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Do firms' pension contributions decrease their investment efficiency in Chinese context?

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Purpose: This research aims to investigate whether increasing the pension contributions of a firm leads to inefficient investments.

Design/methodology/approach: Based on the 26 135 observations of the Chinese listed firms, this study employs ordinary least squares models to investigate the relationship between pension costs and inefficient investments.

Findings/results: This study shows that Chinese listed firms' pension contribution increments result in fewer investment opportunities and a decreased in investment efficiency. This is insignificant for the more profitable firms and state-owned enterprises. It suggests further that a firm's pension cost is significantly associated with its investment inefficiency, particularly for cash flow dominated and financing–restricted firms. This indicates a negative association between pension contributions and cash flows, and several pension contributions may lead to a cash flow shortage in the firms.

Practical implications: For managers, they should improve their investment efficiency within an affordable pension plan; for investors, increasing pension costs potentially decrease their investment returns.

Originality/value: Some findings have reference values for some developing countries.

Keywords: pension contributions; Chinese pension policies; investment efficiency; Chinese listed firms; inefficient investment.

Introduction

As a significant part of the labour cost of a company, a firm's defined pension contributions impact its performance directly. According to the statistics of the Institute of Social Development of the National Development and Reform Commission,[1] the total amount of the pension contributions of five social insurances for employees in China accounts for 39.25% of their salaries, ranking 13th among the selected 173 countries. This statistic approaches rates of 40% in European countries, such as France, Germany and Italy and is 23.2%, 14.01% and 24.12% in the United States, Japan and South Korea, respectively; in more times in the developing countries, for example, 3.04 times of the Philippines 3.84 times of Thailand and 4.76 times of Mexico. To address this concern, the Chinese national government issued 'The Schemes for Social Insurance Rate Reduction' in April 2019 to decrease the employer-sponsored pension contribution rate to 16%.

Since the coronavirus disease 2019 (COVID-19) outbreak in 2020, the Chinese government has implemented a series of policies to ensure economic sustainability. As Myers and Majluf (1984) suggested, firms have had to abandon valuable investments, resulting in investment inefficiency if their cash flows are insufficient. Yu et al. (2020) show significant under-investment for Chinese listed firms because of the co-restraint of corporate governance and financing. As such, further studies are required to investigate the following questions: Are Chinese policies related to firms' investment efficiency? This study attempts to answer the question. It investigates the impact of 10-year defined pension contributions on firms' investment efficiency before 2019, when the Chinese government decreased the pension rate to 16%.

The existing Chinese pension-related research focuses on two aspects. One concerns the defined pension contribution system, such as measuring the fairness and efficiency of the insurance system and suggesting a reduction in the contribution proportion of employees' insurance

1.See https://www.ndrc.gov.cn/xxgk/jd/jd/201608/t20160829_1182746.html

enterprises (Zeng et al., 2019). The other concerns the impact of insurance on the macro economy, for example, the effect of insurance on the resident savings rate, household consumption, resident welfare, foreign investment and gross domestic product (GDP) (Peng et al., 2018). These studies analyse the macroeconomic effects of insurance from different perspectives, and the conclusions are the same: China's current pension system has defects and is not conducive to economic development.

However, only a few researchers have analysed the economic consequences of social insurance at the micro-enterprise level. Zhao and Lu (2018) find the impact of pension plan contributions on a firm's productivity and suggest that pension plan costs are negatively correlated with productivity. Wei and Xia (2020) reveal the impact of pension contributions on a firm's tax avoidance. They document that the higher the social insurance cost, the greater the financial pressure and tax avoidance.

There is not much research on pension contributions abroad, which may be that there is not enough difference in the system to provide differentiated information for analysis. Similar to this topic, it discusses the economic effects of labour protection policies. Banker et al. (2013) and Dessaint et al. (2017) study the impact on company costs and M&A from the perspective of labour protection and legislation. In recent years, other scholars have also studied fixed pension plans. Cocco and Volpin (2013) investigate from an M&A perspective that a company is unlikely to become the M&A target when it has a fixed and high pension cost. Duygun et al. (2018) show that fixed pension plans impact a firm's diversified and non-diversified investment choices.

However, there is not sufficient research on the internal impact of pension contributions on a firm's investment efficiency and inefficiency. In particular, there are differences between the pension systems in China and other developed countries. After the COVID-19 outbreak in 2020, the policy effect of China's social security fee reduction may have been more prominent. Therefore, from an investment inefficiency perspective, this study investigates whether this type of pension reform contributes to a firm's investment efficiency.

This study samples A-shares listed on China's stock market during 2007–2018 and investigates the relationship between increasing pension contributions and investment inefficiency, which may potentially lead to two types of investment inefficiency: overinvestment and underinvestment. Furthermore, this study employs free cash flow as an intermediary variable to investigate the research question, along with some control variables such as cash flow sensitivity, ownership structure, financing restrictions and firm profitability.

This study shows that a firm may access more investment opportunities when its pension cost declines, accordingly improves its investment performance, particularly for cash flow–based and financing-dominated, but not profit-free firms. It indicates a negative association between pension contributions and cash flows. However, high pension costs may lead to a cash flow shortage for a firm, which consequently makes a firm miss some potential investment opportunities. Both policymakers and managers should benefit from the practical implications.

The aims of this research are threefold. Firstly, it enriches the existing literature on pension institutions from a different perspective. It investigates the impact of pension variation on a firm's investment efficiency, unlike other studies on the effect of production efficiency, tax freeness, etc.

Secondly, this research discusses pension cost as a labour cost and its association with investment performance. From agency costs and information asymmetry perspectives, the existing research documents that a majority of factors are related to investment performance, such as free cash flow (Jensen, 1986; Yang & Hu, 2007), debt costs (Whited, 1992), dividend policies (Fazzari et al., 1988), financial report performance (Biddle et al., 2009; Chen et al., 2010), managers' characteristics and their remunerations (Xin & Lin, 2007) and corporate governance performance (Li et al., 2011). However, few studies regard pensions as a cost factor in investigating investment performance. This study is expected to provide new findings to enrich the existing literature on the topic.

Thirdly, its practical implications. Chinese pension rates are relatively higher than in most other countries, putting many cost pressures on Chinese small and medium enterprises and restraining their development, particularly in the context of the pandemic. The Chinese government is reforming and improving pension institutions to facilitate firm development and boost the nation's economy. This study investigates the 10-year impact of high pension costs on firms' investment inefficiency before 2019 when the Chinese government decreased the employer-sponsored pension contribution rate to 16%. These findings may contribute to the performance of the reform.

