Mandatory ESG Disclosure, Earnings Pressure and Corporate Venture Capital

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Abstract: We present initial evidence that mandatory Environmental, Social, and Governance (ESG) disclosure drives firms to engage in Corporate Venture Capital (CVC) investments in China. This effect stems from deterioration in internal innovation: firms facing earnings pressure from mandatory ESG disclosures tend to reduce R&D expenditures, which in turn increases their likelihood of pursuing CVC activities as an alternative innovation strategy. Moreover, we find that this effect is stronger for firms under greater pressure to meet earnings expectations, facing declining profitability or fewer financial constraints, and with higher innovation demands. Further, mandatory ESG disclosure is associated with CVC success, as evidenced by higher exit rates and superior financial returns. Lastly, compared to other firms, those subject to mandatory ESG reporting and involved in CVC activities exhibit higher levels of innovation output and more knowledge flows from their targets to CVC parents. Overall, our findings suggest that the earnings pressure induced by mandatory ESG disclosure leads firms to shift toward CVC investment as a strategy for outsourcing innovation.

Keywords: ESG; mandatory disclosure; earnings pressure; corporate venture capital

1. Introduction

The growing emphasis on socio-economic development and environmental sustainability has triggered a global movement toward mandating corporate disclosure of their Environmental, Social, and Governance (ESG) and/or Corporate Social Responsibility (CSR) activities. [1] For example, in 2013, the European Commission adopted a proposal for a directive to enhance the transparency of certain large firms on social and environmental matters (Hung et al., 2013; Ioannou and Serafeim, 2019; Fiechter et al., 2022). This trend toward mandatory ESG disclosure has garnered significant attention from investors and other corporate stakeholders. Although prior research documents the effects of mandatory ESG disclosure on various aspects, such as those on firms' profitability, value, investment, financial reporting, and environmental footprint (Lin et al., 2024; Krueger et al., 2024; Christensen et al., 2021; Downar et al., 2021; Dhaliwal et al., 2011), its influence on the choice of corporate innovation strategies remains underexplored. This paper investigates how mandatory ESG disclosure affects firms' engagement in Corporate Venture Capital (CVC). Given the prevalence of CVC as a strategic investment vehicle adopted by numerous firms to access external knowledge (Nelson, 1982; Telser, 1982; Jovanovic and Rob, 1989; Ma, 2020), understanding this relationship addresses an emerging and important research question.

To investigate our research question, we focus on a China's mandatory adoption of ESG disclosure. We believe that choosing China as our research setting to study the effects of ESG disclosure on corporate CVC investments distinguishes our paper for several reasons. First, given that the Chinese government is arguably the most influential

[1] In this paper, we consider ESG and CSR disclosure to be synonymous terms (e.g., Tsang et al., 2023), although ESG encompasses corporate governance aspects that are not included in CSR.

stakeholder in China, the mandate was essentially a binding government requirement with strong enforcement mechanisms. Second, non-compliance with mandatory ESG disclosure means stock delisting and public condemnation of firms and managers in charge (Chen et al., 2018). Thus, the mandate created strong pressure on firms to adhere to the regulations. Third, China's CVC market has matured remarkably over the past two decades since 1998, with firms increasingly leveraging CVC as a strategic instrument for innovation and market expansion. The market's remarkable growth is evidenced by a tenfold rise in annual investment deals from approximately 100 deals in 2012 to over 1,000 in recent years. Collectively, these institutional features make China an ideal setting for investigating the effect of mandatory ESG disclosure on CVC activities.

Since innovation is a critical driver of long-term economic growth and competitive advantage for nations (Schumpeter, 1942), many firms pursuing radical innovation to establish sustainable competitive edges (Weber and Weber, 2007). Firms can invest in innovation through internal and external channels, exemplified by research and development (R&D) activities and corporate venture capital (CVC) investments, respectively. These two strategies exhibit distinct characteristics. While R&D investment is a direct pathway to acquire technology, it requires immediate expense recognition and substantial costs, creating significant short-term earnings pressure (Graham et al., 2005; Hall and Lerner, 2010). Moreover, the returns from R&D investments remain uncertain due to long project periods and high failure risks (Cuervo-Cazurra and Un, 2010). This leads firms, especially those underperforming, to reduce R&D spending (Chen and Miller, 2007; Terry, 2023). In contrast, CVC investment, due to its capitalization treatment, has a smaller effect on current earnings (Guo et al., 2019). Furthermore, corporate investors can

achieve financial returns through successful exits (Kang et al., 2022). Additionally, CVC investment complements internal R&D by providing access to radical innovations from startups, which are often more innovative and agile in developing breakthrough technologies (Kortum and Lerner, 2000; Dushnitsky and Lenox, 2005b).

Mandatory ESG disclosure imposes pressure on firms' short-term performance by requiring investment in non-profit ESG activities (Giuli and Kostovetsky, 2014; Kruger, 2015; Manchiraju et al., 2017; Chen et al., 2018). To meet short-term profit targets, firms might cut back on R&D expenses (Baber, 1991; Bushee, 1998; Gentry and Shen, 2013; Terry, 2023). Moreover, the heightened transparency from ESG disclosure increases scrutiny on firms (Hung et al., 2013; Marquis and Qian 2014; Chen et al., 2018; Darendeli et al., 2022), further intensifying earnings pressure. This pressure, stemming from reduced book profits and increased external monitoring under mandatory ESG disclosure, will cause reduction in internal R&D spending. To relieve short-term earnings pressure and maintain their innovation capabilities, we argue that firms will strategically pivot towards CVC investments to access new technologies. Therefore, we expect that mandatory ESG disclosure incentivizes firms to engage in CVC activities.

We use mandatory ESG disclosure in China to test our hypothesis. In December 2008, Shanghai Stock Exchange (SSE) and Shenzhen Stock Exchange (SZSE) implemented mandatory ESG disclosure regulations. Two aspects characterize this setting. First, firms included in the SSE Corporate Governance Sector and SZSE 100 Index lists were required to issue a ESG report along with their annual report. Whether a firm enters the SSE Corporate Governance Sector was evaluated by the SSE corporate governance assessment group consisting of securities companies, fund management companies, insurance

companies, rating agencies, and specialized research institutions. Similarly, entry into the SZSE 100 Index was determined by its average market value and average trading volume, which are largely beyond managerial discretion. Second, the compositions of the firms included in the SSE Corporate Governance Sector and SZSE 100 Index lists undergo adjustments each year. This results in a staggered implementation of the mandate, as a limited number of firms are added to or removed from the lists each year, thus generating a quasi-experimental setting with time-staggered treatment effects, ideal for empirical analysis.

We employ a stacked Difference-in-Differences (DiD) approach to examine differences in CVC activities between mandatory ESG reporting firms and non-mandated firms before and after the implementation of the mandate. Our results show that mandatory ESG disclosure significantly increases the possibility and frequency of CVC investments for mandatory ESG reporting firms compared with non-mandated firms. The economic significance of this effect is substantial: the relative increase in the possibility and frequency of CVC strategy of mandatory ESG reporting firms corresponds to approximately 28% and 39% of the average in our sample, respectively. This result indicates that mandatory ESG disclosure incentivizes firms to adopt CVC strategy.

Next, we examine the channel through which mandatory ESG disclosure affects firms' CVC activities. We find that mandatory ESG disclosure increases the possibility of R&D cutback. Moreover, firms that cut R&D expenses following the mandate are more likely to engage in CVC activities. These findings further confirm our theoretical conjecture that earnings pressure triggered by mandatory ESG disclosure prompts firms to shift from internal innovation strategy to external innovation strategy.

We also conduct cross-sectional analyses to substantiate the role of earnings pressure. First, we find that following the mandatory ESG disclosure, firms exhibit higher likelihood and frequency of CVC investments when managerial incentives to meet or beat earnings expectations are stronger, consistent with our prediction that earnings pressure drives CVC engagement. Second, our results show that the greater the extent of profitability deterioration in the previous year, the higher the likelihood and frequency of firm engaging in CVC activities following the ESG disclosure mandate, suggesting that declining performance intensifies firms' response to the disclosure mandate. Third, we find that this effect is stronger for less financially constrained firms, reflecting the role of financial resources in determining firms' innovation strategies under earnings pressure. Fourth, firms with higher innovation demands show stronger CVC engagement, indicating that firms indeed use CVC investments to maintain their innovation capabilities. Collectively, this cross-sectional evidence further strengthens our conjecture that firms strategically adopt CVC investments to maintain their innovation capabilities in response to the earnings pressure triggered by mandatory ESG disclosure.

