Corporate Labour Practices and Fintech Development: Evidence from China

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ABSTRACT

This thesis studies corporate labour practices and financial technology (Fintech) development in China and contains six chapters. Chapter one introduces my PhD thesis. It discusses the motivation and contribution for each chapter. Chapter two contains a comprehensive literature review, which systematically reviews the current state of knowledge related to the theory, impact and determinants of employee treatment in the firms, based on a review of 150 research papers. We observe a growing trend of firms enhancing employee treatment, suggesting that employee treatment functions as an important mechanism that enhances firm value.

Chapter three investigates the impact of employee medical welfare on firm productivity. We find that such welfare significantly enhances firm performance by improving employees' psychological security, which increases work efficiency. This effect is more pronounced in non-state-owned firms, firms with a higher proportion of low-skilled employees and lower R&D intensity. Additionally, firms offering better medical welfare demonstrate stronger resilience during the COVID-19 pandemic. These results underscore the role of organizational caregiving (Vijayasingham et al., 2018) and stakeholder theory (Titman, 1984) in shaping firm outcomes.

Chapter four investigates the relationship between new financial technology, digital finance (DF), and corporate employee treatment. We find that DF enhances employee conditions through corporate digital transformation and increased demand for skilled labour. This effect is stronger in regions with lower marketization and severe pollution, where disadvantaged firms leverage DF to attract talent. Moreover, government support, corporate governance, and financial flexibility amplify DF's positive impact. DF also contributes to workforce expansion and long-term firm performance, reinforcing its role in shaping corporate labour strategies in line with human capital theory (Sweetland, 1996).

Chapter five presents the last essay focusing on how DF affects people's fertility behaviour. We find that DF negatively influences birth rates by increasing investment opportunities, promoting consumption-driven individualism, and raising women's economic independence and opportunity cost of fertility. Notably, only DF coverage significantly reduces birth rates, whereas its depth and digitalization have weaker effects. More importantly, government's support in education, healthcare, and religious policies can mitigate DF's adverse impact on fertility.

Chapter six concludes by outlining the main findings, the implications of each essay, the limitations of the thesis, and potential avenues for future research.

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CHAPTER ONE

INTRODUCTION

This chapter provides an overview of my PhD thesis. It discusses the motivation, main findings and contribution for each essay.

A stakeholder-oriented view of corporate finance emphasizes the importance of employees as a vital asset to a firm (Titman, 1984). Previous employee theories (e.g., Taylor, 1911) were based on early 20th century capital intensive firms in which employees performed unskilled work and were treated like any other raw material. However, recent finance literature has shifted its focus from conventional perspectives to the importance of human capital impacts (Wright et al., 1994) as technological advances have gradually changed business models and labour demand of the firms. Modern theories like the stakeholder theory consider employees as a strategic asset that can add significant value to the firm (Pfeffer, 1994; Ben-Nasr & Ghouma, 2018). Considering the evolution of employee roles and their significance, the first part of my thesis presents a systematic literature review to summarize the theoretical developments and empirical evidence related to employee roles, thereby laying a foundation for the subsequent research.

Theories regarding the impact of employee benefits on corporate performance and decision-making have emerged, accompanied by series of empirical studies and findings (Berk et al., 2010). Studies have found better treatment increases employee satisfaction with firms which reduces strikes events (Newman, 1980), reduces stock price crash risk (Edmans et al., 2014), and improves innovation performance (Chemmanur et al., 2019). However, it may also undermine firm value, as enhanced employee treatment could foster complacency (Miller, 1995) and contribute to managerial misconduct (Cennamo et al., 2009). These conflicting findings have prompted further research; however, existing studies remain limited, as they tend to view employee treatment policies and tools[1] as a whole and are normally based on the United States market. The COVID-19 pandemic underscored the importance of employee health benefits, highlighting medical insurance, a part of employee treatment scheme, as a key tool for

[1] Employee treatment policy includes many concrete and different plans and tools, such as compensation, welfare, education and incentive plans (e.g. Calzolari & Nardotto, 2017).

protection. This raises important questions in corporate finance about the value of adopting an ethics of care approach through medical welfare provision. In my essay one, I investigate whether the investments in employee health care improve firm productivity and firm value or not.

Apart from the study on employee treatment and firm performance, determinants of employee treatment are also a direction of study. Technology and humanity are timeless topics in the contemporary era (Leonhard, 2016). The advancement of technology, especially the emergence of artificial intelligence, poses significant challenges to the current labour market (Wach et al., 2023). Whether technological development affects employment and welfare policies is a pressing question for firms, as it concerns operating costs and long-term firm value. For employees, how to gain a competitive edge amid technological progress and ensure job security is of great practical importance. The 2024 Nobel Laureates in Economics, Daron Acemoglu and Simon Johnson, pointed out in their book *Power and Progress: Our Thousand-Year Struggle Over Technology and Prosperity* that in the face of the unstoppable force of technological advancement, one major way for workers to respond is by adapting themselves and improving their professional skills. However, in the context of corporate finance research based on the Chinese market, there is a notable lack of literature discussing this issue. The second essay in the thesis is trying to explore whether and how new finance technology affects firm's employee treatment.

Finally, in essay three, we shift the focus from the impact of financial technology on employees within firms to its broader effects on the general population. Digital finance (DF) — the integration of traditional financial services with modern information technology — has demonstrated various direct benefits due to its inclusiveness and convenience, such as expanding financial service coverage and investment (Ji et al., 2021), alleviating liquidity constraints and stimulating consumption (Zhu et al., 2023) and supporting women's

entrepreneurship and promoting gender equality within households (Han et al., 2023). However, few studies have connected these economic and structural shifts at the household level to broader social behaviours, such as fertility decisions. With China facing a rapid decline in its demographic dividend (Peng, 2011), understanding whether and how DF influences fertility behaviour is crucial for assessing long-term economic growth. This study develops an empirical model to examine the relationship between DF and birth rates.

The next four sections present an overview of each of the essays in the thesis, in particular outlining the findings and contributions of each essay to the existing literature. Section 1.5 lists the research outputs from the thesis.

1.1 Literature review paper

Many studies have pointed out that employee treatment directly affects their work efficiency and job satisfaction and indirectly affects firm performance (Zhang et al., 2020). However, these topics have not received much attention in the finance literature. and we focus in particular on the relationship between employee treatment and firm behaviour in this literature review paper by summarizing and analysing current related theories, literatures and empirical findings. We describe past and modern theories about the role of employees in the firm. Then we summarize findings about the influence of employee treatment on firm behaviour and performance. In addition, we identify policies and factors that contribute to greater employee wellbeing.