Institutional background of the Chinese pension schemes

The Chinese pension scheme is threefold. The first is public pension schemes, which include the mandatory Basic Old-Age Insurance (BOAI), voluntary Urban Resident Pension (URP) and the New Rural Resident Pension. These pension plans offer all Chinese residents with basic social security when they reach the retirement age. The second refers to voluntary employer-sponsored annuity plans that supplement public schemes. The third scheme includes household savings-based annuity insurance as the primary and dominant programme. Public pension schemes have the broadest coverage while receiving substantial direct financial subsidies from the Chinese central government. All pension schemes and related products have tax preferences. This study focuses on the mandatory public pension contributions of the BOAI.

The BOAI started in 1951 is very critical public pension scheme for the urban employees. There are two types of pension contributors to the BOAI. The first and most significant feature of the BOAI is compulsory with defined contributions and defined benefit. On the contribution side, employers must contribute 20% of the wages paid to the workforce. The minimum wage level subject to the condition is 60% of the average local salary, and the maximum level is 300% of the average local salary depending on the provinces and cities. The individual account pension as the second contributor has a contribution rate of 8%. On the benefit side, retirees are entitled to the pension benefits upon their contribution history of 15 or more years, and the pension benefit rate is determined by the contribution years and the individual's wage level. A retiree whose pre-retirement wage is equal to the average local salary has a pension benefit ratio of 35% after 35 years of pension contributions.

The development of China's public pension scheme has experienced four stages. The first stage started in 1951 when labour insurance was initially introduced into China as an employer-sponsored pension plan for the employees in state-owned enterprises (SOEs) only, while there was a separate pension plan called the Public Employee Pension for other kinds of employees. However, rural populations have not yet been covered by formal pension plan. The second stage from 1985 to 1991, the employer-sponsored pension system did not facilitate fair market competition and labour mobility because the pension contribution pool financed by enterprises was pay-as-you-go (PAYG). Followed the third period to the late 2000s, the Chinese pension programme was reformed into a three-contributor-based pension system, the BOAI, for urban employees to address population aging issues and SOEs' growing pension costs, including the PAYG programme financed by employers, individual national accounts funded by employees and voluntary retirement savings. The fourth began in 2009 and featured an expanded coverage of non-SOE companies through the New Rural Resident Pension (NRP) in 2009 for rural residents and the URP in 2011 for urban non-employed residents.

As for pension contribution rates, the Chinese government implemented a range of reforms to balance employers' pension costs and employees' security. In July 1997, the central government released 'Decisions on Establishing a Unified Basic Old-Age Insurance System', regulating an institutional contribution rate of at least 20% of employees' salary from their employers and at least 4% from employees themselves. In addition, since 1998, the individual contribution rate has increased by 1% every 2 years until it reaches 11%. In 2011, the State Council required all employers to pay contributions to their employees to meet the full coverage of the BOAI, which greatly increased the financial pressure on their employers. To ease the burden and stimulate the national economy, the Chinese government decided to lower the institutional rate to 19% in 2016 and the individual rate returned to 8% in 2006. The following reform in 2019 allowed the institutional rate to decrease further to 16% to ease the pension costs of small and medium-sized firms.

Nevertheless, China has one of the highest statutory pension contribution rates in the world. As Table 1 shows, the contribution rate of the Chinese BOAI is higher than the rates in some developed nations in 2016, such as Japan, France and the United States. Additionally, Chinese employers have to pay the highest contribution rate of 16%, which restrains a firm's cash flow and decreases investment efficiency.

Although the central government determines the statutory public pension scheme, actual contribution rates vary across regions in China. The current segmented pension system is because of regional imbalances, fiscal inefficiency, economic development disparity and wage inequality (Cai & Cheng, 2014). The employees in economically developed provinces and municipalities, such as Guangzhou, Fujian, Shanghai and Beijing, have higher salaries than those in some underdeveloped provinces. Even if they move to other places to have better jobs, their pension plans are tied to their original city of Hukou (the Hukou in China is a system of official household registration that identifies a person as being a resident of a particular area and determines the person's social security schemes). This pension mechanism results in serious inequality issues with respect to labour mobility and further restrains national economic development (Bar & Diamond, 2010).

Shen et al. (2017) suggest that high pension contributions in China restrict the development of Chinese firms. The government has implemented a range of tax deductions and fee-cutting policies to address this issue. The BOAI contribution has the highest pension cost; decreasing the BOAI contribution is an effective way to ease the financial cost of Chinese firms and help them survive the COVID-19 pandemic, particularly for labour-dominated and high-pension-based firms. In this institutional context, this research is expected to provide policymakers with insights into Chinese BOAI contributions.

Literature review and hypothesis

The literature is comprehensive when it comes to the impact of employer-sponsored pension plans on firms' financial performance. Zhao and Lu (2018) find a negative relationship between total factor productivity and the rate of pension contributions to salaries; the increasing pension cost leads to

TABLE 1: Comparison of contribution rates across nations in 2016.

Nations	Employer rates %	Employee rates %	Total rates %
China	16.0	8.0	24.0
Canada	5.0	5.0	10.0
France	6.8	9.9	16.7
Germany	10.0	10.0	20.0
Sweden	7.0	11.9	18.9
United Kingdom	11.0	12.8	23.8
United States of America	6.2	6.2	12.4
Japan	7.7	7.7	15.4
Korean	4.5	4.5	9.0
Brazil	7.7	20.0	27.7

Source: Word Bank. *HDNSP pension database*. Retrieved n.d. from https://www.worldbank.org/en/topic/socialprotection/brief/pensions-data.

disposable incomes and deteriorates firm innovations. Tang and Feng (2019) show that a firm intends to decrease employees and increase investments in fixed assets (FA) to replace labour expenditure when pension costs increase. Wei and Xia (2020) examine the association between pension contributions and firm tax avoidance, suggesting that pension plans can ease a firm's financial pressure and facilitate its tax avoidance. Du et al. (2021) investigate the effect of pension contributions on the input-output performance of total factors and demonstrate that pension cost reduction may contribute to investment efficiency.

There are two strands of theory on inefficient investment (Naeem & Li, 2019). Overinvestment refers to investments in projects with negative net present values (NPV) or higher investment costs than returns. The other is underinvestment, wherein a firm puts money on the table rather than investing in profitable projects. These two types of investments are both inefficient investments, which are typical for Chinese listed firms. Yu et al. (2020), sampling a wide range of listed firms in China, show significant underinvestment issues for Chinese listed firms subject to the co-restraint of corporate governance and financing. He et al. (2019) document that internal financing may lead to overinvestment, especially in state-owned firms with managerial overconfidence.