Furthermore, we examine the implications of mandatory ESG disclosure for CVC success. We document that mandated firms are more likely to exit through initial public offerings (IPOs) or Mergers and Acquisitions (M&As). Additionally, they tend to yield higher financial returns from CVC investments. These results suggest a positive link between mandatory ESG disclosure and CVC success and indicate that CVC investments, emerging as an unintended consequence of mandatory ESG disclosure, help mitigate the earnings pressure associated with mandatory ESG disclosures.

Finally, we extend our analysis to investigate how CVC activities driven by mandatory

ESG disclosure affect innovation performance. First, we focus on innovation output and find that firms involved in CVC activities under the earnings pressure induced by mandatory ESG disclosure generate more innovation outputs. Second, we focus on knowledge flow, which is manifested through two dimensions: direct knowledge acquisition from portfolio firms (measured by whether parent firms cite patents owned by their portfolio firms) and utilization of portfolio firms' existing knowledge space (measured by whether parent firms cite patents previously cited by their portfolio firms). We document that firms CVC investments triggered by mandatory ESG disclosure can strengthen the knowledge exchange between parent firms and their portfolio firms. Taken together, these results suggest that CVC strategy serves as an effective strategy for mandated firms to sustain innovation under earnings pressure.

Our paper contributes to two lines of research. First, we add to the literature on the real effects of non-financial information disclosure. Existing literature has examined the effect of ESG disclosure on corporate performance, financing, investment, and other firm behaviors (e.g., Dhaliwal et al., 2011; Chen et al., 2018; Grewal et al., 2019; Fiechter et al., 2022). Our paper is unique in demonstrating the effect of mandatory ESG disclosure on corporate innovation strategy, shedding new light on the consequences of mandatory ESG disclosure. Specifically, we study its impact on CVC investment, an alternative way to acquire external technologies beyond the boundaries of firms. We find that mandatory ESG disclosure is associated with higher possibility and frequency of CVC investment, which in turn drives greater innovation output and higher possibility of CVC success, defined as exits via IPO or M&A and higher financial returns. These unexpected effects highlight the role of earnings pressure caused by mandatory ESG disclosure in shaping corporate

innovation strategy.

Second, our paper also contributes to the literature on determinants of CVC investments. Prior literature documents that technology acquisition is one of the most important drivers of CVC investments, which effectively complement internal R&D spending in enhancing incumbent firms' innovation capabilities (Dushnitsky and Lenox, 2005b; Cassiman and Veugelers, 2006; Wadhwa et al., 2016; Hamm et al., 2018). Firms typically initiate CVC programs following deteriorations in internal innovation, invest in startups that innovate in parent firms' weakening technological classes, and terminate these programs when internal innovation recovers (Ma, 2020). Since managers are more inclined to cut R&D expenses in response to a decrease in earnings (Baber, 1991; Bushee, 1998; Gentry and Shen, 2013; Terry, 2023), the earnings pressure induced by mandatory ESG disclosure can alter firms' innovation strategies, prompting them to rely more on CVC investments for innovation after mandatory ESG disclosure. Our findings offer new insights into how strategic considerations influence the CVCs' decisions and what drives firms to engage in CVC activities.

2. Institutional Background and Hypothesis

2.1 Institutional Background

2.1.1 The Evolution of CVC in China

China's CVC market has matured remarkably over the past two decades. CVC has recently emerged as a vital force within China's innovation landscape, with corporations, particularly in the technology and manufacturing sectors, increasingly leveraging it as a strategic tool for innovation and market expansion. According to China Bridge's statistics, the number of CVC institutions grew from 631 to 747 between 2012 and 2022, reflecting

a compound annual growth rate of 1.70%. We also compiled statistics on the number and value of CVC investments in China between 2005 to 2022 (shown in Figure 1), which clearly indicate the rapid growth of China's CVC market in recent years. Meanwhile, the Chinese government has complemented this market development with supportive policy initiatives, emphasizing the central role of enterprises in driving innovation. At the local level, municipalities such as Shanghai and Shenzhen have implemented targeted support measures, including specialized policies for CVC institutions and the development of dedicated fund of funds (FOF) programs focused on CVC investments.

[Insert Figure 1 here]

2.1.2 Mandatory ESG Disclosure Policy in China

ESG has emerged as another critical dimension of firm development. With increasing attention to the social externalities of corporate actions, ESG disclosure has become one of the most important initiatives to promote sustainable economic development in countries around the world. To address public concerns about ESG practices of listed firms in China, the Chinese government has implemented several CSR-related initiatives in recent decades. For example, the 2002 "Guidelines for Governance of Listed Companies" stipulated that firms should undertake social responsibilities in their operations. The 2006 Chinese Company Law provided a detailed definition of what constitutes CSR. The 2008 "Guidelines on Environmental Disclosure of Companies Listed on Shanghai Stock Exchange" and 2006 "Guidelines on Social Responsibility of Companies Listed on the Shenzhen Stock Exchange" provided additional guidelines to encourage listed firms to fulfill their ESG obligations.

The ESG disclosure mandate was announced in December 2008 by SSE and SZSE.

SSE announced that firms listed in its SSE Corporate Governance Sector list, firms with shares listed abroad, and financial firms would be required to issue a ESG report along with their annual report. Similarly, SZSE released a similar announcement about firms listed in its SZSE 100 Index. The SSE Corporate Governance Sector and SZSE 100 Index lists are subject to annual adjustments, with a limited number of firms being added to and dropped from the lists each year. This staggered adjustment mechanism provides plausibly exogenous variations in treatment for mandatory ESG disclosure, providing an ideal opportunity for us to examine the effect of mandatory ESG disclosure on CVC activities.

We focus on the China setting around this mandatory adoption of CSR disclosure in 2008. Although mandatory CSR disclosure itself is not unique in China, our study benefits from the Chinese setting in several ways. First, given that SSE and SZSE are governed by the China Securities Regulatory Commission, a regulatory unit under the State Council of China, the mandate effectively required firms to prioritize and disclose their ESG activities. Moreover, the mandate stipulated that "firms that fail to provide CSR disclosure are subject to delisting" and that "both the firms and persons in charge are subject to public condemnation" (Chen et al., 2018), creating significant pressure for firms to adhere to the requirements. With rapid development of CVC as a strategic instrument among Chinese firms for pursuing innovation, the China setting serves as an ideal setting for investigating the effect of mandatory ESG disclosure on CVC.

2.2 Hypothesis Development

Given that innovation plays a pivotal role in driving a nation's long-term economic growth and competitive advantage (Schumpeter, 1942), many firms strive for radical innovation to secure sustainable competitive edges (Weber and Weber, 2007). There are

primarily two avenues to acquire technologies: research and development (R&D) investment and corporate venture capital (CVC) investment. We focus on R&D investment and CVC investment as example of internal innovation strategy and external innovation strategy, respectively. R&D investment serves as a direct pathway to technology acquisition (Hall and Lerner, 2010). In addition to this, CVC investment, involving minority equity investments in startups by established firms, stands out as an effective means to externalize R&D efforts (Chesbrough, 2002; MacMillan et al., 2008). This approach has been demonstrated to provide insights into new technologies, blending the attributes of corporate research labs with venture-backed startups (Gompers and Lerner, 2007; Lerner, 2012; Maula et al., 2013; Chemmanur et al., 2014; Wadhwa et al., 2016; Rossi et al., 2020; Battisti et al., 2022; Shuwaikh and Dubocage, 2022).

These two innovation strategies possess distinct characteristics. As R&D expenditures are required to be expensed immediately in most cases, they directly impact short-term earnings (Baber, 1991; Bange and Bondt, 1998; Bushee, 1998; Graham et al., 2005; Gunny, 2010), particularly accompanied with its substantial costs (Hall and Lerner, 2010). Firms typically maintain a high proportion of R&D expenditure, of which the wages and salaries of highly skilled scientists and engineers constitute a significant portion. For example, Huawei invested CNY 164.9 billion (approximately USD 23.2 billion) in R&D, accounting for 23.4% of its total revenue, according to Huawei's Annual Report 2023; SMIC invested USD 707.3 million in R&D in 2023 with 2,362 R&D personnel, and the average compensation for R&D staff was USD 67,000, accounting for approximately 22% of total R&D expenditure. Moreover, because of the long project period and high failure risks associated with investment in R&D (Cuervo-Cazurra and Un, 2010), the profitability of

R&D investments remains uncertain, if realized, accruing in future periods rather than in current periods. Consequently, higher costs and uncertain returns generate significant earnings pressure on firms in the current period. Given this pressure, Chen and Miller (2007) document that underperforming firms, particularly those in financial distress, are less inclined to engage in R&D investment. Terry (2023) find that firms cut spending on R&D to ease short-term earnings pressure because R&D investment reduces current profits. Therefore, managers may decrease R&D investments in order to maintain positive short-term earnings when faced with earnings pressure.