By summarizing theoretical discussions, we find that the role of the employee in firms has changed from that of human raw materials to value-added assets (Taylor, 1911; Akerlof, 1982). To attract and retain talents, as the efficiency wage theory and the stakeholder theory imply, employee treatment and welfare is used as a tool in exchange for employees' increased efforts and improved efficiency (Bae et al, 2011). Social exchange theory and the reciprocity norm

(Blau, 1964; Eisenberger et al., 1986; Whitener, 2001) further explain employee behaviour under the efficiency wage theory and the stakeholder theory, showing employees establish a psychological bond with the organization (Patrick et al., 2007), which triggers positive outcomes (Korschun et al., 2014). These positive outcomes have been empirically investigated, such as higher stock market return (Edmans, 2011), higher firm productivity (Gupta & Krishnamurti, 2020) and innovation performance (Mao & Weathers, 2019). In addition, employee friendly firms are likely to hold more cash (Ghaly et al., 2015), maintain lower leverage ratios (Bae et al., 2011) and limit financial covenants usage (Francis et al., 2019). Furthermore, we find that government regulations on employee protection from the perspective of the political environment (Chen et al., 2019), employee psychological factors (Fehr & Gachter, 2000) and good corporate governance (e.g. Adams & Funk, 2012; Rein et al., 1997) contribute to greater employee wellbeing.

This survey makes contributions to the literature in the following ways. First, we summarize 150 theoretical and empirical literature on employee treatment and wellbeing. These studies are interdisciplinary, across economics, finance, management, psychology and law. Our review is also across industries, countries, as well as over time, thus facilitating a deeper understanding of employee roles and their influence in modern firms. Second, to our knowledge, few studies have systematically summarized and critically reviewed the literature on employee treatment policies and the outcomes of these policies from the finance perspective.

1.2 Essay one

Essay one investigates the impact of employee medical welfare on firm productivity in China. Employee medical insurance is an important part of the current employee welfare and care system. It is viewed as an investment in employee care and is an additional cost along with the employees' compensation and other benefits (Fairlie et al., 2011). Our paper investigates

whether investments in employee health care improve firm productivity or not. We also examine how COVID-19 pandemic highlighted the importance of health insurance for employees as a way to protect themselves and raises the question of whether there is benefit for firms in taking an ethics of care approach by providing better medical welfare and insurance to employees.

By employing data from all non-financial Chinese listed firms on the A-share markets from 2011 to 2020, we present strong evidence of a positive relationship between employee medical welfare and firm productivity; these findings are consistent with the stakeholder theory. To control for possible endogeneity concerns, we use several fixed effects and an instrumental variable (IV) two-stage least square (2SLS) regression. We introduce two IVs of medical insurance expenditures, which are regional air pollution level and green space per capita. We also conduct a number of robustness tests. The results all remain consistent. We perform several cross-sectional analyses to examine the channels. We argue that medical welfare is different from compensation or bonus incentives; rather it can be viewed as an example of organisational caregiving (Vijayasingham et al., 2018) that enhances the work lives of employees and provides them with a sense of security. The psychological safety theory (Kahn, 1990) states that employees with sufficient organisational protection have an enhanced feeling of safety which boosts their work engagement and effectiveness (Edmondson & Lei, 2014). The results show that the effect of medical welfare incentives is more pronounced for non-state-owned firms, firms with more low-skilled employees, firms with low R&D intensity where employees' sense of security is weaker. Furthermore, we find medical insurance has a greater impact on productivity when local medical facilities are well developed. Finally, we conduct what we believe is the first analysis of the impact of employee medical welfare on firm stock performance and value during the period of COVID-19 in China. We find employee medical welfare in 2019 is positively and significantly related to market adjusted return on 3 February

2020 (the first trading day after the Wuhan lockdown), CARs with different estimation windows, and firm Tobin's Q during the years 2020 and 2021 when COVID-19 was spreading.

This study contributes to the existing literature by demonstrating how firms can develop an ethics of care approach to support employee wellbeing and at the same time increase firm productivity and value. Our evidence provides support for government policy on increasing firm labour insurance and employee welfare and also demonstrates the importance of developing a regional healthcare system. Also we explore the way in which employee psychological security can serve as an underlying channel that fosters firm productivity by enhancing employees' feeling of security, especially in the case of low-skilled groups. Thus, as well as extending the current theoretical background in relation to employee treatment in corporate finance, our research enriches the field of business ethics research in relation to employee care and wellbeing. Last, strategies that firms use to deal with shocks such as a pandemic warrant further investigation. We test the relationship between employee medical welfare and firm resilience during COVID-19 and expand the current understanding of the determinants of firm resilience during a crisis period via a more labour-oriented approach.

1.3 Essay two

In essay two, we focus on the determinants of employee treatment policies. In particular, we investigate the impact of digital finance (DF), a new type of Fintech, on employee treatment, given the implications of technology for humanity is a timeless topic (Leonhard, 2016). From a resource-based perspective (Barney, 1991), DF alleviates financing constraints and improves transparency (Ji et al., 2022; Sun et al., 2023), enabling greater investment in welfare programmes and fostering stronger trust between management and employees. It also promotes broader digital adoption (Cascio & Montealegre, 2016; Wu & Huang, 2022), supporting process optimisation, better decision-making, and inclusive management practices that enhance human capital. Conversely, DF-driven efficiency gains may substitute labour

(Carpenter et al., 2019) and shift resources toward technological investment at the expense of employee welfare (Schein, 2010), while cultural emphasis on shareholder returns may crowd out employee-oriented considerations (Li et al., 2024). Overall, DF may strengthen or weaken employee treatment depending on whether firms prioritise inclusive strategies or cost efficiency.

We use panel data of 12,421 observations from 2011 to 2020 to examine the relationship between DF and employee treatment in China. The empirical results indicate that DF promotes employee treatment; these findings are consistent with the technological enablement and organisational change theory (Cascio & Montealegre, 2016). The result is robust to a series of tests including adding forward values of employee treatment measures, adapting sub-categories of the DF index in the ranking system, employing the propensity score matching (PSM) approach and entropy balancing approach (EB). To address potential endogeneity from reverse causality, where firms with more employee-friendly practices may contribute to local DF facilities and infrastructure and thereby bias upward the estimated effect of digital finance on employee treatment, we adopt a two-stage least squares (2SLS) approach with two instrumental variables (IVs). The first IV, following Zhu et al. (2023), uses the geographical distance from a firm's city to Hangzhou, the birthplace of Alipay and a central hub for DF development, and is made time-varying by interacting distance with the national average DF index (excluding the specific city) as in Zhang et al. (2020). The second IV, based on Chen and Zhang (2021), combines historical communication infrastructure (fixed-line telephones per 100 people in 1984) with the previous year's Internet users to capture exogenous variation in DF. First-stage regressions confirm that both instruments are significantly related to DF, and second-stage results remain consistent with baseline findings, supporting the robustness of the positive effect of DF on employee treatment. Further analysis of mechanisms (Ji et al., 2022; Mu et al., 2023) shows that the effect is concentrated in financially constrained firms and those with lower

transparency, indicating that DF enhances employee-oriented practices by easing resource limitations and reducing information asymmetry.