Inefficient investments are attributed to agency and information asymmetries. Jensen and Meckling (1976) initially document that inadequate investments originate when information asymmetry exists between managers and stakeholders; managers overinvest in negative NPV cases for personal gains. This agency issue also exists between majority and minority stakeholders (La Porta et al., 1998), suggesting that majority shareholders seek to rake in stakes by buying or investing in majority shareholder-owned projects. Furthermore, inside managers have more information on firm performance than investors, creditors or outside supervisors; this asymmetry leads to more investment restraints. Myers and Majluf (1984) reveal that under-investment occurs when firms have to abandon profitable investments when they are restrained from financing because of information asymmetry.

Cash flow is critical for investment decisions. Fazzari et al. (1998) examine the relationship between investment and cash flow and documents that the association is more significant for more financing-restrained firms. Based on the evidence from the Chinese listed firms, Lian and Cheng (2007) reveal that a firm's investment efficiency is significantly subject to its cash flow, which is supported by the findings of Luo et al. (2007). This study follows a theoretical framework to investigate the impact of pension contribution on firm investment efficiency.

Generally speaking, this impact also includes two kinds of potential consequences: under-investment and over-investment. On the one hand, more pension contributions may potentially result in under-investment (Shen et al., 2017) and, consequently, cash flow pressures (Autor et al., 2007). As Myers and Majluf (1984) suggested, firms have to abandon some valuable investments and result in decreasing investment efficiency if their cash flows are insufficient.

Higher pension costs for firms that prefer over-investment may restrain their investment volumes and potentially improve their investment efficiency. Interest conflicts between managers and shareholders appear when a company has much more cash flow than what is needed for its positive NPV investments. Jensen and Meckling (1976) suggest that managers intend to maintain firm profits for subsequent rounds of business and investment opportunities. They overinvest in negative NPV cases for their personal gains. Therefore, higher BOAI costs may result in cash flow shortages and subsequently ease overinvestment motivations, improving investment efficiency accordingly.

In summary, pension contributions are a significant part of firm labour costs, so an increasing volume of contributions leads to higher labour costs (Zhao & Lu, 2018), which generates significant pressure on cash flows and accordingly increases a firm's business and financial risks. In addition, a high volume of pension contributions accounts for innovation expenditures and restrains new technological development (Brown et al., 2012). For firms with sufficient cash flows, increasing pension costs may restrain over-investments and potentially improve firm investment efficiency. However, pension cost growth may deteriorate cash shortages and decrease investment efficiency for cash flow–insufficient firms. Nevertheless, whether pension contributions empirically reduce a firm's investment efficiency has not been investigated extensively. This study aims to examine and bridge this gap.

Based on the arguments above, two hypotheses are proposed:

> **H1a:** For cash flow–insufficient firms, increasing pension contributions may reduce their cash flow, leading to under-investment and consequently decreasing investment performance.
>
> **H1b:** For cash flow-sufficient firms, increasing pension contributions may result in their cash flow reduction, restraining over-investment and improving their investment performance.

Data and methodology

Data

The sample data are from the Wind Information Company Ltd. (WIND) and China Stock Market & Accounting Research (CSMAR) databases, the nominal tax-related information is from WIND and the rest is from CSMAR. According to the new accounting law issued in 2007, listed firms have to report any changes in pension expenditures and employees' salaries. Thus, pension-related data were available for 2007. There were 1250 listed firms in the Chinese stock market in 2007, which increased to 3029 in 2018. We collected 12 years of data from these listed firms, and 29 521 samples in total were observed from 2007 to 2018.

The database is initially screened, and three types of samples are excluded. They are public financial firms, key-variable-

missing and abnormally listed firms and specially treated (ST), including delisting-expected (*ST) firms. In addition, approximately 1% of the samples with extreme-value distributions are excluded. As Table 2 shows, 26 135 valid observations are obtained.

Variable descriptions

According to related research, pension plan contributions are defined as an independent variables and investment efficiency is defined as a dependent variable. According to the prior literature (Bzeouich et al., 2019; Cao et al., 2020), the following factors are included as control variables: free cash flow (cash flow), firm size (size), rates of debt to assets (Lev), return rate on total assets (ROA), rate of fixed assets (FA), rate of intangible assets (Intang), inventory rate (Invent), nominal tax rate (Tax), ownership concentration (OCO) and equity property (SOE). Table 3 presents the details of these variable measurements.

TABLE 2: Sample data selections.

Selection criterion	Excluded	Rest
Listed firms from 2007 to 2018	-	29 521
Minor: Variable–missing and abnormal listed firms	2251	-
Minor: Public financial firms	1074	-
Minor: ST and *ST firms	61	-
Valid sample firms	**-**	**26 135**

ST, specially treated.

TABLE 3: Variable measurements based on related literature.

Variables	Abbreviation	Measurements	Related literature
Pension contributions	Pension	Pension increment/ salary payable in a year *t*	Liu and Ye (2014)
Investment inefficiency	Inv	An absolute value of a regression model's residual error	Richardson (2006)
Over-investment	Over	Dummy variable, it equals 1 when a regression model's residual error is more than 0, otherwise it equals 0.	Naeem and Li (2019), Richardson (2006)
Under-investment	Under	Dummy variable, it equals 1 when a regression model's residual error is more than 0, otherwise it equals 0.	Naeem and Li (2019), Richardson (2006)
Free cash flows	Cashflow	Operating cash inflows (Inf) – ongoing investment (Oinv) – expected investment (Einv)	Wei and Xia (2020), Yu et al. (2010)
Firm size	Size	Natural logarithm of total assets in year *t*	Bzeouich et al. (2019), Cao et al. (2018)
Debt to assets	Lev	Liabilities/total assets in year *t*	Biddle et al. (2009), Naeem and Li (2019)
Returns on total assets	ROA	Net profit /total assets in year *t*	Bzeouich et al. (2019), Naeem and Li (2019)
Rate of fixed assets	FA	Net fixed assets/total assets in year *t*	Gao and Yu (2018), Kothari et al., (2010)
Rate of intangible assets	Intang	Net intangible assets/ total assets in year *t*	Chen et al. (2018), Tahat et al. (2018),
Inventory rate	Invent	Net inventory/total assets in year *t*	Lai et al. (2020), Moon et al. (2018)
Nominal tax rate	Tax	The tax rate of a firm income tax	Bradley et al. (2021), Ohrn (2018)
Ownership concentration	OCO	The shareholding ratio of the biggest shareholder	Wang et al. (2019, 2021)
State ownership	SOE	1 for state-owned enterprises, 0 for others.	Chen et al. (2017), Cole and Sommer (2010)

Free cash flows (Cashflow)

Cash flow is critical for investment decisions. Fazzari et al. (1998) examine the relationship between investment and cash flow and documents that the association is more significant for more financing-restrained firms. Investigating Chinese listed firms, Lian and Cheng (2007) reveal that a firm's investment efficiency is subject to cash flow. Thus, free cash flow is a vital factor in determining investment efficiency, and this study investigates the impact of pension contribution on investment efficiency.