In contrast, CVC investments should have a smaller effect on pretax earnings because capitalized investments can't affect earnings unless through impairment loss, which may not happen for every accounting period as it exists only if the fair value is lower than their costs (Guo et al., 2019). [2] Moreover, corporate investors can directly gain financial benefits by selecting valuable ventures and adding value to their portfolio firms (Dushnitsky and Lenox, 2006; Kang et al., 2022). First, the industry expertise possessed by corporate investors help mitigating information asymmetry problems, facilitating their selection of valuable ventures. Second, corporate investors can provide complementary resources to their portfolio firms, such as manufacturing capability, commercial networks, and in-depth knowledge of market and technology, which increases the likelihood of venture success (i.e., IPO or M&A), ultimately leading to higher financial returns (Gompers and Lerner, 1998; Dushnitsky and Lenox, 2006). Most importantly, CVC

[2] According to the Zero2IPO Database, the average shareholding ratio of VC investments by Chinese listed firms from 2007 to 2021 was 5%. Under the China Accounting Standards (CAS), prior to 2017, listed firms were required to recognize such investments as trading financial assets measured at fair value. The difference between fair value and book value was recognized in current profit or loss if fair value exceeded book value, otherwise recorded as expenses. After 2017, firms must recognize these investments as financial assets measured at fair value through other comprehensive income, with the difference between fair value and book value recorded in equity, without affecting profit or loss for the current period.

investments effectively complement internal R&D spending in increasing incumbent firms' innovation (Dushnitsky and Lenox, 2005b; Cassiman and Veugelers, 2006; Wadhwa et al., 2016; Hamm et al., 2018). Small firms are always motivated to engage in "R&D race" in order to be acquired by large firms (Phillips and Zhdanov, 2013), and are more likely to generate higher innovation output and more radical innovation than established firms (Kortum and Lerner, 2000; Shane, 2001). CVC investments provide a window for corporate parents to learn about the latest innovative ideas of these entrepreneurial ventures. Exposure to new technologies in turn nurtures the innovativeness of corporate parents, which helps increase their future patents (Dushnitsky and Lenox, 2005b; Ma, 2020).

Mandatory ESG disclosure prompts firms to fulfill social responsibility and make investments in non-profit-related ESG activities such as pollution reduction, public relations, and social welfare. Although these investments can improve firms' financial performance by extending customer base, attracting and retaining talented employees, or improving firms' relations with other key stakeholders in the long run (Luo and Bhattacharya, 2006; Edmans, 2012; Flammer, 2015; Lins et al., 2017), they can also come at a substantial cost to firms' short-term performance because firms may be forced to spend on ESG at a sub-optimal level under the pressure of governments, NGOs or any other stakeholders, or these ESG activities would have been undertaken if they are beneficial to performance (Giuli and Kostovetsky, 2014; Kruger, 2015; Manchiraju et al., 2017; Chen et al., 2018). As mandatory ESG disclosure leads to increase in ESG spendings and decrease in book profits, firms facing earnings pressure may be less motivated to engage in R&D activities. Instead, managers will cut back R&D expenses to make up for the lower book profits, driven by a pressing need to meet earning targets and remedy the balance sheet

(Baber, 1991; Bushee, 1998; Gentry and Shen, 2013; Terry, 2023). Furthermore, increased transparency through mandatory ESG disclosure can make it easier for governments and interest groups to monitor firms to ensure politically and socially desirable investment levels and value creation (Marquis and Qian, 2014; Chen et al., 2018; Darendeli et al., 2022). Consequently, firms will face greater earnings pressure and heightened scrutiny in the face of declining performance.

The above circumstances will result in a reduction in internal innovation within the firm due to reduced R&D investment. CVC, as noted by Ma (2020), is used by firms experiencing deterioration in internal innovation to access new technologies, which can be instrumental for increasing their innovation output. Meanwhile, corporate investors can achieve financial benefits through venture selection and value addition, which relieve their short-term earnings pressure caused by mandatory ESG disclosure. In sum, our main hypothesis is stated as follows:

Hypothesis: *Firms have more inclined to adopt CVC strategy following mandatory ESG disclosure.*

3. Research Design

3.1 Data and Sample

Our initial sample consists of all listed Chinese firms over the period from 2005 to 2022. We apply the following criteria: (1) we exclude firm-year observations with voluntary ESG disclosure since our focus is on the effect of mandatory ESG disclosure; [3] (2) we exclude financial firms and foreign share firms as they are subject to different

[3] We identify voluntary ESG reporting firms using ESG spending data in the CSMAR database under the premise that firms spending on ESG have no reason not to report (Lu et al., 2021).

regulations and trading rules; and (3) we exclude observations with missing data for calculating the variables used in this paper. Since the SSE Corporate Governance Sector and SZSE 100 Index lists are subject to annual adjustments, with a small number of firms being added to and dropped from the lists each year, we require that mandated firms not be dropped from the list of being mandated to disclose ESG reports, and benchmark firms to be never mandated during our sample period. [4] We employ a "stacked design" following Gormley and Matsa (2011) and Baker et al. (2022) to address concerns about the use of a staggered DiD approach to study regulatory changes. Treated firms are the mandated firms that were initially included in the mandatory ESG disclosure list, and control firms are never-treated firms during 2008 to 2019. Given that our CVC dataset extends through 2022, we construct cohorts with three years before and after each mandatory disclosure shock. Each cohort is composed of treated observations and control observations in a t-3 to t+3 window around the shock in year t. [5] We require each firm to have non-missing data for at least three years before and after the year of the mandate. By stacking these cohorts, we identify 473 treated firms and 2,388 control firms, with the final sample including 98,784 firm-year observations.

We obtain VC deals from Zero2IPO Database, one of the most commonly used and specialized Chinese VC databases which began to track Chinese VC investments since 2000 and provided detailed information on local deals, including the identities of investors and companies invested, the dates, stages and rounds of investments, and the transaction

[4] A DiD regression with two-way fixed effects can introduce an estimation bias when the already-treated firms act as counterfactuals (i.e., effective control firms) for later-treated firms (Baker et al., 2022). By having our mandated firms not be dropped from the list of being mandated and benchmark firms to be never mandated, we try to address the issue of counterfactuals being contaminated by already-treated firms becoming control firms for later-treated firms.

[5] Following Firth et al. (2014), we exclude the year of mandate (t=0) for a cleaner identification of the treatment effect. The results are similar when we include the year of the mandate in the post-mandate period.

value, exit way, and financial return of each deal. [6] To distinguish investments involving CVCs from those involving normal VCs, we start by identifying CVC investors in each deal, that is, investors that are categorized into public firms, subsidiaries controlled by these public firms, or VC funds in which public firms or their subsidiaries serve as limited partners. We verify every investor manually by cross-checking with full list of public firms from CSMAR and clarifying their ownership networks through China's Administrative Registration Database (CARD). [7] This process leaves us with 1,948 distinct CVC investors, out of which 607 are public firms, 831 are subsidiaries affiliated with public firms, and 528 are VC funds involving public firms or their subsidiaries. Furthermore, we collect data on all venture capital investments made by these CVC investors from the Zero2IPO Database. We retain those investments in non-listed firms from non-financial industries and eventually obtain 19,624 deals during the period from 2005 to 2022. The adjusted lists of SSE Corporate Governance Sector and SZSE 100 Index in each year are manually collected from the announcements of SSE and SZSE. Corporate financial data are collected from both the China Stock Market and Accounting Research (CSMAR).

3.2 Regression Model

Our baseline regression model examines how mandatory ESG disclosure affects firms' CVC activities using the following stacked DiD framework:

$$CVC\_Dum \text{ or } Ln(CVC\_Num+1)_{i,t} = \boldsymbol{\alpha_1 Mandated}_{i,t} + \sum \beta_i Controls_{i,t-1} + \delta_i + \theta_t + \varepsilon_{i,t} \quad (1)$$

where i indexes a firm, and t indicates year. The dependent variable is either the dummy of

[6] For a detailed comparison of Zero2IPO with other domestic and international VC databases, please refer to Chen (2023).
[7] Similar to EDGAR, CARD is an enterprise information query system that provides basic registration information of both public and private firms, such as firm name, date of establishment, registration number, registered capital, and so on. Most importantly, it also provides detailed shareholder information, which allows us to track shareholders or subsidiaries of each investor at multiple levels.

