]	[-0.0000]
Collab. Universities (log)	-0.0008	-0.0011	-0.0022**	-0.0007	-0.0011	-0.0022**
	(0.463)	(0.285)	(0.019)	(0.473)	(0.284)	(0.019)
Firm Size	0.0028***	0.0050***	0.0060***	0.0028***	0.0050***	0.0060***
	(0.005)	(0.000)	(0.000)	(0.005)	(0.000)	(0.000)
ROA	-0.0342***	-0.0057	0.0026	-0.0342***	-0.0057	0.0026
	(0.000)	(0.248)	(0.636)	(0.000)	(0.249)	(0.636)
Leverage	-0.0275***	-0.0189***	-0.0151***	-0.0275***	-0.0189***	-0.0151***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market to Book	-0.0003	-0.0001	0.0004	-0.0004	-0.0001	0.0004
	(0.236)	(0.759)	(0.302)	(0.232)	(0.761)	(0.302)
Cash Holding	0.0019	0.0040	0.0010	0.0018	0.0040	0.0010
	(0.610)	(0.275)	(0.796)	(0.618)	(0.275)	(0.796)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	29,838	26,398	23,587	29,838	26,398	23,587
Adjusted R^2	0.797	0.788	0.787	0.797	0.788	0.787

Table 10: University-Firm-Year Evidence

This table reports regression estimates examining whether university paper retractions affect the likelihood that a firm-university pair forms a collaboration in subsequent years. The dependent variable is *Collaboration (dummy, t+k)*, which equals one if firm i and university u jointly file any patents in the subsequent k years following year t, where $k = 1, 2$, or 3. The key independent variable, *Paired University Retraction (log)*, measures the number of retractions at university u in year t. Columns (1)-(3) include firm, university, and year fixed effects. Columns (4)-(6) additionally include firm-university pair fixed effects to absorb all time-invariant characteristics of the collaborative relationship. All control variables are measured at the firm-university-year level. Standard errors are clustered at the firm-university pair level and reported in parentheses. $*$, $*$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively. The values in brackets indicate economic significance of the main independent variable, computed as the product of the coefficient estimate and the independent variable's standard deviation divided by the dependent variable's standard deviation.

	(1)	(2)	(3)	(4)	(5)	(6)
	Collab. (dummy, $t+1$)	Collab. (dummy, $t+2$)	Collab. (dummy, $t+3$)	Collab. (dummy, $t+1$)	Collab. (dummy, $t+2$)	Collab. (dummy, $t+3$)
Paired University	-0.0073*	-0.0103*	-0.0175**	-0.0076*	-0.0107*	-0.0180**
Retraction (log)	(0.067)	(0.083)	(0.019)	(0.054)	(0.078)	(0.018)
	[-0.0614]	[-0.0480]	[-0.0566]	[-0.0639]	[-0.0500]	[-0.0583]
Collab. Universities (log)	0.0397***	0.0203	-0.0057	0.0397***	0.0202	-0.0057
	(0.000)	(0.122)	(0.713)	(0.000)	-0.12	(0.711)
Firm Size	0.0550***	0.0742***	0.0902***	0.0550***	0.0742***	0.0902***
	(0.000)	(0.002)	(0.005)	(0.000)	(0.001)	(0.005)
ROA	0.0074	0.1499	0.2400	0.0074	0.1499	0.2400
	(0.937)	(0.259)	(0.127)	(0.936)	(0.256)	(0.125)
Leverage	0.0023	0.0564	0.0324	0.0024	0.0564	0.0325
	(0.960)	(0.448)	(0.737)	(0.959)	(0.444)	(0.734)
Market to Book	0.0058	0.0052	0.0045	0.0058	0.0052	0.0045
	(0.276)	(0.553)	(0.647)	(0.272)	(0.550)	(0.645)
Cash Holding	-0.0175	0.0108	0.0224	-0.0175	0.0108	0.0225
	(0.660)	(0.864)	(0.778)	(0.658)	(0.862)	(0.776)
R&D Intensity	0.2493	0.1055	-0.1389	0.2494	0.1056	-0.1387
	(0.235)	(0.705)	(0.685)	(0.232)	(0.702)	(0.683)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
University FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
# Obs.	18,581	18,581	18,581	18,565	18,565	18,565
Adjusted R^2	0.068	0.108	0.131	0.146	0.185	0.196

Table 11: University Paper Retractions and New Collaborations

This table reports regression estimates examining whether university paper retractions affect firms' propensity to form new university collaborations. The dependent variable is *New University Collaboration (log, t+k)*, which is the natural logarithm of one plus the annual number of university partners that newly appear as co-applicants relative to the firm's pre-existing collaboration network in the subsequent k years following year t, where $k = 1, 2$, or 3. *University Paper Retraction (log)* represents the log-transformed count of retractions occurring at universities linked to each firm in year t. All control variables are measured at the firm-year level. All regressions include firm fixed effects and year fixed effects. Standard errors are clustered at the firm level and reported in parentheses. $*$, $**$, and $***$ denote significance at the 10%, 5%, and 1% levels, respectively. The values in brackets indicate economic significance of the main independent variable, computed as the product of the coefficient estimate and the independent variable's standard deviation divided by the dependent variable's standard deviation.