On the other hand, more pension contributions may potentially result in under-investment (Shen et al., 2017) and, consequently, cash flow pressures (Autor et al., 2007). As Myers and Majluf (1984) suggested, firms have to abandon some valuable investments and result in decreasing investment efficiency if their cash flows are insufficient. Thus, free cash flow is a vital factor determining investment efficiency, and this paper investigates pension contribution impact on investment performance.

Firm size (Size)

Some studies document that firm size is associated with investment efficiency. Bzeouich et al. (2019) report a positive association between firm size and investment efficiency. Cao et al. (2020) suggest that large firms have more access to capital and consequently have under-investing issues. But we argue that firms with more capital access are more likely to face the over-investing problems. Large firms usually have well-developed and mature governance mechanisms to supervise investment efficiency and restrain over-investment. Furthermore, Watts and Zimmerman (1978) document that firm size is a crucial indicator of the political visibility of a firm because large firms have more exposure to changes in politicians. As such, firm size is essential for investment efficiency.

Debt to assets (Lev)

Financing constraints and agency issues are more prominent in countries with less-developed capital markets because of information asymmetries between different stakeholders (Naeem & Li, 2019). Many firms that may not raise funds from the stock market are more creditworthy for lenders and prefer to raise debt funds at lower rates (Cole, 1998). Meanwhile, Love (2003) finds that financial development may reduce a firm's financing constraints and improve investment efficiency by analysing the relationship between financial leverage and investment efficiency. Furthermore, Biddle et al. (2009) document that firms with higher free cash flows and low debts are prone to over-investing because this favourable situation tempts managers to pursue their own interests, which results in over-investment. Based on these discussions, the financing constraint measured by debt-to-assets is included as a control variable and is supposed to impact investment inefficiency.

Returns on total assets

Some studies have used ROA as a profit indicator to measure a firm's performance. Firms with higher ROA are more

discretionary in spending their profits on investments than others. Meanwhile, a higher value of ROA means more benefits earned from capital investments, which indicates investment efficiency. It has been adopted as a control variable to estimate investment efficiency by prior research (Bzeouich et al., 2019; Naeem & Li, 2019). Therefore, it is included in the model as a control variable.

Rate of fixed assets

Firm investment is identified as two types of investments in FA and current assets. The former refers to buying new FA (properties, plants and equipment) for production purposes or repairing and upgrading existing FA to extend working life or productivity (Gao & Yu, 2018). Theoretically, efficient investment means capital flows to the most highly valued and return-gained projects (Kothari et al., 2010). However, it is difficult to balance the capital flows between the two assets and maximise the assets' value, which eventually results in investment inefficiency. Under-investment in the FA-dominated manufacturing sector and over-investments in intelligence-driving sectors may contribute to an inefficient investment. Therefore, FA investments impact investment efficiency differently across the sectors.

Rate of intangible assets (Intang)

Intangible assets refer to those identified and economic resources without physical characteristics, which may generate revenues in the long run for a company, including patents, copyrights, trademarks and corporate philanthropy. Studies show that investments in intangible assets, especially R&D, may contribute to better firm performance in the future (Canibano et al., 2000; Tahat et al., 2018). Tahat et al. (2018) confirm that intangible assets improve firms' future financial performance and market value. Chen et al. (2018) find a positive relationship between philanthropy and investment efficiency in China, and the association is much stronger for companies in places with better institutional environments. Therefore, intangible assets are taken into account as a control variable.

Inventory rate (Invent)

Lai et al. (2020) investigate the relationship between inventory weaknesses and investment efficiency and report that weak inventory management results in inefficient investments, including over- and under-investments. Beatty et al. (2013) find that operating underperformance in inventory negatively affects cash flows and investments. Wu et al. (2010) suggest that an optimum investment in FA leads to financial pressure and subsequently show a negative relation between inventory volatility and capital investment. Similarly, Kim (2020) proves this negative relation and demonstrates that high inventory-based firms have weak investment performance. Inventory investment is viewed as a vital indicator of business cycles, particularly in the manufacturing sector (Moon et al., 2018). Manufacturing firms dominate our sample (see Table 5); thus, inventory rate is discussed as a control variable.

Nominal tax rate (Tax)

Prior research demonstrates the relationship between corporate taxation and investment decisions and performance as well (Bradley et al., 2021; Ohrn, 2018; Davis & Henrekson, 2004; Djankov et al., 2010) because tax policy may stimulate national economic growth by motivating firms to increase investment expenditures and contribute to the labour market. The research discusses many different taxes, such as individual, capital gains, corporate taxes, etc., and various investments, for instance, FA, foreign direct, portfolio investments, etc. Davis and Henrekson (2004) reveal that corporate income taxes are differently associated with investments in different sectors and influence resource allocation between other sectors. Djankov et al. (2010) show a significantly positive relationship between an effective corporate tax rate and an aggregate debt to equity ratio. Bradley et al. (2021) suggest that a 1.0% – 1.2% tax benefit contributes to growth in a merger and acquisition activity in an intellectual property tax regime. Therefore, this study includes tax rate as a control variable for the regression models.

Ownership concentration

Ownership concentration is an important governance tool in which owners control the management of a firm to protect their interests. The effect of OCO on firm performance is diversified across nations, such as positive effects in China (Wang et al., 2019), various effects in Europe (Gedajlovic & Shapiro, 1998) and insignificant relationships in the USA (Demsetz & Lehn, 1985), and nonlinear relations in Japan (Hu & Izumida, 2008). Wang et al. (2019) show that OCO positively affects firm performance. Similarly, investigating the relationship between OCO and investment efficiency of the Chinese energy firms, Wang et al. (2021) show that the firms with more OCO have more investment efficiency. Meanwhile, concentration acts as an essential role in improving investment efficiency. Accordingly, OCO is proposed as a control variable to test its effect on investment efficiency.