CVC investments (*CVC_Dum*) or the natural logarithm of the number of entrepreneurial firms invested by CVCs plus one (*Ln(CVC_Num)*) in a given year. The variable, *Mandated*, is an indicator variable that takes the value of one after the firm is listed in the SSE Corporate Governance Sector and SZSE 100 Index that are mandated to provide ESG disclosure and zero prior to the mandate. Following Chemmanur et al. (2014), Guo et al. (2019) and Ma (2020), we include a set of control variables including: the natural logarithm of total assets (*Size*); return on assets (*ROA*); total debt divided by total assets (*Leverage*); operating cash flow divided by total assets (*Cash*); sum of market value of equity and book value of debt divided by total book value of assets (*Tobin's Q*); intangible assets divided by total assets (*Intangibility*), the natural logarithm of the number of years since listing plus one (*Ln(Age)*), and an indicator variable for SOEs with a firm being considered as state-owned if the ultimate controlling owner is the government and zero otherwise (*SOE*). The definitions of these variables included in the selection model are provided in Appendix 1. Our baseline specification includes cohort-firm fixed effects (δ_i) and cohort-year fixed effects (θ_t). [8] In this model, we focus on coefficient estimate on *Mandated* (α_1) that captures the difference in the change in CVC activities of mandated firms relative to the change in CVC activities of non-mandated firms following the ESG disclosure mandate. Lastly, we winsorize all continuous variables at the 1st and 99th percentiles before estimating the model. Standard errors are clustered at the cohort-firm level.

3.3 Descriptive Statistics

Table 1 presents the descriptive statistics for the main variables used in this paper. On average, 8.9% of firm-year observations have conducted CVC investments. The average

[8] We also modify this model to include a set of additional fixed effects including industry-year and province-year fixed effects in the robustness tests.

annual number of target firms in our sample is 0.298, and the standard deviation is 2.431, suggesting that the number of target firms exhibits significant cross-sectional variations. On average, our sample exhibits a *ROA* of 2.9%, *Leverage* of 45.5%, *Cash* of 4.3%, *Tobin's Q* of 2.466, *Intangibility* of 4.8%, and *Age* of about 11.2 years old. In addition, 44.7% of the firms in our sample are state-owned enterprises, which is consistent with prior research on the Chinese listed firms.

[Insert Table 1 here]

4. Empirical Results

4.1 Main Results

Table 2 provides the results from estimating Equation (1). In each set of results, we first present results from the baseline model as expressed in Equation (1) without including control variables (columns (1) and (3)). We then layer on control variables in subsequent columns (columns (2) and (4)). In columns (2), we present the results for the dummy of CVC behavior (*CVC_Dum*). The coefficient estimate on *Mandated* is positive and statistically significant at the 5% level. In terms of economic significance, we find that mandatory ESG disclosure increases the possibility of CVC behavior by 2.5%, which corresponds to about 28% of the mean (0.089) of *CVC_Dum*. In columns (4), we present the results for the natural logarithm of the number of target firms plus one (*Ln(CVC_Num)*). The coefficient estimate on *Mandated* is positive and statistically significant at the 1% level. The economic significance of the effect corresponds to approximately 39% of the mean (0.094) of *CVC_Num*. Consistent with the findings of Guo et al. (2019) and Ma (2020), firms with larger size, stronger profitability and higher Tobin's Q tend to have more likelihood of engaging in CVC activities and more firms within their portfolios. In contrast,

firms with lower leverage are less likely to choose CVC strategies. We also document that older firms engage more in CVC activities. Collectively, these results are consistent with our hypothesis that mandatory ESG disclosure drives firms to opt for CVC strategy, as both the possibility of CVC behavior is higher and the number of target firms increases after the mandate.

[Insert Table 2 here]

4.2 Parallel Trends

The empirical validity of the DiD design is based on a parallel trend assumption. That is, CVC activities of mandated firms and non-mandated firms should have a parallel trend before the ESG disclosure mandate. To validate this assumption in our data, we use a dynamic DiD test to examine whether our results support the parallel trend assumption. In Table 3, we replace the *Mandated* variable with indicator variables for years around the year of the ESG disclosure mandate. Specifically, *Pre (-3)*, *Pre (-2)*, *Post (1)*, *Post (2)*, and *Post (3)* are equal to one if a firm-year observation is three years before the mandate, two years before the mandate, one year after the mandate, two years after the mandate, and three years after the mandate, respectively. Accordingly, the benchmark observations are one years before the mandate. We do not have an indicator variable for the year of the mandate as we exclude year t=0 observations from our sample. The coefficient estimates on *Pre (-3)* and *Pre (-2)* are statistically insignificant, while the coefficient estimates on *Post (1)*, *Post (2)*, and *Post (3)* are positive and significant at the conventional levels. In sum, the results support the parallel trend assumption for our DiD design, with mandated firms exhibiting an increase in the probability and frequency of CVC strategy relative to non-mandated firms following the ESG disclosure mandate.

[Insert Table 3 here]

4.3 Robustness Tests

4.3.1 Results using Matched Sample

The identification relies on the DiD regression with two-way fixed effects, which might introduce an estimation bias when the already-treated firms act as counterfactuals (i.e., effective control firms) for later-treated firms (Baker et al., 2022). By having our mandated firms not be dropped from the list of being mandated and benchmark firms to be never mandated during our sample period, we try to address the issue of counterfactuals being contaminated by already-treated firms becoming control firms for later-treated firms. We acknowledge that our approach might still inevitably introduce some estimation biases. As a robustness check, we use matching sample to re-exam the impact of mandatory ESG disclosure, to address the concern that entry into the treatment group may not be exogenous to CVC activities.

First, we use Propensity Score Matching (PSM) to identify suitable control firms not subject to the ESG disclosure mandate. We estimate a logit regression to calculate the possibility of being a mandatory ESG reporting firm based on firms' pre-mandate (year $t-1$) observable characteristics. We include the same set of control variables used in the baseline model including *Size*, *ROA*, *Leverage*, *Cash*, *Tobin's Q*, *Intangibility*, *Age*, and *SOE*. The variables are defined in Appendix 1. Also, we include industry fixed effects and year fixed effects and use the nearest neighbor matching method without replacement and caliper set at 0.05 to pair treated firms with control firms. After this procedure, our final PSM sample consists of 369 treated-control firm pairs, with a total of 4,428 firm-year observations. The results in column (1) and (2) of Panel A of Table 4 are consistent with

our main results.

Second, we use Entropy Balanced Matching (EBM) to ensure comparability between treated and control firms, since observable covariates are matched only on their mean values and matching necessarily reduces the number of observations for PSM approach. We match observable covariates on the second moments of their respective distributions. The matching variables are the same variables used in the baseline model in year $t-1$. The results in column (3) and (4) of Panel A of Table 4 still hold, indicating that comparability issue is unlikely to be driving our results.

4.3.2 Results Using Different Fixed Effects Structure

As described above, our baseline model includes firm and year fixed effects. We also examine whether our results are robust to alternative fixed-effects structures. We replace cohort-year fixed effects with cohort-industry-year and cohort-province-year fixed effects to rule out that unobservable time-varying industry factors such as industrial policy and local factors such as regional policies drive our results. Panel B of Table 4 presents the regression results after including cohort-industry-year and cohort-province-year fixed effects, and the conclusions remain unaffected.

4.3.3 Confounding Events

We then consider significant event that could potentially influence CVC investments. Prior literature suggests that financial crisis significantly shape firms' investment decisions based on firms' financial positions (Lins et al., 2017). To ensure our main findings are not driven by the 2008 financial crisis, we augment our baseline specification with additional interaction term. In Panel C of Table 4, we introduce an interaction term between

CrisisImpacted and *Post2008*, where *CrisisImpacted* is a dummy variable indicating whether the firm is in an industry severely impacted by the financial crisis, and *Post2008* indicates firm-year observations after 2008. The results show that coefficient estimates on *Mandated* remain positive and statistically significant after controlling for the crisis impacts, suggesting that our findings are robust to this major economic event.

4.3.4 Ruling Out the Possibility of Follow-on Investments

Lastly, we examine how the impact of mandatory ESG disclosure differs across CVC investment stages. This analysis helps distinguish between two potential investment motivations: strategic pursuit of new external innovation resources versus the continuation of existing investment relationships. Initial investments, representing firms' first entry into new portfolio firms, typically reflect a strategic decision to access external innovation capabilities. In contrast, follow-on investments in existing portfolio firms might indicate firms' commitment to previous investment decisions or the natural progression of investment stages.