	New University Collab. (log, $t+1$)	New University Collab. (log, $t+2$)	New University Collab. (log, $t+3$)
University Retraction (log)	-0.0338***	-0.0213***	-0.0100
	(0.000)	(0.000)	(0.210)
	[-0.848]	[-0.258]	[-0.083]
Collab. Universities (log)	0.3607***	0.2837***	0.1505***
	(0.000)	(0.000)	(0.000)
Firm Size	0.0009	0.0096**	0.0109*
	(0.615)	(0.010)	(0.068)
ROA	0.0060	0.0612***	0.1054***
	(0.620)	(0.003)	(0.000)
Leverage	0.0006	-0.0057	-0.0022
	(0.937)	(0.711)	(0.925)
Market to Book	0.0014*	0.0029*	0.0038*
	(0.087)	(0.052)	(0.073)
Cash Holding	0.0095	0.0326**	0.0425**
	(0.216)	(0.023)	(0.044)
R&D Intensity	0.0111	-0.0473	-0.1217*
	(0.668)	(0.285)	(0.059)
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
# Obs.	33,630	28,876	24,675
Adjusted R^2	0.305	0.404	0.491

Table A1: Variable Definitions

Variable	Definition
Retraction (dummy)	An indicator that equals one if any of the universities linked to a firm experience at least one paper retraction on a day.
High Retraction (dummy)	An indicator that equals one if the firm is associated with more than three retractions on a day.
High Concern Retraction (dummy)	An indicator that equals one if the firm's associated retractions involve more than three stated issues or concerns.
High University Collaboration (dummy)	An indicator that equals one if the firm has collaborated with more than one university prior to the event.
CAR MM [-1, +1]	The cumulative abnormal returns from one day before to one day after a retraction event using the market model.
CAR MM [-3, +3]	The cumulative abnormal returns from three days before to three days after a retraction event using the market model.
CAR MM [-5, +5]	The cumulative abnormal returns from five days before to five days after a retraction event using the market model.
CAR FF3 [-1, +1]	The cumulative abnormal returns from one day before to one day after a retraction event using the Fama–French three-factor model.
CAR FF3 [-3, +3]	The cumulative abnormal returns from three days before to three days after a retraction event using the Fama–French three-factor model.
CAR FF3 [-5, +5]	The cumulative abnormal returns from five days before to five days after a retraction event using the Fama–French three-factor model.
University Paper Retraction (log)	The natural logarithm of one plus the number of total retractions associated with a firm in a year.
Total Patent (log)	The natural logarithm of one plus the total number of all patents that a firm applies for (and are eventually granted) in a year.
University Total Patent (log)	The natural logarithm of one plus the total number of all patents that a firm co-files with universities (and are eventually granted) in a year.
Innovative Patent (log)	The natural logarithm of one plus the number of innovative patents that a firm applies for (and are eventually granted) in a year.
University Innovative Patent (log)	The natural logarithm of one plus the number of innovative patents that a firm co-files with universities (and are eventually granted) in a year.
Average Total Citation (log)	The natural logarithm of one plus the average lifetime citations per patent for all patents that a firm applies for in a year.
Average University Total Citation (log)	The natural logarithm of one plus the average lifetime citations per patent for all patents that a firm co-files with universities in a year.

Table A1: Variable Definitions – continued

Variable	Definition
Average Innovative Citation (log)	The natural logarithm of one plus the average lifetime citations per patent for innovative patents that a firm applies for in a year.
Average University Innovative Patent Citation (log)	The natural logarithm of one plus the average lifetime citations per patent for innovative patents that a firm co-files with universities in a year.
R&D Intensity	The ratio of a firm's annual R&D spending to total assets.
Total Patent / Total R&D	The ratio of the number of all patents that a firm applies for in a year to R&D expenditure in that year.
University Total Patent / Total R&D	The ratio of the number of all patents that a firm co-files with universities in a year to R&D expenditure in that year.
Total Citation / Total R&D	The ratio of the total lifetime citations of all patents that a firm applies for in a year to R&D expenditure in that year.
University Total Citation / Total R&D	The ratio of the total lifetime citations of all patents that a firm co-files with universities in a year to R&D expenditure in that year.
New University Collaboration (log, $t+k$)	The natural logarithm of one plus the annual number of university partners that newly appear as co-applicants relative to the firm's pre-existing collaboration network in the subsequent k years following year t, where $k = 1, 2$, or 3.
Collaborated Universities (log)	The natural logarithm of one plus the total number of universities linked to a firm in a year.
Firm Size	The logarithm of a firm's total assets in a year.
ROA	The ratio of net income to total assets of a firm in a year.
Leverage	The ratio of total debt to total assets of a firm in a year.
Market to Book	The ratio of the market value of equity to the book value of equity of a firm in a year.
Cash Holding	The ratio of cash and cash equivalents to total assets of a firm in a year.
Paired University Retraction (log)	The natural logarithm of one plus the number of retractions by a linked university of a firm in a year.
Collaboration (dummy, $t+k$)	An indicator that equals one if the firm and the university jointly file any patents in the subsequent k years following year t, and zero otherwise.