State ownership

Li et al. (2007) suggest that ownership structure has a positive effect on firm performance, whereas Firth et al. (2007) find that managerial ownership may not impact the financial performance of Chinese firms with many minority shareholders. Furthermore, Chen et al. (2017) find a more significant relationship between firm ownership structure and investment efficiency in the Chinese SOEs than non-SOEs. The government appoints the executive managers, so they prefer to pursue political goals for their own interests rather than better investment efficiency (Huang et al., 2011). Meanwhile, Chen et al. (2010) suggest that the political connections negatively affect investment efficiency in the Chinese stock market. State-owned enterprises dominate the Chinese stock markets; therefore, this study proposes SOE as an independent variable that determines investment efficiency.

Regression models

To investigate the impact of a firm's pension contributions on its investment inefficiency, this study proposes the following basic ordinary least squares (OLS) regression model:

$$Inv\left(Over/Under\right)_{i,t} = \beta_0 + \beta_1 Pension_{i,t} + \beta_k Control_{i,t} + \varepsilon \quad \text{[Eqn 1]}$$

where dependent Inv means investment inefficiency and the independent variable Pension refers to a firm's pension contributions, which is measured by the rate of pension contribution increment divided by salary payable in year *t*. The independent variable Inv indicates the inefficient investment level.

If β_1 is positive, a positive relationship exists between Pension and Inv, which indicates that a firm's pension contributions lead to investment inefficiency, thereby decreasing its investment efficiency. Otherwise, they do not.

As both overinvestment and underinvestment are regarded as investment inefficiency, a firm's investment inefficiency is further estimated under the two circumstances. Following Richardson (2006) and including all the aforementioned variables in Table 3, the full OLS regression models are developed as follows:

$$Inv_{i,t} = \beta_0 + \beta_1 Pension_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} + \beta_4 ROA_{i,t} + \beta_5 FA_{i,t} + \beta_6 Intang_{i,t} + \beta_7 Invent_{i,t} + \beta_8 Tax_{i,t} + \beta_9 OCO_{i,t} + \beta_{10} SOE_{i,t} + \beta_{11} \sum_{i=1}^{12} Year + \beta_{12} \sum_{i=1}^{17} Industry + \varepsilon_{i,t} \quad \text{[Eqn 2]}$$

$$Over_{i,t} = \beta_0 + \beta_1 Pension_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} + \beta_4 ROA_{i,t} + \beta_5 FA_{i,t} + \beta_6 Intang_{i,t} + \beta_7 Invent_{i,t} + \beta_8 Tax_{i,t} + \beta_9 OCO_{i,t} + \beta_{10} SOE_{i,t} + \beta_{11} \sum_{i=1}^{12} Year + \beta_{12} \sum_{i=1}^{17} Industry + \varepsilon_{i,t} \quad \text{[Eqn 3]}$$

$$Under_{i,t} = \beta_0 + \beta_1 Pension_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} + \beta_4 ROA_{i,t} + \beta_5 FA_{i,t} + \beta_6 Intang_{i,t} + \beta_7 Invent_{i,t} + \beta_8 Tax_{i,t} + \beta_9 OCO_{i,t} + \beta_{10} SOE_{i,t} + \beta_{11} \sum_{i=1}^{12} Year + \beta_{12} \sum_{i=1}^{17} Industry + \varepsilon_{i,t} \quad \text{[Eqn 4]}$$

Furthermore, Richardson (2006) investigates the relationship between a firm's overinvestment and free cash flow, finding that overinvestment is concentrated in firms with a high level of free cash flow. Other studies have demonstrated a relationship between investment efficiency and cash flow (Lian & Cheng, 2007). Thus, a firm's free cash flow is considered an independent variable. Meanwhile, because a firm's pension contributions may restrain its free cash flow, this study estimates the extent to which they do so in China. Following Richardson (2006) and Naeem and Li (2019), the models are developed as follows:

$$Cashflow_{i,t} = \beta_0 + \beta_1 Pension_{i,t} + \beta_2 Size_{i,t} + \beta_3 Lev_{i,t} + \beta_4 ROA_{i,t} + \beta_5 FA_{i,t} + \beta_6 Intang_{i,t} + \beta_7 Invent_{i,t} + \beta_8 Tax_{i,t} + \beta_9 OCO_{i,t} + \beta_{10} SOE_{i,t} + \beta_{11} \sum_{i=1}^{12} Year + \beta_{12} \sum_{i=1}^{17} Industry + \varepsilon_{i,t} \quad \text{[Eqn 5]}$$

$$Inv_{i,t} = \beta_0 + \beta_1 cashflow_{i,t} + \beta_2 Pension_{i,t} + \beta_3 Size_{i,t} + \beta_4 Lev_{i,t} + \beta_5 ROA_{i,t} + \beta_6 FA_{i,t} + \beta_7 Intang_{i,t} + \beta_8 Invent_{i,t} + \beta_9 Tax_{i,t} + \beta_{10} OCO_{i,t} + \beta_{11} SOE_{i,t} + \beta_{12} \sum_{i=1}^{12} Year + \beta_{13} \sum_{i=1}^{17} Industry + \varepsilon_{i,t} \quad \text{[Eqn 6]}$$

If $\alpha_1 < 0$, it means that a firm's pension contribution restrains its free cash flow. If $\beta_1 > 0$, it shows a positive relationship between cash flow and investment inefficiency, indicating that cash flows may lead to inefficient investments (possibly over-investments). However, if $\beta_1 < 0$, cash flows may also result in inefficient investments (possibly underinvestments).

To test this theory, we employ models (2–4) to examine the significance of pension contributions to inefficient investments and then utilise model (5) to estimate the relationship between pension contributions and cash flows. Finally, model (6) was adopted to investigate the cash flow effect on investment inefficiency. If the empirical results support this, we may conclude that pension contributions restrain firms' cash flows and result in investment inefficiency.

Results

Descriptive analysis

Table 4 shows some descriptive statistics of the quantitative variables. Comparing the over with the under variables, the mean, median and max values are 0.029, 0.020 and 0.140, respectively, which are less than the values of the under variable. Meanwhile, the oversample size is 10 388, which is less than the undersample size of 11 093. This indicates that underinvestment is more dramatic and remarkable than overinvestment.

Table 4 shows the *Pension* values: mean (0.076), median (0.073), minimum (0.017) and maximum (0.176), which indicates a significant regional disparity in pension costs between firms because each Chinese province has its discretion in executing pension rates ranging from 60% to three times the regional salary on average. Additionally, under-investment is more significant than over-investment for most firms. The mean value of SOE is 0.423, which indicates approximately 42.3% of the listed SOEs in the Chinese stock market.