In the heterogeneity tests, we find this positive relationship is more prominent in firms located in the regions with lower marketization levels and regions with severe air pollution, indicating that disadvantaged firms are taking advantage of digital inclusive finance to attract employees in a competitive market. In addition, we find government support and good corporate governance strengthen DF's positive impact on employee treatment. Finally, we find that DF development accelerates corporate digital transformation and raises demand for high-skilled labour, highlighting the complementary relationship between technological advancement and workforce upskilling and underscoring the importance of human capital investment for both individual and organizational competitiveness.

This essay contributes to literature in several ways. First, it advances understanding of how digital finance (DF) benefits firms by alleviating financing constraints and enhancing information transparency. By easing access to external capital while increasing scrutiny from investors and regulators, DF shapes both the capacity and motivation for firms to adopt more responsible labour practices, extending financial research to consider employees as critical internal stakeholders. Second, we provide evidence on the inclusive role of DF in supporting disadvantaged firms. By mitigating institutional and environmental disadvantages in highly polluted or less market-oriented regions, DF reduces systemic barriers, promotes equitable participation in economic development, and highlights the importance of sound corporate governance in translating financial access into improved employee-related policies. Third, we document the impact of DF on corporate digital adoption and employment structure, finding that greater DF adoption accelerates digital transformation and increases the share of high-skilled workers. This underscores the complementary relationship between technological advancement and workforce upskilling, aligning with Johnson and Acemoglu's (2023) view

that technological forces are inexorable and that investing in future-relevant skills is essential. Overall, our study shows that DF not only reduces financing frictions and improves transparency but also acts as a transformative force reshaping labour structures and human capital development in the digital economy.

1.4 Essay three

In the last essay of this thesis, we try to extend our focus from Chinese employees in particular to the total population in China more generally. We argue DF not only affects employees within firms but also affects household behavior and the economy. Studies show that DF promotes personal consumption (Li et al., 2020), stimulates household online purchases (Zhu et al., 2023), improves investment services and increases income (Ji et al., 2021). Also DF contributes to industrial structure upgrading (Ren et al., 2023), regional economic resilience (Yu et al., 2023), and air pollution decreases (Wang & Guo, 2022). However, how this new financial technology affects people's fertility behaviour is still under investigation and worth exploring from the point of view of long-term economic benefits. Given China's serious fertility dilemma and the gradual prevalence of digital financial services, it is important to explore whether financial technology has an impact on birth rates.

By employing DF index and publicly available city-level birth rates in 287 Chinese cities, this essay explores the impact of DF on fertility and finds DF has a negative influence on birth rates; this finding is supported by endogeneity and robustness tests. To further explore the potential mechanisms in this negative relationship, we conduct a channel test. We suggest DF increases investment opportunities and therefore reduces the need for having children for support in old age. DF increases consumption and possibly individualism and also increases women's economic independence and their opportunity cost of having children, leading to lower birth rates. Given the development of DF is an inevitable trend, we further find that out of the three components of the DF index measures in the ranking system, the coverage of DF significantly

decreases birth rates, while the higher level of DF development, depth and digitalization of the technology, has much less negative impact on birth rates. Lastly and most importantly, we find this negative impact can be moderated when governments make policy efforts to increase people's fertility willingness through increased educational and medical resources and protection of religion.

This study contributes to the literature in the following ways. First, as DF continues to evolve rapidly, its influence is extending beyond economic activities into broader aspects of social behaviour. Existing evidence suggests that DF enhances financial services and products, stimulates consumption, and promotes women's economic independence. While these direct economic effects are largely positive, they may also produce unintended social consequences, such as a decline in birth rates, which could undermine long-term economic development. Policymakers should be mindful of the challenges associated with the rapid expansion of DF. In this context, understanding the relationship between DF and birth rates is both academically significant and policy relevant. To the best of our knowledge, this study is the first to investigate the impact of DF on birth rates at the city level in China. By exploring this relationship, we contribute a novel perspective on how DF influences social behaviour and long-run economic outcomes.

Second, although empirical evidence indicates that DF tends to reduce birth rates, our findings suggest that certain policies can effectively mitigate this negative impact. Specifically, increased government investment in healthcare and education, along with protections for religious freedom, play important roles in offsetting the adverse effects of DF on fertility. Furthermore, we find that the initial phase of DF development—namely, the expansion of coverage—has the most pronounced negative impact on birth rates. In contrast, more advanced stages of DF, such as improvements in service depth and digitalization, exhibit a significantly weaker negative effect. These insights underscore the importance of shifting policy emphasis

from broad coverage to deeper and more targeted development of DF. Overall, our study offers timely and policy-relevant implications for both fertility promotion and sustainable DF development.

1.5 Research outputs from the thesis

Essay one - Organisational medical welfare and firm productivity: Evidence from China

- has been accepted for presentation at Massey Sustainable Finance Conference (2025)
- has been presented at AsianFA Conference in Vietnam (2023)
- has been presented at New Zealand Finance Meeting in Auckland (2022)

Essay two - Does digital finance adoption impact corporate employee treatment? Evidence from China

- has been presented at The 8th Shanghai-London-Edinburgh Fintech Conference in Shanghai (2024)

Essay three - How does digital finance impact birth rates: Evidence from China

- has been published in *Economic Analysis and Policy*
- has been presented at The 28th NZ Finance Colloquium in Auckland (2024)
- has been presented at The 2nd edition of the International Society for the Advancement of Financial Economics in Thailand (2024)
- has been presented at Massey Sustainable Finance Conference in Auckland (2024)

1.6 Structure of the thesis

The remainder of this thesis is structured as follows. Chapter 2 presents a comprehensive literature review that systematically examines the existing body of knowledge on the theory, impact, and determinants of employee treatment across firms in multiple countries. Chapter 3 presents the first essay, which investigates the relationship between employee medical welfare

and firm productivity. Chapter 4 introduces the second essay, which explores the interaction between DF and corporate employee treatment. Chapter 5 presents the final essay, focusing on the influence of DF on individuals' fertility behaviour. Finally, Chapter 6 concludes the thesis by summarizing the key findings and implications of each essay, and by discussing the limitations of the research and directions for future work.