To capture the investment stage characteristics, we further classify CVC investments based on their investment rounds. Specifically, we define *Early_CVCDum* as an indicator variable equal to one if the CVC investment occurs in seed round, angel round or Series A round, and zero otherwise. *Early_CVCNum* is measured as the natural logarithm of the number of CVC investments in seed round, angel round or Series A round for a firm plus one. Similarly, *Later_CVCDum* equals one if the CVC investment occurs after Series A round, and zero otherwise, while *Later_CVCNum* is the natural logarithm of the number of CVC investments after Series A round for a firm plus one. We classify a CVC investment as initial if it represents the firm's first investment in a particular portfolio firm, and as

follow-on if the firm has made previous investments in the same firm. We then estimate model (1) separately for these categories of CVC investments. In Panel D of Table 4, we find that the coefficient estimates on *Mandated* are significant for initial investments (column (1) and (2)), while the coefficient estimates on *Mandated* are insignificant for follow-on investments (column (3) and (4)), suggesting that mandatory ESG disclosure primarily drives firms to seek new external innovation resources rather than expanding existing investments. This finding is consistent with the notion that firms use CVC investments as a strategic tool to access external innovation capabilities in response to earnings pressure, rather than merely supporting their existing portfolio firms.

[Insert Table 4 here]

5. Channel Analysis

In the theoretical section, we posit that firms increase CVC activities due to earnings pressure triggered by mandatory ESG disclosure, leading them to cut R&D expenses, thus turn to CVC investment for external innovation in order to maintain their existing innovation level. If the above explanation stands, we should observe that mandatory ESG disclosure leads firms to cut R&D expenses, thus resulting in more CVC activities.

To test this conjecture, we design two sets of tests in this section. First, we replace the dependent variable in our baseline model with a dummy variable indicating whether firms cut R&D expenses or not (*R&D_Cut*), which is equal to one if firms' R&D expenses scaled by assets in the current year is lower than that in the previous year. The results are presented in column (1) of Table 5. We find a positive and significant coefficient on *Mandated*, which suggests that mandatory ESG disclosure prompts firms to reduce R&D expenditures. Second, we interact *Mandated* with *R&D_Cut* and tabulate the results in column (2) and

(3) of Table 5. As it is shown, the coefficient estimates on the interaction term between *Mandated* and *R&D_Cut* are positive and significant at the conventional levels, which suggest that firms that cut R&D expenses following the mandatory ESG disclosure are more likely to engage in CVC activities. In sum, these results confirm our theoretical conjecture regarding how firms strike a compromise between in-house R&D and outside CVC investment in response to mandatory ESG disclosure.

[Insert Table 5 here]

6. Cross-sectional Tests

In this section, we conduct cross-sectional analyses to validate the underlying mechanism, that is, the earnings pressure caused by mandatory ESG disclosure to make firms outsource innovation. Specifically, we focus on earnings expectation, profitability, financial constraint, and how firms with greater innovation demands respond to such earnings pressure.

6.1 Meet or Beat Earnings Expectation

We first examine whether firms conduct more CVC investments in response to mandatory ESG disclosure when managers face the incentive to meet or beat earnings expectations. Following Liu et al. (2017), we calculate the difference between actual earnings and the consensus analyst forecast to capture firms' pressure to meet or beat earnings expectations. A firm must have at least one earnings per share analyst forecast over the [-180, -4] day window prior to the actual earnings announcement date. For each firm-year, we designate the median of all analyst forecasts in that window as the consensus forecast. We then calculate the forecast error, defined as the actual earnings per share in year *t*-1 minus the corresponding consensus analyst forecast. *Meet_or_beat* is defined as

an indicator variable equal to one if the difference between firm *i*'s actual earnings per share and the consensus analyst forecast in the previous year falls within [0, 0.01], and zero if the difference falls within [-0.01, 0]. An interaction term between *Mandated* and *Meet_or_Beat* is introduced in model (1). In Panel A of Table 6, the coefficient estimates on *Mandated×Meet_or_Beat* are positive and significant, which suggests that following the mandatory ESG disclosure, when managers have stronger incentive to meet or beat earnings expectations, firms are more likely to engage in CVC investments.

6.2 Change in Profitability

We then examine whether firms conduct more CVC investments in response to mandatory ESG disclosure when the profitability deteriorates in the previous year. If earnings pressure does work in promoting firms to reduce R&D expense, we posit that the managers are more likely to increase CVC investment in the current year. We measure the change of profitability(*ΔROA*) using net income divided by total assets in year *t*-1 minus net income divided by total assets in year *t*-2. Similarly, we interact *Mandated* with *ΔROA* in model (1). In panel B of Table 6, we find that the coefficient estimates on the interaction term, *Mandated×ΔROA*, are negative and significant, which indicates that following the ESG disclosure mandate, the greater the extent of performance decline in the previous year, the more likelihood and frequency of firms' engaging in CVC activities.

6.3 Financial Constraint

We next investigate whether firms' financial constraints affect their CVC investment decisions following mandatory ESG disclosure. Firms with different financial resources may adopt different strategies (Kerr and Nanda, 2015), especially when facing earnings pressure. Well-resourced firms have greater flexibility to pursue more aggressive

innovation strategies, including increasing CVC investments (Dushnitsky and Lenox 2005b; Ma, 2020). In contrast, financial constraint firms may be more inclined to adopt conservative strategies (Kerr and Nanda, 2015; Ma, 2020), such as build the profit margins on existing products, and thus are more likely to maintain their in-house R&D activities rather than shift towards CVC investments. We use the KZ index (*KZ*) to measure financial constraints and interact *Mandated* with *KZ* in model (1). In Panel C of Table 6, the coefficient estimates on *Mandated* × *KZ* are negative and significant, suggesting that financially constrained firms are less likely to increase their CVC investments after the ESG disclosure mandate.

6.4 Innovation Demands

We further examine whether firms' innovation demands influence their CVC investment decisions under mandatory ESG disclosure. Firms with greater innovation demands may face stronger pressure to maintain their innovation capabilities while managing earnings pressure from the mandate. We use the number of patent applications in the year prior to the mandate (*Ln(Pat+1)*) to measure firms' innovation demands, drawing on prior literature that uses patent counts to identify innovative firms (Suh, 2023; Mao, 2021). In Panel D of Table 6, the positive and significant coefficient estimates on *Mandated*×*Ln(Pat+1)* indicate that firms with higher innovation demands are more likely to engage in CVC investments following the mandate, possibly as a way to maintain their innovation output while managing earnings pressure.

[Insert Table 6 here]

Collectively, our cross-sectional analyses provide strong support for our hypothesis, further strengthening our conjecture that earnings pressure triggered by mandatory ESG

disclosure drives firms to adopt CVC investments as an alternative approach to maintain innovation capabilities.

7. Implication for CVC Success

Considering the results above, our next question is whether mandatory ESG disclosure is associated with successful CVC. We estimate the following model at the parent-VC-target-year level for this analysis:

$$Exit\ or\ Returns_{i,v,j,t} = \boldsymbol{\alpha_1 Mandated}_{i,v,j,t} + \sum \beta_i Controls_{i,t-1} + \delta_i + \gamma_j + \theta_t + \varepsilon_{i,v,j,t} \qquad (2)$$

where i indicates parent firm i, v indicates VC firm v, j indicates portfolio firm j, and t indicates investment year t. The dependent variable is an indicator variable for whether parent firm i investing in portfolio firm j in year t ultimately successfully exit (*Exit*), which is equal to one if the portfolio firm j successfully go public or is acquired by another firms, and zero otherwise. *Mandated* is an indicator variable that takes the value of one if parent firm i's investment in portfolio firm j occurs after the mandatory ESG disclosure in year t, and zero prior to the mandate. The definitions of control variables are the same as regression (1). We include parent firm fixed effects (δ_i), portfolio firm fixed effects (γ_j) and year fixed effects (θ_t). Standard errors are clustered at the parent firm-portfolio firm pair level. In column (1) of Table 7, the coefficient estimate on *Mandated* is positive and significant, which indicates that mandated firms are more likely to exit through IPO or M&A. Then we examine whether mandatory ESG disclosure is associated with higher financial returns. Similarly, we replace the dependent variable in our regression (2) with *ROI*, which are defined as the ratio of the return to investment in portfolio firm j of firm i in year t. The results are shown in column (2) of Table 7. We find that the coefficient estimate on *Mandated* is significantly positive. These results suggest that mandated firms

tend to have higher financial return on CVC investments, thereby helping to alleviate performance pressure. [9]

[Insert Table 7 here]

8. Implications for Innovation Performance

Our last question is about the outcomes of CVC activities driven by earnings pressure on innovation performance. We focus on innovation output and knowledge flow.