Table 5a and Table 5b reports the descriptive statistics of the sample firms according to years and industrial sectors. As panel A shows, an increasing number of firms, from 1250 to 3029, went public during 12 years from 2007 to 2018, and 26 135 listed firms were observed. Panel B shows that the manufacturing sector has the most significant number of

TABLE 4: Descriptive statistics of the quantitative variables.

Variables	Observ.	Mean	Standard deviation	Mini	25% quantile	Median	75% quantile	Max
Inv	26 135	0.031	0.030	0.000	0.010	0.022	0.041	0.145
Over	10 388	0.029	0.029	0.000	0.010	0.020	0.038	0.140
Under	11 093	0.033	0.031	0.000	0.011	0.023	0.045	1.000
Pension	26 135	0.076	0.031	0.017	0.054	0.073	0.097	0.176
Size	26 135	22.00	1.316	14.94	21.07	21.82	22.73	28.52
Lev	26 135	0.430	0.210	-0.195	0.264	0.426	0.590	2.681
ROA	26 135	0.045	0.679	-2.746	0.015	0.038	0.067	1.084
FA	26 135	0.226	0.170	0.000	0.094	0.191	0.322	0.971
Intang	26 135	0.048	0.064	0.000	0.016	0.033	0.057	0.890
Invent	26 135	0.155	0.147	0.000	0.061	0.119	0.196	0.943
Tax	26 135	0.191	0.058	0.000	0.150	0.150	0.250	0.330
OCO	26 135	0.356	0.152	0.003	0.235	0.337	0.460	0.900
SOE	26 135	0.423	0.494	0.000	0.000	0.000	1.000	1.000

ROA, rate on total assets; FA, rate of fixed assets; OCO, ownership concentration; SOE, state ownership.

TABLE 5a: Sample distribution by years and industrial sectors.

Years	Observed firms	Percentages (%)	Years	Observed firms	Percentages (%)
Panel A					
2007	1250	4.78	2013	2251	8.61
2008	1320	5.05	2014	2367	9.06
2009	1481	5.67	2015	2554	9.77
2010	1812	6.93	2016	2733	10.46
2011	2057	7.87	2017	3046	11.65
2012	2235	8.55	2018	3029	11.59
Sum	**26 135**	**100**	-	-	-

TABLE 5b: Sample distribution by years and industrial sectors.

Industrial sectors	Observed firms	Percentages (%)	Industrial sectors	Observed firms	Percentages (%)
Panel B					
Agriculture	411	1.57	Real estate	1240	4.74
Mining	640	2.45	Business service	300	1.15
Manufacturing	16 713	63.95	Science and technology	685	2.62
Utilities	922	3.53	Environment	272	1.04
Construction	689	2.64	Public service	539	2.06
Wholesale and retail	1519	5.81	Education	513	1.96
Transportation	867	3.32	Social work	49	0.19
Hospitality	100	0.38	Culture and entertainment	314	1.20
Others	360	1.38	-	-	-
Sum	**26 135**	**100**	-	-	-

listed firms with 16713, accounting for 63.95% of 26135 in total, followed by 1519 in the wholesale and retail industry. The manufacturing sector is the largest industry and dominates the Chinese economy, and there is a large labour force population in the industry. As pension contributions are significant parts of firm labour costs, these sample firms are substantial for the research.

Regression analysis

Following the regression models (2–4), Table 6 shows the relationship between the pension costs and investment performance. In column (1), the coefficient is 0.025 at the 1% significance level, and this positive association demonstrates that pension contributions increase inefficient investment; in other words, a firm's pension contributions decrease its investment efficiency. To further investigate this relationship further, we divide inadequate assets into two types: over-investments and under-investments. In column (2), there exists a negative relationship (–0.009) between the variables of pension and over-investment, indicating that increasing pension contributions decreases a firm's investment motivation. In column (3), the coefficient is 0.025 at a 5% significance level, and this positive relationship between the variables of pension and under-investment shows that pension cost increment leads to under-investment. This result supports H1a.

In addition, there exists a negative relationship (–0.001) between firm size and inefficient investment because larger firms have higher investment efficiency than smaller ones (Park et al., 2017). Additionally, this negative relationship exists for under-investment firms (–0.003) because larger firms have more money to invest. On the contrary, firm size positively correlates with over-investment (0.001) because large firms waste much more money investing in some underperformed investments. Still, small firms would like to waste their limited money on non-profitable investments.

TABLE 6: Association between defined pension contributions and investment inefficiency.

Variables	(1) Inv	(2) Over	(3) Under
Pension	0.025***	-0.009	0.025**
	(3.551)	(-0.913)	(2.333)
Size	-0.001***	0.001***	-0.003***
	(-7.545)	(2.708)	(-10.057)
Lev	0.006***	-0.004*	0.012***
	(4.848)	(-1.761)	(5.902)
ROA	0.000	0.000*	-0.007
	(0.780)	(1.751)	(-1.059)
FA	0.009***	0.004	0.017***
	(6.272)	(1.643)	(6.789)
Intang	0.025***	0.023***	0.026***
	(6.658)	(4.090)	(3.863)
Invent	-0.033***	-0.027***	-0.038***
	(-19.540)	(-10.177)	(-14.418)
Tax	0.020***	0.028***	0.008
	(5.077)	(4.893)	(1.275)
OCO	-0.002*	-0.003*	0.002
	(-1.843)	(-1.778)	(1.167)
SOE	-0.004***	-0.005***	-0.004***
	(-8.858)	(-6.881)	(-6.104)
Constant	0.067***	0.016***	0.107***
	(16.274)	(2.624)	(15.528)
Year	control	control	control
Industry	control	control	control
N	26 135	10 388	11 093
Adjusted R^2	0.042	0.043	0.068

Note: The figures reported in brackets are *t*-values adjusted by heteroscedasticity, ***, **, * means significant levels at 1%, 5%, 10%, respectively.

ROA, rate on total assets; FA, rate of fixed assets; OCO, ownership concentration; SOE, state ownership.

Employer-sponsored pension contributions restrain firms' investment cash flows. This study employs model (5) to test this relationship and model (6) to further test the relationship between cash flow and investment inefficiency. Table 7 reports these relationships. The coefficient (–0.160) at the 1% significance level shows a negative relationship between pension and cash flow, indicating that more pension contributions lead to less investment cash flows. Additionally, a negative relationship exists between cash flow and size (–0.010). However, a positive relationship exists between cash flows and Lev (0.004) and FA (0.006). This means that larger companies have more leveraged financing approaches to invest in FA and others; this kind of over-investment partially leads to a cash flow shortage. Therefore, more leveraged financing leads to greater investment inefficiencies.