CHAPTER TWO

LITERATURE REVIEW

This chapter offers a comprehensive and interdisciplinary review of the extant literature concerning the theoretical foundations, impacts and determinants of employee treatment.

Employee treatment and firm financial behaviour: A literature review

Abstract

Based on a review of 150 papers, we provide a comprehensive and interdisciplinary survey of the current state of knowledge related to the theory, impact and determinants of employee treatment. These topics have not received much attention in the finance literature, and we focus in particular on the relationship between employee treatment and firm behaviour. First, we describe past and modern theories about the role of employees in the firm. Second, we summarize findings about the influence of employee treatment on firm behaviour and performance. Third, we identify policies and factors that contribute to greater employee wellbeing. We conclude by suggesting a number of potential areas for future research.

Keywords: employee treatment, employee wellbeing, firm behaviour, firm performance

JEL classification: G30, I30, J30, J53

"The competitiveness of an enterprise depends on whether its employees are treated as value-added assets or as liabilities."

Mr. Zhang Ruimin, the Honorary Chairman of the Board of Directors and founder of Haier Group

2.1. Introduction

Since its founding in 1984, Zhang Ruimin has led Haier from a small collective-owned factory on the brink of bankruptcy to a world-leading eco-enterprise. 2014 was a transformative year for Haier when Zhang proposed the concept of "Chuang Ke", that is, the idea that all employees are participants in the process of firm innovation. Firms should treasure their employees as they play important roles in creating firm value. Also, employees will use the company as a platform to serve customers and realize their own potential[2]. Haier has now been the world's top household appliance brand for 12 consecutive years[3].

Recent finance literature has shifted its focus from conventional topics such as the capital structure, cash holdings, and dividend payouts, to the importance of human capital impacts (Wright et al., 1994). The upper echelon theory states the characteristics of CEO and top management team do affect firm behaviours and decisions (e.g. Hambrick, 2007; Yülek & Akkemik, 2022), but the role of the largest human group inside a firm, employees, is still under-investigated. From the standpoint of human resource management and firm value maximization, employee policies such as Chuang Ke in Haier pose the question of whether good employee treatment (and therefore greater employee wellbeing) is beneficial for corporate performance

[2] Zhang Ruimin - Pursue genuine knowledge in the Internet age, retrieved from China Economic Observation Network – eeo.com.cn
https://baike.baidu.com/reference/19495/9349jed6HZs3Ywz2mqcgtZlEublyOZ8eBtjpAKiquVUbNVY3gdrZp4361CvHpfzPoNI8GpmVJLl4Idd-gVD0IKJo8U3WkN0TBg

[3] From "the first year of the company" to "the first year of ecology": Haier initiated a new inheritance mechanism published by China Daily – CHINADAILY.com.cn
https://baike.baidu.com/reference/19495/8325XCNgPdR-0tCjd27tJ_XuxpMQzBH5zc3dJcl6BXIsLvcfhPc76zBEqvIEHaq2jAMokoeOmFQoNZTewRGL9-gPVP01bnDHFiHp7ZBX_pdVs7pj39dkWfqDWTTUmUmbJFxRmD1fJkascDiX

and also which factors affect employee wellbeing. Therefore, the purpose of this survey is to review the current state of knowledge with respect to employee treatment and firm behaviour.

Employee treatment policy includes many concrete plans to encourage and improve employee general wellbeing and also gives employees more opportunities and flexible time with respect to work breaks, education and family issues (Pouliakas & Theodossiou, 2013; Calzolari & Nardotto, 2017)**.** Traditional employee theories (e.g., Taylor, 1911) were based on early 20th century capital intensive firms in which employees performed unskilled work and were treated like any other raw material; management's goal was simply to maximize profit while reducing costs and increasing productivity. In contrast, modern theories consider employees as a strategic asset that can add significant value to the firm (Titman, 1984; Pfeffer, 1994; Ben-Nasr & Ghouma, 2018). According to these theories, firm policies relating to employees are particularly significant as they are designed to enhance employee engagement in daily work and therefore contribute to better firm performance and enhanced firm value. On the other hand, there is also some debate as to whether the pursuit of enhanced employee treatment may breed employee laziness and hide corrupt managerial behaviour which ultimately results in poor firm performance and enhanced risk (Hemingway & Maclagan, 2004; Edmans, 2009; Kim et al., 2014).

Why is the subjective wellbeing of employees so important to enterprises or organizations? Many studies have pointed out that employee treatment directly affects their work efficiency and job satisfaction and indirectly affects firm performance (Zhang et al., 2020a). Mao and Weathers (2019) find that favourable employee treatment increases the innovation quantity and quality of a firm. Verwijmeren and Derwall (2010) argue that firms with good reputations on employee wellbeing can significantly reduce the probability of bankruptcy by operating with lower leverage. In addition, fostering employees' subjective wellbeing is closely bound up with customers' satisfaction (Amin & Akbar, 2013). However other studies show that

overinvestment in employee welfare may increase stock price crash risk as, consistent with agency theory, employees are viewed as a tool to help managers withhold bad news from investors (Ben-Nasr & Ghouma, 2018).

Existing studies about employee treatment in economics and finance are limited and normally based on the United States market. Most literature uses the data from the Kinder, Lydenberg, and Domini (KLD) database, which is managed by MSCI ESG Research[4], as the proxy for employee treatment (Bereskin et al., 2018; Mao & Weathers, 2019; Verwijmeren & Derwall, 2010; Bae et al., 2011; Zhang et al., 2020a)[5]. The second most commonly used data for the measure of high employee treatment are the Fortune's 100 Best Companies to Work For lists (BC100). This list was first published in March 1984 (Levering et al., 1984) and it has been published in Fortune magazine each January since 1998 (Edmans, 2011)[6]. Other substitute measures for employee treatment are also used, for example employee satisfaction survey data from Gallup (Krekel et al., 2019) and the employee welfare index from Thomson Reuters (Ben-Nasr & Ghouma, 2018).

In this study, we focus in particular on the relationship between employee treatment and firm behaviour. Taking advantage of relevant theories in management, psychology and finance, we first discuss the current state of knowledge with respect to employee treatment theory and highlight why employee treatment is important for modern firms. Then, we discuss the impact and consequences of employee treatment on firm performance and decisions. Last, we explore

[4] http://www.msci.com/resources/factsheets/MSCI_ESG_Research.pdf

[5] KLD rates the firm's employee relations in the following sub-categories: employee involvement (strength), cash profit-sharing (strength), other strong employee relations initiatives not covered by other KLD ratings (strength), union relations (strength or concern), retirement benefits (strength or concern), health and safety (strength or concern), workforce reductions (concern), and other employee relations controversy that is not covered by other KLD ratings (concern). The KLD signs 0/1 in the strength and concern of each sub-category.