8.1 The Outcome of Innovation Output

First, we examine whether firms and their subsidiaries or VC funds involved in CVC activities following the mandatory ESG disclosure are associated with higher innovation output. We replace the dependent variable in our baseline model with innovation output, which are defined as the natural logarithm of one plus the number of patents applied for by firm *i* in year *t* (*Ln(Pat+1)*) and the natural logarithm of one plus the number of invention patents applied for by firm *i* in year *t* (*Ln(Ipat+1)*), respectively. Panel A of Table 8 presents the results. We find that the coefficient estimates on *Mandated* are positive and significant, which suggests that firms involved in CVC activities under the earnings pressure induced by mandatory ESG disclosure exhibit higher innovation productivity.

8.2 The Outcome of Knowledge Flow

Second, we investigate whether mandatory ESG disclosure is associated with increased knowledge flow among firms conducting CVC activities. For this analysis, we estimate the following model in parent-portfolio-year level:

$$Citing_{i,j,t} = \boldsymbol{\alpha_1 Mandated}_{i,j,t} + \sum \beta_i Controls_{i,t-1} + \delta_i + \gamma_j + \theta_t + \varepsilon_{i,j,t} \quad (3)$$

[9] The analysis is conducted at the parent-VC-target-year level, which contains 19,624 observations.

where *i* indicates parent firm *i*, *j* indicates portfolio firm *j*, and *t* indicates investment year *t*. The dependent variable is a dummy variable that equals one if parent firm *i* directly cites patents owned by portfolio firm *j*, or patents that were previously cited by portfolio firm *j* within the five-year window after ESG mandatory disclosure, and zero otherwise. *Mandated* is an indicator variable that takes the value of one if parent firm *i*'s investment in portfolio firm *j* occurs after the mandatory ESG disclosure in year *t*, and zero prior to the mandate. The definitions of control variables are the same as regression (1). We include parent firm fixed effects (δ_i), portfolio firm fixed effects (γ_j) and year fixed effects (θ_t). Standard errors are clustered at the parent firm-portfolio firm level. Panel B of Table 8 presents the results. [10] We find that the coefficient estimates on *Mandated* are positive and significant, which shows that CVC investments resulting from mandatory ESG disclosure can enhance the knowledge exchange between firms and their portfolio firms.

[Insert Table 8 here]

In sum, the above results indicate that CVC investment serves as an alternative strategy to maintain innovation levels when firms face earnings pressure stemming from mandatory ESG disclosure.

9. Conclusion

In this paper, we use the adoption of mandatory disclosure regulation in China to examine the effect of mandatory ESG reporting on CVC activities. We find that mandatory ESG reporting firms have more likelihood and frequency of opting for CVC strategy following the mandate compared to non-ESG reporting firms. Moreover, we demonstrate

[10] The analysis is conducted at the parent-portfolio level, where multiple CVC investments from the same parent firm to the same portfolio firm in a given year are consolidated into one observation, reducing our sample size to 18,503 observations.

that cutback in R&D expenses explain the increasing likelihood and frequency of firms opting for CVC investments following the ESG disclosure mandate. We also find that the effect of mandatory ESG disclosure on CVC strategy is stronger when firms face stronger pressure to meet or beat earnings expectations, experience deteriorating performance, have fewer financial constraints, and possess greater innovation demands. With respect to the outcome implications of our results, we show evidence that mandatory ESG reporting firms involving in CVC activities not only exhibit higher possibility of CVC success, as evidenced by higher exit rates and superior financial returns, but also greater innovation output and more knowledge flows from their portfolio firms to parent firms. Our collective evidence indicates the effect of mandatory ESG disclosure on corporate innovative strategic adjustments.

Our paper has important theoretical and practical significance. First, existing studies have not examined the effect of mandatory ESG disclosure on CVC. Our paper contributes by presenting evidence that mandatory ESG disclosure drives firms to engage in CVC activities. This evidence suggests that mandatory disclosure interacts with earnings pressure in bringing about the real effects of ESG disclosure. Second, our paper sheds light on the important role of nonfinancial disclosure in innovative strategic adjustments, focusing on ESG disclosure. Since many countries now require firms to disclose ESG information and innovation is a critical driver of long-term economic growth for nations, our evidence on mandatory ESG disclosure impacting innovation strategy is also relevant to other countries. An interesting avenue for future research is to explore the effect of mandatory ESG disclosure on other investment strategies. Another is to utilize more detailed data on CVC decisions such as the characteristics of the target firms of CVC

investments.

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Appendix 1
Variable Definitions

Main Variables

CVC_Dum: Indicator variable equal to one if firm *i* and its subsidiaries or their VC funds have engaged in venture capital activities in year *t*, and zero otherwise [Source: Zero2IPO]

Ln(CVC_Num+1): Natural logarithm of the number of portfolio firms plus one in year *t* [Source: Zero2IPO]

Mandated: Indicator variable equal to one after the firm is listed in the SSE Corporate Governance Sector and SZSE 100 Index that are mandated to provide CSR disclosure, and zero otherwise [Source: SSE and SZSE websites]

Size: Natural logarithm of total assets [Source: CSMAR]

ROA: Net income divided by total assets [Source: CSMAR]

Leverage: Total debt divided by total assets [Source: CSMAR]

Cash: Operating cash flow divided by total assets [Source: CSMAR]

Tobin's Q: Sum of market value of equity and book value of debt divided by total book value of assets [Source: CSMAR]

Intangibility: Intangible assets divided by total assets [Source: CSMAR]

Age: Natural logarithm of the number of years up to listing plus one [Source: CSMAR]

SOE: Indicator variable for state-owned enterprises equal to one if the ultimate controlling owner is either the central government or local governments, and zero otherwise [Source: CNRDS]

Variables in Channel, Cross-sectional and Further Tests

R&D_Cut: Indicator variable equal to one if firm *i*'s R&D expenses scaled by total assets in year *t* is lower than that in year *t* [Source: CSMAR]

Meet_or_Beat: Indicator variable equal to one if the difference between firm *i*'s actual earnings per share and the consensus analyst forecast in year *t*-1 falls within [0, 0.01], and zero if the difference falls within [-0.01, 0] [Source: CSMAR]

ΔROA: Net income divided by total assets in year *t*-1 minus net income divided by total assets in year *t*-2 [Source: CSMAR]

KZ: Composite index of financial constraints constructed using cash flow, Tobin's Q, leverage, dividends and cash holdings, as in Kaplan and Zingales (1997) [Source: CSMAR]

Ln(Pat+1): Natural logarithm of one plus the number of patents applied for by firm *i* in year *t* [Source: CNRDS]

Early_CVCDum: Indicator variable equal to one if the CVC investment occurs in seed round, angel round or Series A round, and zero otherwise [Source: Zero2IPO]

Early_CVCNum: Natural logarithm of the number of CVC investments in seed round, angel round or Series A round for a firm plus one in year *t* [Source: Zero2IPO]

Later_CVCDum: Indicator variable equal to one if the CVC investment occurs after Series A round, and zero otherwise [Source: Zero2IPO]

Later_CVCNum: Natural logarithm of the number of CVC investments after Series A round for a firm plus one in year *t* [Source: Zero2IPO]

Exit: Indicator variable equal to one if firms involved in the CVC investment ultimately exit through IPO or M&A, and zero otherwise [Source: Zero2IPO]

ROI: Return amount divided by total investment amount [Source: Zero2IPO]

Ln(IPat+1): Natural logarithm of one plus the number of invention patents applied for by firm *i* in year *t* [Source: CNRDS]

Citing: Indicator variable equal to one if firm *i* directly cites patents owned by target *j*, or patents that were previously cited by target *j* in post-period, and zero otherwise [Source: CNRDS]

CrisisImpacted: Indicator variable equal to one if the firm is in the following industries that are severely impacted by the financial crisis: manufacturing, wholesale and retail trade, financial sector (excluded), real estate, transportation, storage, and postal services, and zero otherwise

Post2008: Indicator variable equal to one if the firm-year observation is after 2008, and zero otherwise