Column (2) shows a positive relationship (0.033) between cash flow and Inv, indicating that a firm's cash flow shortage may result in inefficient investments. The coefficient of 0.050 between Pension and Inv is greater than 0.025 in column 1 in Table 6. A firm's pension contributions lead to a cash flow shortage, resulting in investment underperformance. As Table 6 indicates, this type of inefficient investment refers to under-investment. In addition, the positive relationship (0.002) between Size and Inv is different from it in Table 6. Subjected to cash flow, larger firms are more likely to have investment inefficiency.

TABLE 7: Association between defined pension contributions, free cash flow and investment inefficiency.

Variables	(1) Cashflow	(2) Inv
Cashflow	-	0.033***
	-	(8.742)
Pension	-0.160***	0.050***
	(-3.614)	(3.478)
Size	-0.010***	0.002**
	(-6.381)	(2.408)
Lev	0.004	0.011***
	(0.738)	(4.385)
ROA	0.001	-0.000
	(1.129)	(-1.600)
FA	0.006	-0.021***
	(0.768)	(-5.959)
Intang	-0.012	0.012
	(-0.730)	(1.430)
Invent	-0.031***	-0.038***
	(-2.830)	(-9.612)
Tax	-0.004	-0.001
	(-0.212)	(-0.119)
OCO	-0.026**	-0.008*
	(-2.465)	(-1.828)
SOE	0.009*	-0.007***
	(1.904)	(-3.548)
Constant	0.143***	0.017
	(3.653)	(1.127)
Year	0.143***	0.017
Industry	(3.653)	(1.127)
N	26 583	26 129
Adjusted R^2	0.063	0.025

Note: The figures reported in brackets are *t*-values adjusted by heteroscedasticity, ***, **, * means significant levels at 1%, 5%, 10%, respectively.

ROA, rate on total assets; FA, rate of fixed assets; OCO, ownership concentration; SOE, state ownership.

Factor-adjusted tests

Investment cashflow sensitivity-adjusted test

As shown in Table 7, cash flow is a significant factor associated with pension contributions and investment performance. This study employs the cash flow sensitivity-adjusted methodology from Broussard et al. (2004) to further test the research question. Following Broussard et al. (2004), the sample firms by the cashflow mean value are sorted into two groups: one group with sufficient investment cash flows and the another with insufficient cash flows.

In terms of firms having sufficient investment cash flow, in Table 8, the coefficient of 0.032 at the 1% significance level indicates that pension contributions result in investment inefficiency. This result is consistent with that in Table 6, based on the full sample of firms. However, there is a negative relation (–0.008) for the firms with insufficient cash flow. For this type of firm, a growing pension contributions restrict their cash flows, so they are unable to squander their limited money investing in non-profitable investments.

Ownership structure-adjusted test

As Table 5 indicates, 42.3% of the sample comprise SOEs. Moreover, a firm's investment efficiency is associated with its ownership structure. This study examines the differences in

TABLE 8: Investment cashflow sensitivity–adjusted test.

Variables	Sufficient cashflow	Insufficient cashflow	Full sample
	(1) Inv	(2) Inv	(3) Inv
Pension	0.032***	-0.008	0.025***
	(3.626)	(-0.727)	(3.551)
Size	-0.001***	-0.003***	-0.001***
	(-3.285)	(-8.552)	(-7.545)
Lev	-0.000	0.014***	0.006***
	(-0.233)	(6.345)	(4.848)
ROA	-0.006	0.000	0.000
	(-0.870)	(0.775)	(0.780)
FA	0.007***	0.010***	0.009***
	(3.884)	(3.103)	(6.272)
Intang	0.022***	0.034***	0.025***
	(5.127)	(3.956)	(6.658)
Invent	-0.032***	-0.039***	-0.033***
	(-16.181)	(-10.769)	(-19.540)
Tax	0.014***	0.027***	0.020***
	(2.810)	(4.233)	(5.077)
OCO	-0.001	-0.003	-0.002*
	(-0.610)	(-1.625)	(-1.843)
SOE	-0.004***	-0.003***	-0.004***
	(-7.667)	(-4.037)	(-8.858)
Constant	0.057***	0.094***	0.067***
	(11.200)	(13.153)	(16.274)
Year	control	control	control
Industry	control	control	control
N	16 339	9796	26 135
Adjusted R^2	0.046	0.044	0.042

Note: The figures reported in brackets are t-values adjusted by heteroscedasticity, ***, * means significant levels at 1% and 10%, respectively.

ROA, rate on total assets; FA, rate of fixed assets; OCO, ownership concentration; SOE, state ownership.

the impact of pension costs on investment efficiency between SOEs and non-SOEs.

Table 9 reports a negative relation (−0.036) and a positive relation (0.059) between Pension and Inv. An SOE's pension contributions do not result in investment underperformance, but they do for non-SOEs. This kind of under-performance may partially attribute to a firm's under-investment because of the coefficient of 0.077 between the Pension and Under (Non-SOEs). It is more significant for non-SOEs than SOEs (0.028).

Financing-adjusted test

Financing capacity is a significant factor in investment decision making. This study further investigates the extent to which investment inefficiency can be attributed to pension contributions for different financing-restricted firms. According to Kaplan and Zingales (1997), a larger KZ value indicates more restricted financing. This study uses the KZ index to measure a firm's extent of financing restriction. The sample firms by median KZ are sorted into two groups: financing restricted and financing accessible firms.

As shown in Table 10, both firms have a positive relationships between pension costs and investment underperformance. Particularly for financing-restricted firms, pension contributions (0.046) are associated with inefficient investments more than their counterparts (0.037).

TABLE 9: Ownership structure-adjusted test.