[6] http://www.greatplacetowork.com/best-companies/about-applying-to-best-companies-lists/about-the-process B&C 100 List is compiled from two principal sources. Two-thirds of the score comes from the employee responses to a 57-question survey created by the Great Place to Works Institute in San Francisco. The remaining one-third of the score comes from the Institute's evaluation of factors in four firm areas: credibility (communication to employees), respect (opportunities and benefits), fairness (compensation, diversity), and pride/camaraderie (teamwork, philanthropy, celebrations) (Edmans, 2011; Faleye & Trahan, 2010; Mao & Weathers, 2019).

the determinants of employee treatment and better employee wellbeing. When investigating the impact of ownership on employee treatment, we focus on Chinese state-owned enterprises (SOEs) as an example.

This survey makes contributions to the literature in the following ways. First, we summarize the theoretical and empirical literature on employee treatment. These studies are interdisciplinary, across economics, finance, management, psychology and law. Our review is across industries, countries, as well as over time, thus facilitating a deeper understanding of employee roles and their influence in modern firms. Second, to the best of our knowledge, few studies have critically reviewed employee treatment policies and their outcomes in the area of finance.

The remainder of the paper is structured as follows. In Section 2, we review existing theories about employee treatment and its importance for firms. Section 3 examines previous empirical findings in respect to the relationship between employee treatment and firm performance and decisions and the channels through which firm's employee treatment policy affects firm behaviour and performance. In Section 4, we discuss the factors that contribute to better employee treatment. The final Section 5 concludes by identifying potential avenues for future research.

2.2. Theoretical background on roles of employees and employee treatment

This section reviews traditional and current theories on the role of employees in firms, which provides the necessary background to the debate as to whether employees are value-added assets or liabilities.

2.2.1 Traditional theories

2.2.1.1 Taylor's theory

Taylor (1911) views employees that perform unskilled work as not having special status, but

as simply one of the firm's raw materials, so that any investment in employee welfare represents wasteful and meaningless expenditure. Based on this view, employee satisfaction is an indicator that employees are overpaid or underworked, and the only goal for the firm is to pursue maximum output from employees while minimizing their cost. In traditional manufacturing firms, since employees' output could be easily measured, motivation to work was simply achieved by allowing the use of extrinsic factors such as monetary "piece rates" or the threat of termination of employment (Taylor, 1911). Cash is viewed as the most effective motivator, because workers are mainly concerned with physical needs. Such a view would motivate a study of wages rather than satisfaction (Edmans, 2011).

2.2.1.2 The agency theory

The agency view, based on the agency relationship between managers and shareholders (Jensen & Meckling, 1979), suggests that better employee treatment may be used by managers to achieve personal benefits, resulting in value destruction (Fama & Jensen, 1983). Agency problems can lead managers to tolerate inadequate effort or excessive pay at the expense of shareholders in order to build more pleasant working relationships with subordinates (Jensen & Meckling, 1979; Miller, 1995). If this relationship continues for a long time, it causes an imbalance between work and remuneration, and then breeds inefficiency and laziness among employees.

In addition, improving job conditions and the working environment can be seen as a strategy by managers to appear to investors as ethical leaders in order to cover up their misconduct (Petrovits, 2006; Prior et al., 2008; Ben-Nasr & Ghouma, 2018). This can lead to problems multiplying until the bad news cannot be hidden and has to be disclosed to the public.

In summary, managers can use the consideration of stakeholders such as employees as an excuse to enlarge their personal power and increase managerial discretion. Employees are less likely to object to excessive executive compensation and welfare, and unions turn a blind eye

to the management misbehaviour, ultimately incapacitating the corporate monitoring system (Cennamo et al., 2009).

2.2.2 Modern theories

The role of the employee, however, has changed due to the development of technology over recent decades. In the early 1960s, discussion on labour-capital complementarity by Griliches (1969), suggests that humans are not necessarily a substitute for machines. Further research presents evidence for the view that physical capital is more complementary to educated labor than to less educated labor (Fallon & Layard, 1975). Also Becker (1962) suggests that human-capital investment may be particularly important with respect to high-skilled employees, as they are valuable assets in firms. More recent theories argue that human capital resources meet the criteria for sustained competitive advantage as they are valuable, rare, inimitable, and non-substitutable, which means they are vitally significant to help firms pursue long term success, ("human capital inalienability") (Akerlof, 1982; Pfeffer, 1994; Wright et al., 1994). Furthermore, a varying degree of labour mobility, which affects a firm's competition for talent, has been extensively studied as a factor contributing to employee treatment (Marx et al., 2009), as human capital investment is often interrupted by employee job changes.[7] We next review some of the modern theories of employee treatment.

2.2.2.1 The efficiency wage theory

Wages have long been the most basic and widespread form of reward in firms. From the point of view of employees, salary is not only a kind of labour reward, but also a "gift" from the firm to which the employee responds with increased effort (Akerlof, 1982). According to Akerlof and Yellen (1986), wages can increase job satisfaction. In order to avoid being fired from a job that brings steady income, employees increase their productivity. Also, Wadhwani and Wall (1991) find that greater levels of wages lead to higher productivity. Therefore the theory of

[7] We thank an anonymous reviewer for this suggestion.

efficiency wages suggests that employers who pay their employees more than the going market rate are likely to have more productive workers. However, Herzberg et al. (2017) argue that money is only an effective motivator up to a point, once workers' physical needs are met. Hence, wages are integral to employee satisfaction, but only partly satisfactory, and not enough to improve overall employee wellbeing.

2.2.2.2 The stakeholder theory

Titman (1984) is the first to point out that the stakeholders, such as customers, suppliers, and workers, can have a significant influence on firm decisions and performance. Among these nonfinancial stakeholders, employees may be the most important value-relevant partial contributors to firm value maximization (Edmans, 2011; Bae et al, 2011). Also, attracting and retaining skilled and talented employees has proved to be a key component of modern enterprise competitiveness (Barney, 2001). Aoki (1984) argues that shareholders and employees are the two main stakeholders and that managers serve as referees between the two. According to the above views, the role of employees as stakeholders of the firm cannot be ignored and value maximization requires management to direct some of the benefits to stakeholders when they generate present value benefits that exceed costs (Jensen, 2002; Faleye & Trahan, 2011).