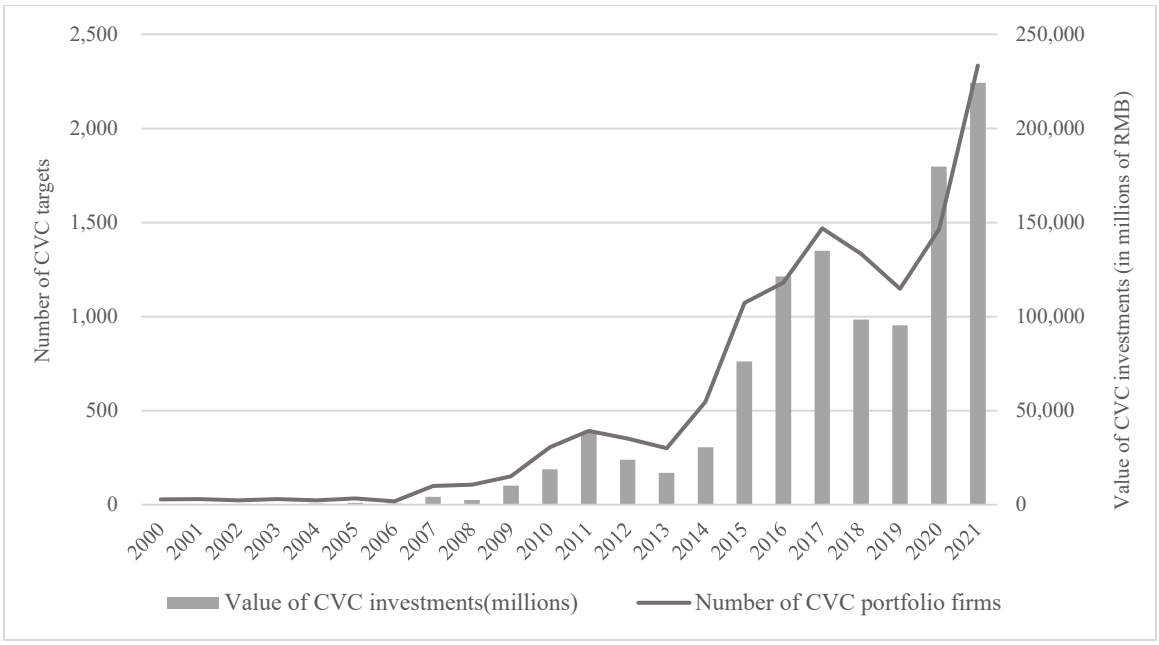

Figure 1 Annual trend of the number of CVC investments and the value of CVC investments. This figure depicts the development of CVC in China between 2005 and 2022.

Table 1
Descriptive statistics

VARIABLES	Mean	S.D.	Min	Median	Max	Obs.
CVC_Dum	0.089	0.284	0	0	1	98,784
CVC_Num	0.298	2.431	0	0	150	98,784
Ln(CVC_Num+1)	0.094	0.329	0	0	1.946	98,784
Pat	46.855	195.612	0	11	9,025	98,784
LN(Pat+1)	2.298	1.785	0	2.485	6.267	98,784
IPat	20.753	120.366	0	3	5,860	98,784
LN(IPat+1)	1.603	1.509	0	1.386	5.481	98,784
Mandated	0.014	0.119	0	0	1	98,784
Size	21.924	1.157	19.350	21.828	25.207	98,784
Age	11.239	6.358	0	11	31	98,784
Ln(Age+1)	2.326	0.663	0	2.485	3.258	98,784
ROA	0.029	0.060	-0.249	0.029	0.183	98,784
Leverage	0.455	0.206	0.056	0.456	0.898	98,784
Cash	0.043	0.073	-0.180	0.042	0.249	98,784
Tobin's Q	2.466	1.784	0.852	1.884	11.283	98,784
Intangibility	0.048	0.053	0	0.034	0.318	98,784
SOE	0.447	0.497	0	0	1	98,784

This table provides the descriptive statistics of our main variables. The sample consists of firm-year observations between 2005 and 2022. All continuous variables are winsorized at the 1st and 99th percentiles. Variable definitions are in Appendix 1.

Table 2
The Impact of Mandatory ESG Disclosure on Corporate Venture Capital

VARIABLES	(1) *CVC_Dum*	(2) *CVC_Dum*	(3) *Ln(CVC_Num+1)*	(4) *Ln(CVC_Num+1)*
Mandated	**0.040*** **	**0.025** **	**0.056*** **	**0.037*** **
	(3.625)	**(2.259)**	**(3.913)**	**(2.656)**
Size		0.034***		0.040***
		(12.000)		(12.140)
Ln(Age+1)		0.028***		0.030***
		(5.373)		(4.727)
ROA		0.077***		0.099***
		(4.251)		(4.850)
Leverage		-0.025**		-0.015
		(-2.523)		(-1.334)
Cash		-0.001		-0.017
		(-0.112)		(-1.169)
Tobin's Q		0.004***		0.006***
		(4.238)		(4.998)
Intangibility		-0.060*		-0.084***
		(-1.933)		(-2.641)
SOE		-0.008		0.003
		(-1.233)		(0.426)
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.342	0.344	0.425	0.427
Observations	98,784	98,784	98,784	98,784

This table reports the results of estimating the effect of mandatory ESG disclosure on corporate venture capital. *CVC_Dum* equals one if firm *i* and its subsidiaries have engaged in venture capital activities in year *t*, and zero otherwise. *Ln(CVC_Num+1)* is the natural logarithm of the number target firms plus one in year *t*. *Mandated* equals one for mandatory ESG disclosure firms in the post-mandate period, and zero otherwise. Other variable definitions are in Appendix 1. Displayed in parentheses are *t*-statistics, estimated using cohort-firm level clustering of standard errors. *, **, *** indicate significance at the 10%, 5%, and 1% levels (two-tailed), respectively.

Table 3
Parallel Trend Tests

VARIABLES	(1) *CVC_Dum*	(2) *Ln(CVC_Num+1)*
Pre (-3)	0.014	0.015
	(1.199)	(1.222)
Pre (-2)	0.002	0.011
	(0.186)	(0.852)
Post (1)	**0.030****	**0.042****
	(2.038)	**(2.545)**
Post (2)	**0.029***	**0.046****
	(1.858)	**(2.338)**
Post (3)	**0.031****	**0.050*****
	(2.041)	**(2.706)**
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.344	0.427
Observations	98,784	98,784

This table shows the results of estimating parallel trend tests for the effect of mandatory ESG disclosure on corporate venture capital. *CVC_Dum* equals one if firm *i* and its subsidiaries have engaged in venture capital activities in year *t*, and zero otherwise. *Ln(CVC_Num+1)* is the natural logarithm of the number target firms plus one in year *t*. *Pre (-3)*, *Pre (-2)*, *Post (1)*, *Post (2)* and *Post (3)* equal one if a mandated firm-year observation is three years before the mandate (year *t*-3), two years before the mandate (year *t*-2), one year after the mandate (year *t*+1), two years after the mandate (year *t*+2), and three years after the mandate (year *t*+3). Controls in model (1) are included but not reported. Other variable definitions are in Appendix 1. Displayed in parentheses are *t*-statistics, estimated using cohort-firm level clustering of standard errors. *, **, *** indicate significance at the 10%, 5%, and 1% levels (two-tailed), respectively.

Table 4
Robustness Tests

Panel A: Matched sample

VARIABLES	(1) *CVC_Dum*	(2) *Ln(CVC_Num+1)*	(3) *CVC_Dum*	(4) *Ln(CVC_Num+1)*
	PSM Sample		EBM Sample	
Mandated	**0.031****	**0.042****	**0.046*****	**0.060*****
	(2.140)	**(2.129)**	**(3.001)**	**(3.065)**
Controls	Yes	Yes	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.382	0.483	0.370	0.476
Observations	4,428	4,428	98,784	98,784

Panel B: Different fixed effects structures

VARIABLES	(1) *CVC_Dum*	(2) *Ln(CVC_Num+1)*
Mandated	**0.025****	**0.038*****
	(2.165)	**(2.646)**
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Industry-Year, Cohort-Province-Year	Cohort-Firm, Cohort-Industry-Year, Cohort-Province-Year
Adjusted R^2	0.343	0.429
Observations	98,663	98,663

Panel C: Rule out the impact of the 2008 financial crisis

VARIABLES	(1) *CVC_Dum*	(2) *Ln(CVC_Num+1)*
Mandated	**0.025****	**0.038*****
	(2.306)	**(2.700)**
CrisisImpacted×Post2008	-0.017***	-0.017**
	(-2.749)	(-2.287)
CrisisImpacted	0.002	-0.003
	(0.210)	(-0.345)
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.345	0.428
Observations	98,784	98,784