Variables	(1) Inv	(2) Inv	(3) Under	(4) Under
	Non-SOEs	SOEs	Non-SOEs	SOEs
Pension	0.059***	-0.036	0.077**	0.028
	(3.144)	(-1.636)	(2.478)	(0.763)
Size	-0.000	0.003***	-0.001	0.007***
	(-0.339)	(3.554)	(-0.703)	(4.338)
Lev	0.010***	0.013***	-0.004	0.009
	(2.758)	(3.877)	(-0.741)	(1.512)
ROA	0.003	-0.000	0.008	0.000*
	(0.617)	(-0.547)	(1.073)	(1.868)
FA	-0.029***	-0.016***	-0.007	-0.030***
	(-5.919)	(-2.850)	(-1.110)	(-3.722)
Intang	-0.001	0.026**	0.017	0.039**
	(-0.096)	(2.064)	(1.114)	(1.961)
Invent	-0.032***	-0.039***	-0.016**	-0.043***
	(-6.620)	(-6.699)	(-2.071)	(-5.156)
Tax	0.009	-0.009	0.031**	-0.011
	(1.051)	(-0.796)	(2.474)	(-0.670)
OCO	-0.010*	-0.006	-0.007	-0.019**
	(-1.772)	(-0.891)	(-0.813)	(-2.087)
Constant	0.058***	-0.026	0.053*	-0.114**
	(2.841)	(-1.060)	(1.775)	(-2.500)
Year	control	control	control	control
Industry	control	control	control	control
N	15 071	11 064	6047	5046
Adjusted R^2	0.027	0.019	0.030	0.043

Note: The figures reported in brackets are t-values adjusted by heteroscedasticity, ***, **, * means significant levels at 1%, 5%, 10%, respectively.

ROA, rate on total assets; FA, rate of fixed assets; OCO, ownership concentration; SOE, state ownership.

Profitability-adjusted test

Profitable firms have sufficient cash flows and fewer financing restrictions; accordingly, it is hypothesised that a firm's pension contributions cannot result in investment underperformance for the more profitable firms, but for less profitable firms, they can. This study employs the ratio of surplus cash (current net operating cash flows/net profit) to test this hypothesis to measure a firm's profitability. Based on the median profitability value, these firms are sorted into two groups: profitable firms and less profitable ones.

Table 11 indicates a positive association (0.049) between pension and Inv for the less profitable firms but a negative relationship (−0.022) for profitable firms, which means that contributions result in investment underperformance for the less profitable firms. By contrast, a firm's pension contributions may increase its investment performance for profitable firms.

Conclusions and implications

Pension contributions are significant labour costs, particularly in China. Facing the economic impacts of the COVID-19 pandemic and economic downward pressures, the Chinese government has reduced pension contribution rates several times to support firms' development and maintain economic sustainability. Under these circumstances, this study collects data from Chinese listed firms from 2007 and 2018 and employs OLS models to investigate the relationship between the pension contribution rate and investment inefficiency.

TABLE 10: Financing-adjusted test.

Variables	(1) Inv	(2) Inv
	Finance restricted firms	Financing accessible firms
Pension	0.046**	0.037
	(2.356)	(1.475)
Size	0.002*	0.006***
	(1.927)	(4.732)
Lev	0.007**	0.022***
	(2.010)	(4.665)
ROA	-0.000	-0.014*
	(-1.076)	(-1.895)
FA	-0.032***	-0.002
	(-6.888)	(-0.308)
Intang	0.000	0.035**
	(0.000)	(2.148)
Invent	-0.038***	-0.041***
	(-7.767)	(-4.847)
Tax	0.000	-0.014
	(0.025)	(-0.976)
OCO	-0.002	-0.014*
	(-0.467)	(-1.655)
SOE	-0.006**	-0.012***
	(-2.202)	(-3.148)
Constant	0.021	-0.079**
	(1.071)	(-2.083)
Year	control	control
Industry	control	control
N	15 361	10 774
Adjusted R^2	0.022	0.033

Note: The figures reported in brackets are t-values adjusted by heteroscedasticity, ***, **, * means significant levels at 1%, 5%, 10%, respectively.

ROA, rate on total assets; FA, rate of fixed assets; OCO, ownership concentration; SOE, state ownership.

TABLE 11: Profitability-adjusted test.

Variables	(1) Inv	(2) Inv
	Less profitable firms	Profitable firms
Pension	0.049***	-0.022
	(2.922)	(-0.835)
Size	0.002***	0.002*
	(3.162)	(1.727)
Lev	0.009***	0.013**
	(3.198)	(2.424)
ROA	-0.000*	-0.001
	(-1.867)	(-0.037)
FA	-0.018***	-0.025***
	(-4.106)	(-4.004)
Intang	0.016	0.000
	(1.404)	(0.005)
Invent	-0.040***	-0.026***
	(-9.388)	(-3.288)
Tax	0.003	-0.005
	(0.377)	(-0.438)
OCO	-0.009*	-0.003
	(-1.827)	(-0.460)
SOE	-0.005**	-0.014***
	(-2.277)	(-3.418)
Constant	0.004	0.013
	(0.265)	(0.435)
Year	control	control
Industry	control	control
N	18 547	7588
Adjusted R^2	0.020	0.023

Note: The figures reported in brackets are t-values adjusted by heteroscedasticity, ***, **, * means significant levels at 1%, 5%, 10%, respectively.

ROA, rate on total assets; FA, rate of fixed assets; OCO, ownership concentration; SOE, state ownership.

This study shows that the pension contribution increments of Chinese listed firms result in fewer investment opportunities and decreases in their investment efficiency (see Table 6), because more pension contributions lead to less investment cash flows, and firms' cash flow shortages may result in inefficient investments (see Table 7). Particularly for financing-restricted firms, pension contributions are associated with inadequate investments more than their counterparts (see Table 10). For the firms with insufficient cash flow, a growing number of pension contributions restricts their cash flows, so they cannot waste their limited money investing in non-profitable investments (see Table 8). However, these results are insignificant for the more profitable firms and SOEs (see Table 9 and Table 11).

These findings suggest that pension contribution deductions may release firms' financial pressure and reduce labour costs, thereby improving investment efficiency. Efficient investment may accelerate resource configuration and contribute to economic development; in turn, it generates more profits for business operations and pension contributions. This type of a virtuous cycle is sustainable.

Implications: This research suggests that the government has two solutions for firms that survive the current economic challenge: subtraction and addition. Improving investment efficiency is an effective subtraction option to ease the defined pension contributions of listed companies. Meanwhile, perfecting the pension system is an alternative solution for reducing firms' labour costs and stimulating their growth potential. In contrast, improving the fundraising environment as a supporting measure for small firms is an additional strategy to achieve synergistic development.

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Competing interests

The authors have declared that no competing interest exists.

Authors' contributions

J.W. and H.L. designed the model and the computational framework and analysed the data. J.W. and D.W. carried out the implementation. J.W. and D.W. performed the calculations. J.W. wrote the manuscript with input from all authors. H.L. reviewed and edited the manuscript. Y.C. was in charge of visualisation, validation and collecting resources. J.W. conceived the study and was in charge of overall direction and planning.

Ethical considerations

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Data availability

The data that support the findings of this study are available from the corresponding author, H.L., upon reasonable request.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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