In addition, stakeholder theory views stakeholder management as a means to implement firm decisions (Berman et al., 1999; Francis et al., 2019) and increase shareholder wealth (Donaldson & Preston, 1995). Instrumental stakeholder theory (Francis et al., 2019) argues that stakeholder management facilitates executives' communication, negotiation and contract signing with stakeholders. At the same time, stakeholder management can promote trust and reduce information, agency and transaction costs (Jones, 1995). Overall, stakeholder theory predicts that high quality employee welfare may lower firm risk and improve firm performance and value.

2.2.2.3 The organisational caregiving theory

Previous research finds that organisational protection boosts employees' faith in the organisation, which helps them to maintain superior performance in the face of constant challenges (D'Cruz & Noronha, 2010). In recent organisational studies, Vijayasingham et al. (2018) argue that organisational care assists in the achievement of positive outcomes that are of value to a firm's shareholders. Vijayasingham et al. (2018) discuss how organisations can use an ethics of care perspective to enrich the work lives of employees with a chronic illness by means of "organisational caregiving". For instance, chronic illness is expensive, especially in the absence of insurance or universal healthcare, but firm treatment for chronic illnesses reduces the employees' burden and improves their health and employment outcomes (Carls et al. 2012).

2.2.2.4 Psychological theories – employee gratitude for receiving better treatment

Social exchange theory and the reciprocity norm (Blau, 1964; Eisenberger et al., 1986; Whitener, 2001) effectively explain employee behaviour under the efficiency wage theory and the stakeholder theory. Employees interpret the firm's policies and actions as a commitment to them, and they normally reciprocate with loyalty and commitment to the organization (Faleye & Trahan, 2011), which decreases employee absenteeism (Gellatly, 1995) and lowers turnover rates (Francis et al., 2019). Moreover, Day and Randell (2014) find employees with a high level of wellbeing put more thought and effort into their work. Therefore, greater employee benefits may increase employees' loyalty to the firm, enhance the close relationship and psychological trust between employees and the firm, and stimulate employees' productivity in order to repay the company.

Furthermore, the psychological safety theory (Kahn, 1990) argues that psychological safety enables employees to establish trust in organisations. Baer and Frese (2003) find that psychological safety is an important moderator of the relationship between R&D investment

and outputs, because an organizational environment that makes people feel safe to share ideas contributes to more critical thinking. In addition, psychological safety has been found to play a role in workplace effectiveness (Edmondson & Lei, 2014) and leads to more employee engagement in their work (Ge, 2020).

Also, evidence shows that firms with active social responsibility initiatives such as responsible employee treatment, are ethical, and their managers are good citizens, which makes employees feel a sense of pride in the organization (Glavas & Kelley, 2014). Through employee-friendly practice, the firm encourages employees to establish a psychological bond with the organization (Patrick et al., 2007), and this triggers positive employee outcomes (Korschun et al., 2014).

2.3. Employee treatment, firm performance and firm decisions

As employees have become a more valued resource for firms, theories on the influence of employee treatment on firm performance and decision-making have been developed and evidence gathered to test those theories (Berk et al., 2010). In section 3, we first summarize the published literature in academic journals focusing on employee treatment in the area of finance. Then we review the literature on how employee treatment influences firm performance, firm decisions and other stakeholders from Section 3.2 to 3.4. In Section 3.5, we discuss the potential channel through which employee treatment affects firm performance, which is rooted in psychological and economic mechanisms. Last, we specifically focus on the current empirical efforts that have been made to address methodological challenges, such as omitted variables, reverse causality and isolating the effect of employee treatment on firm performance from other concurrent effects (e.g. Bae et al., 2011; Ben-Nasr & Ghouma, 2018; Fauver et al., 2018).

2.3.1 Overview of the literature

In this section, we aim to summarize the published literature on employee treatment in

corporate finance. The idea is to better understand “why” and “how” employee treatment affects firms’ performance and decisions. After reviewing the current findings, we will provide a guideline on what has been done in current research and what remains to be done, which indicates the research gap for future academic studies.

We review studies of employee treatment in firms from 2005 to the present. Literature was searched from the Google Scholar database using various keywords such as “employee treatment”, “employee wellbeing”, “employee and firm behaviour”, “employee and finance”. Conference papers and working papers are excluded from this review. As a result of the search process, 72 papers were found to be suitable for the purpose of our review. Appendix 1 summarises the papers. We include focus, year of publication, title, author(s) information, and employee treatment measurement information in the table. We find current literature focuses on studying the relationship between employee treatment and firm performance and decisions whereas some new studies have started focusing on the relationship between employee treatment and other stakeholders. We next present some detailed analysis of this literature.

Regarding the measurement of employee treatment, nearly 60% of papers use KLD, BC 100 list or other ESG rating databases, e.g. Hexun on Chinese markets. The rest of the articles are based on research data mainly sourced from government or inter-governmental organisations, for example, the US Department of Labor, OECD's Employment Protection Legislation and Commerce, and State Administration for Industry and Commerce of the People’s Republic of China. A small number of articles are based on questionnaire data, such as the Gallup survey and Workplace Employment Relations questionnaire. Only a few studies directly use annual report information from listed companies, which indicates the annual report lack sufficient information in terms of employee treatment and welfare.

Among these papers, there has been a notable increase in publications over the last decade, reflecting the growing interest in studies of employees in corporate finance. These papers are

published in 29 journals that indicate the interdisciplinary orientation of employee treatment research. The number of papers published in top journals with very high impact factors include *Journal of Corporate Finance (10)*, *Journal of Business Ethics (9)* and *Journal of Financial Economics (9)*. Table 2.1 presents the journal distribution of the papers.

Table 2.1. Journal distribution of published studies of employee treatment in corporate finance

Journal	Impact factor[8]	2005 - 2010	2011 - 2015	2016 - 2020	2021 -	Total
Academy of Management Perspectives	6.623		1			1
Accounting & Finance	2.586			1	1	2
Applied Economics Letters	1.078			1		1
China Economic Review	4.063			1		1
Economic Modelling	3.314			1	2	3
Economics Letters	2.211				1	1
European Accounting Review	3.0				1	1
European Financial Management	1.993			1		1
Finance Research Letters	5.268				1	1
Global Finance Journal	2.693				2	2
International Review of Finance	1.624			1		1
International Review of Financial Analysis	5.156				1	1
Journal of Accounting and Economics	5.961			1		1
Journal of Banking and Finance	3.509	1	1		1	3
Journal of Business Ethics	6.137		2	3	1	9
Journal of Business Finance and Accounting	2.842	1		1		2
Journal of Business Research	8.098			1	1	2
Journal of Contemporary Accounting and Economics	2.582			1		1
Journal of Corporate Finance	4.675		2	7	1	10
Journal of Economic Behaviour and Organization	1.797				1	1
Journal of Economics and Finance	0.911			2		2
Journal of Finance	8.532	2				2
Journal of Financial and Quantitative Analysis	4.231	1		1	1	3
Journal of Financial Economics	7.786		5	4		9
Journal of Financial Research	1.075		1			1
Management Decision	4.417	1		2	1	4
Management Science	5.417			3		3
Pacific-Basin Finance Journal	2.968				1	1
Review of Accounting Studies	3.966			1		1
Review of Finance	4.295			1		1
Review of Financial Studies	7.099		1	1		2

[8] The impact factor is based on the five-year average as of 2022.