Panel D: Initial versus follow-on investments

VARIABLES	(1) *Early_CVCDum*	(2) *Early_CVCNum*	(3) *Later_CVCDum*	(4) *Later_CVCNum*
Mandated	**0.028****	**0.033*****	**0.007**	**0.013**
	(2.524)	**(2.853)**	**(0.776)**	**(1.454)**
Controls	Yes	Yes	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.304	0.363	0.299	0.357
Observations	98,784	98,784	98,784	98,784

This table reports the results of robustness tests. *CVC_Dum* equals one if firm *i* and its subsidiaries have engaged in venture capital activities in year *t*, and zero otherwise. *Ln(CVC_Num+1)* is the natural logarithm of the number target firms plus one in year *t*. *Mandated* is as defined in Table 3. Panel A presents the results using PSM sample in column (1) to (2) and entropy balanced sample column (3) to (4), respectively. For PSM approach, we match each treated firm to a control firm 1:1 using the nearest neighbor matching technique (without replacement, and caliper set at 0.05). Panel B presents the results using different fixed effects structures. Panel C presents the results ruling out the impact of financial crisis in 2008. Panel D presents the results ruling out the possibility of follow-on investments. *Early_CVCDum* equals one if CVC invests in seed, angel or Series A round, and zero otherwise. *Early_CVCNum* is the natural logarithm of one plus the number of CVC investments in seed round, angel round or Series A round for firm *i* in year *t*. *Later_CVCDum* equals one if CVC invests after Series A round, and zero otherwise. *Later_CVCNum* is the natural logarithm of one plus the number of CVC investments after Series A round for firm *i* in year *t*. Controls in model (1) are included but not reported. Other variable definitions are in Appendix 1. Displayed in parentheses are *t*-statistics, estimated using cohort-firm level clustering of standard errors. *, **, *** indicate significance at the 10%, 5%, and 1% levels (two-tailed), respectively.

Table 5
Channel Test

VARIABLES	(1) *R&D_Cut*	(2) *Ln(CVC_Num+1)*	(3) *Ln(CVC_Num+1)*
Mandated×R&D_Cut		**0.037****	**0.041****
		(2.029)	**(2.013)**
R&D_Cut		-0.001	0.001
		(-0.327)	(0.263)
Mandated	**0.052*****	0.015	0.026*
	(3.710)	(1.359)	(1.849)
Controls	Yes	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.196	0.345	0.428
Observations	98,784	98,784	98,784

This table reports the results of channel test. *CVC_Dum* equals one if firm *i* and its subsidiaries have engaged in venture capital activities in year *t*, and zero otherwise. *Ln(CVC_Num+1)* is the natural logarithm of the number target firms plus one in year *t*. *Mandated* is as defined in Table 3. *R&D_Cut* equals one if firm *i*'s R&D expenses scaled by total assets in year *t* is lower than that in year *t*-1. Controls in model (1) are included but not reported. Other variable definitions are in Appendix 1. Displayed in parentheses are *t*-statistics, estimated using cohort-firm level clustering of standard errors. *, **, *** indicate significance at the 10%, 5%, and 1% levels (two-tailed), respectively.

Table 6
Cross-Sectional Tests

Panel A: Meet or beat earnings expectation

	(1)	(2)
VARIABLES	*CVC_Dum*	*Ln(CVC_Num+1)*
Mandated×Meet_or_Beat	**0.210****	**0.211****
	(2.478)	**(2.071)**
Mandated	-0.038	-0.026
	(-0.679)	(-0.388)
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.304	0.368
Observations	9,856	9,856

Panel B: Change in profitability

	(1)	(2)
VARIABLES	*CVC_Dum*	*Ln(CVC_Num+1)*
Mandated×ΔROA	**-0.366****	**-0.341****
	(-2.510)	**(-2.301)**
Mandated	0.019*	0.028**
	(1.781)	(2.125)
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.345	0.428
Observations	98,765	98,765

Panel C: Financial constraint

	(1)	(2)
VARIABLES	*CVC_Dum*	*Ln(CVC_Num+1)*
Mandated×KZ	**-0.013*****	**-0.016*****
	(-3.028)	**(-2.938)**
Mandated	0.047***	0.065***
	(3.155)	(3.313)
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.347	0.431
Observations	93,066	93,066

Panel D: Innovation demands

	(1)	(2)
VARIABLES	*CVC_Dum*	*Ln(CVC_Num+1)*
Mandated×Ln(Pat+1)	**0.009***	**0.013***
	(1.774)	**(1.831)**
Mandated	0.005	0.010
	(0.380)	(0.559)
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.345	0.428
Observations	98,784	98,784

This table reports the results of heterogeneity tests on the effect of mandatory ESG disclosure on

corporate venture capital. *CVC_Dum* equals one if firm *i* and its subsidiaries have engaged in venture capital activities in year *t*, and zero otherwise. *Ln(CVC_Num+1)* is the natural logarithm of the number target firms plus one in year *t*. *Mandated* is as defined in Table 3. *Meet_or_beat* equals one if the difference between firm *i*'s actual earnings per share and the consensus analyst forecast in year *t*-1 falls within [0, 0.01], and zero if the difference falls within [-0.01, 0]. *ΔROA* is income divided by total assets in year *t*-1 minus net income divided by total assets in year *t*-2. *KZ* is the composite index of financial constraints as in Kaplan and Zingales (1997). *Ln(Pat+1)* is the natural logarithm of the number of patents applied for by firm *i* in year *t* plus one. Controls in model (1) are included but not reported. Other variable definitions are in Appendix 1. Displayed in parentheses are *t*-statistics, estimated using cohort-firm level clustering of standard errors. *, **, *** indicate significance at the 10%, 5%, and 1% levels (two-tailed), respectively.

Table 7
The Impact of Mandatory ESG Disclosure on CVC Success

VARIABLES	(1) *Exit*	(2) *ROI*
Mandated	**0.019**** **(2.229)**	**0.047**** **(2.454)**
Controls	Yes	Yes
Fixed effects	Parent Firm, Portfolio Firm, Year	Parent Firm, Portfolio Firm, Year
Adjusted R^2	0.656	0.677
Observations	19,624	19,624

This table reports the outcome of corporate venture capital success following mandatory ESG disclosure in deal level. *Exit* equals one if the parent firm ultimately successfully exit, and zero otherwise. *ROI* is the return amount divided by total investment amount. Controls in model (1) are included but not reported. Other variable definitions are in Appendix 1. Displayed in parentheses are *t*-statistics, estimated using parent firm-portfolio firm pair level clustering of standard errors. *, **, *** indicate significance at the 10%, 5%, and 1% levels (two-tailed), respectively.

Table 8
The Impact of Mandatory ESG Disclosure on Innovation Performance

Panel A: The outcome of innovation output

	(1)	(2)
VARIABLES	*Ln(Pat+1)*	*Ln(Ipat+1)*
Mandated	**0.127*** **	**0.170*** **
	(2.633)	**(3.764)**
Controls	Yes	Yes
Fixed effects	Cohort-Firm, Cohort-Year	Cohort-Firm, Cohort-Year
Adjusted R^2	0.807	0.789
Observations	98,784	98,784

Panel B: The outcome of knowledge flow

	(1)	(2)
	Citing	
VARIABLES	*Citing patents owned by portfolio firms*	*Citing patents cited by portfolio firms*
Mandated	**0.016** **	**0.014** **
	(2.350)	**(1.979)**
Controls	Yes	Yes
Fixed effects	Parent Firm, Portfolio Firm, Year	Parent Firm, Portfolio Firm, Year
Adjusted R^2	0.344	0.200
Observations	18,503	18,503

This table reports the outcomes of corporate venture capital on innovation following mandatory ESG disclosure. In Panel A, *Ln(Pat+1)* is the natural logarithm of the number of patents applied for by firm *i* in year *t* plus one. *Ln(IPat+1)* is the natural logarithm of the number of invention patents applied for by firm *i* in year *t* plus one. In Panel B, *Citing* equals one if parent firm *i* directly cites patents owned by portfolio firm *j*, or patents that were previously cited by portfolio firm *j* within the five-year window after ESG mandatory disclosure, and zero otherwise. *Mandated* is as defined in Table 3. Controls in model (1) are included but not reported. Other variable definitions are in Appendix 1. Displayed in parentheses are *t*-statistics. Standard errors are clustered at cohort-firm pair level in Panel A and parent firm-portfolio firm pair level in Panel B. *, **, *** indicate significance at the 10%, 5%, and 1% levels (two-tailed), respectively.