2.3.2. Employee treatment and firm performance

2.3.2.1. Employee treatment and stock market return and risk

According to the stakeholder theory (Titman, 1984), high standards of employee welfare and greater benefits may enhance stock market performance. First, the improvement in working conditions usually increases employees' work motivation and productivity (Ben-Nasr & Ghouma, 2018). Second, a high level of employee satisfaction with firms reduces the probability of strikes, which may be harmful to firm value (Newman, 1980). In addition, better employee treatment policies often help companies build a positive reputation in society as a whole. Such a good reputation effectively ensures the continuous participation of firms' stakeholders, including shareholders (Ben-Nasr & Ghouma, 2018).

Edmans (2011) finds that employee satisfaction leads to higher shareholder returns. Edmans et al. (2014) further show that employee satisfaction is associated with positive abnormal returns in firms in the United States and the United Kingdom, where labour market flexibility is relatively high, but not in countries with low labour market flexibility, such as Germany. In a flexible labour market, high employee satisfaction is a valuable tool for recruiting, retaining and motivating employees. In a regulated labour market, by contrast, legislation already sets minimum standards for worker benefits, so any additional spending on employees may represent a cost that can result in diminishing returns for the company (Edmans et al., 2014).

Contrary to the stakeholder theory, agency theory (Jensen & Meckling, 1979) holds that a higher level of employee welfare may lead to a higher stock price crash risk, as improved working conditions can be seen as a targeted strategy by management to cover up corporate misconduct (Hemingway & McLaggen, 2004; Prior et al., 2008). In addition, employees benefit from these policies which make them less likely to become potential whistle-blowers (Dyck et al., 2010), since no one is willing to sacrifice their immediate interests (Bowen et al., 2010). Ben-Nasr and Ghouma (2018) presents robust evidence which is consistent with the

agency theory that high level employee welfare helps managers to withhold bad news from investors, resulting in higher stock price crash risk. They also indicate two potential channels through which employee welfare affects stock price crash risk, namely earnings management and the likelihood of whistleblowing.

2.3.2.2. Employee treatment and firm productivity

According to the stakeholder theory, good employee treatment enhances employee productivity and in turn improves firm productivity. Many studies have provided evidence of these relationships. Gupta and Krishnamurti (2020) argue that higher firm productivity is associated with many factors and employee treatment is one of the main sources of the productivity increase. Employee-friendly policies can attract and retain skilled employees to work for the firm, which is especially important when employees are increasingly becoming a key competitive factor for firm success (Pfeffer, 1994; Bae et al., 2011).

With regard to the mechanisms through which employee treatment affects productivity, two main channels have been tested in previous literature. The first channel is the psychological factor of employee commitment. Good employee treatment will enhance job satisfaction and thus encourage them to work efficiently (Parks & Steelman, 2008). The second factor is employee wellness programs that help improve employee physical health, thereby decreasing their sick leave (Gubler et al., 2016).

2.3.3. Employee treatment and firm decisions

2.3.3.1. Employee treatment and firm innovation

Many studies have shown that innovation plays a role in promoting economic development (Romer, 1990; Aghion & Howitt, 1992) and helps firms gain a competitive advantage (Porter, 1992). Zingales (2000) finds that creating an employee-friendly organization to retain skilled employees is the key factor to ensure innovation quantity and quality. In fact, modern firms tend to be human capital-intensive organizations that operate in a highly competitive

environment that emphasizes workplace quality and innovation (Zingales, 2000; Edmans, 2011; Chen et al., 2016).

The main challenge for firms in developing innovation strategies is unpredictability and a high probability of failure (Holmstrom, 1979). The wellbeing of innovative staff becomes particularly critical and how managers invest in the firm's human capital is the main factor in innovation success. Chemmanur et al. (2019) find that the quality of the employee policy is an important determinant of firm innovation. If companies can improve their employees' job satisfaction and enhance their trust, they can offset the negative effects of risky innovation activities and promote experimentation and innovation (Chen et al., 2016). Chen et al. (2016) find that employee-friendly policy helps firms achieve greater innovation success, as the workplace develops a failure tolerant environment that encourages employee engagement in the innovation process. Also, Mao and Weathers (2019) find a positive relationship between high quality employee treatment and the innovation quantity and quality of the firm. They further test the economic value of firm patents and show that innovation represents a channel through which employee wellbeing enhances firm value. In addition, Acharya et al. (2013) find that employee job protection can strengthen employees' innovation efforts and encourage companies to invest in riskier projects, especially in innovation-intensive industries.

2.3.3.2. Employee treatment and M&As

Differences between firms can be a source of value creation in a merger (Bouwman, 2013). This is a popular topic in recent research when considering the differences in employee policies between the targets and acquirers. Normally, cost reduction in the pursuit of economies of scale is believed to be a major driver in corporate takeovers (Houston et al., 2001). Overall, existing literature finds that labour is a cost or hindrance in the corporate acquisition process. Good employee treatment may prevent M&As or reduce their value.

According to John et al. (2015), acquirers with the goal of achieving synergies and productivity

gains may increase layoffs, and reductions in pay or benefits. Once employee welfare declines at the post-acquisition stage, it will lead to the deterioration of the employee-friendly policies. In addition, many labour protection laws require union approval for some of the firm decisions (which usually involves negotiating concessions on workforce restructuring, compensation, welfare and benefits). Consequently, unions in acquirer firms may not approve the M&A deals with targets since acquisitions may result in layoff and lower welfare benefits in acquirer firms. John et al. (2015) find that acquiring firms with strong labour rights have lower announcement returns from acquisitions. They argue that employees may suffer lost wages or reputational damage if the firm fails as a result of a takeover, so that employees are likely to prefer deals that reduce risk, even if they are not optimal or may result in a loss of shareholder value. Also Dessaint et al. (2017) show the number of takeover deals drops by almost 15% and deal volume in dollars drops by almost 30% in response to major employee protection increases.

From the perspective of the target, Pagano and Volpin (2005) show that entrenched managers can use a strong employee base to thwart takeover threats, reduce the likelihood of deals being completed, and reduce the return to the acquirer. Also target employees may try to prevent the deals, especially when target firms are in weak labor rights states and less unionized, because their voice will be weaker in the new union after the combination (Dessaint et al., 2017).

2.3.3.3. Employee treatment and cash holdings and capital structure

Direct evidence of the roles that human capital and employee relations play in a firm's cash management policy is provided by Ghaly et al. (2015). Their empirical results indicate that firms strongly committed to employee welfare hold more cash. This relationship is much stronger in industries with intensive human capital, fierce competition and high labour mobility. As employees in these industries have more competitive advantages in the labour market with more employment opportunities, firms need to attract and retain these skilled and talented employees. Schmalz (2013) shows that after unionization, holding cash helps companies to

achieve greater financial flexibility. In a recent paper, Devos and Rahman (2018) argue that employees always worry about unemployment risk, even when the firm is not close to potential bankruptcy (Brown & Matsa, 2015). Specifically, companies with less conservative cash policies may appear less secure to their employees, and so when workers are exposed to high risk of unemployment, they will require companies to pay higher premiums in wages and other benefits as compensation for potential unemployment (Abowd & Ashenfelter, 1981; Topel, 1984).

In addition, a firm's relationship with its employees is an important determinant of the firm's financing policy. Titman (1984) argues that employees as stakeholders may face switching costs if the firm is liquidated. When the firm has a higher probability of liquidation due to high leverage, employees' work motivation is affected (Jaggia & Thakor, 1994). Berk et al. (2010) examine the impact of human capital on capital structure and argue that human costs like employee compensation help to explain firm leverage; in particular the firm's optimal capital structure depends on the trade-off between these human costs and the tax benefits of debt. In later studies, results show that firms with higher employee-friendly ratings maintain lower leverage ratios (Bae et al., 2011).

2.3.4. Employee treatment and other stakeholders' benefits

Francis et al. (2019) argue that the way firms treat one group of stakeholders has an impact on other groups of stakeholders. Studies on how employee policies affect other stakeholders are scarce (indicating potential for future research). Existing papers mainly focus on three stakeholders (creditors, bondholders and auditors). By adopting an instrumental stakeholder management approach, Francis et al. (2019) find that good employee treatment significantly reduces loan prices and limits financial covenants usage, but that competition in the industry and intangibility of firm assets moderate this relationship. Also, employee-friendly policies benefit bondholders and lead to a lower bond spread (Chen et al., 2019). This is because a

friendly employee environment reduces product failures, labour strife, and employee turnover, and total firm productivity is enhanced. However, Chen et al. (2019) also show that if firms face financial distress or agency problems, a higher level of employee satisfaction is costlier for bondholders. In terms of employee-friendly policies, Li et al. (2020b) and Sun et al. (2020) both find that firms with such policies have a good workforce environment; and auditors perceive these firms as being less risky clients and therefore put in less effort and charge lower audit fees as a result.

2.3.5. Channels through which employee treatment affects firm performance

Next, we focus on the channels or mechanisms through which the firm's employee treatment policies affect firm performance. In other words, how do employees react to and perform under friendly employee policies in order to improve performance? First, through the implementation of daily employee-friendly practice, the firm aims at the development of overall employee wellbeing. This signals that companies attach great importance to the welfare of their employees, which in turn encourages employees to form a strong psychological bond with the organization, measured as the low turnover rate (Patrick et al., 2007). When employees feel the organization supports and values them, they repay the favor through work, for example, higher productivity or innovation outputs (Mao & Weathers, 2019). Consistent with the 'broaden-and-build' theory in Fredrickson (2001), good treatment policies provide employees with more positive feelings and emotions, which, among other things, helps to improve employees' abilities.

Another possible mechanism is that an employee-friendly organization creates a failure-tolerant environment that encourages employees to experiment without fear of failure, so that firms with employee-friendly workplaces achieve great innovation successes (Chen et al, 2016). Chen et al. (2016) find that firms with higher tolerance for employee failure keep investing in R&D during recessions.

Employee resilience could also be a potential channel through which well-treated employees enhance firm performance. Resilience reflects the ability to maintain a stable equilibrium (Bonanno, 2004). Luthans (2002) defines it as “the developable psychological capacity to rebound or bounce back from adversity, conflict, failure or even positive events, progress and increased responsibility” (p.702). Resilience allows for not only passive recovery, but active learning and growth through overcoming challenges and also allows for the use of setbacks as "springboards" or growth opportunities beyond equilibrium (Bonanno, 2004; Luthans et al., 2006). Furthermore, resilience can help people adjust to adversity (Bandura, 1997; Youssef & Luthans, 2007). In terms of employee resilience, Youssef and Luthans (2007) propose that it can be improved by creating a friendly and positive organizational environment.

Another possible mechanism is the greater sense of personal control and efficacy achieved through a good balance between work and family. Berg et al. (2003) find that employees' ability to balance work and family depends on their work characteristics within the company. To be specific, high-performing work practices, opportunities to participate in decision-making, informal training, performance-related pay, and good opportunities for promotion all have a positive impact on employees' work-family balance. Negative work traits, such as forced overtime, involuntary long work hours and conflicts and unhappy relationships with colleagues all reduce employees' ability to balance work and family responsibilities. Using the survey data, previous literature finds that participation in a high-performing work system leads to a greater sense of personal control and efficacy, which has a positive impact on employees’ ability to manage the other aspects of their lives (Piotrkowski, 1979; Greenhaus & Beuteil, 1985). Grover and Crooker (1995) find that various family-friendly benefits have a positive impact on employee commitment and reduced turnover.

Last, research into economic mechanisms has mainly come from labour economics and management in relation to labour adjustment costs and human resource allocation. The

literature finds that better employee treatment reduces labour adjustment costs and benefits firm financing conditions. Labour adjustment costs are mainly incurred in the processes of dismissal and recruitment. As laws and regulations enhance the protection of human capital, they restrict firms from laying off employees and increase workforce rigidity (Banker et al., 2013). There is also an impact on recruitment costs. Some firms have high human capital requirements, and when significant costs are invested upfront in employee training, firms avoid losing skilled employees through better treatment (Sanati, 2017). In addition, considering labour as a factor of production, its allocation has an impact on firm operations (Almeida et al., 2015; Boutin et al., 2013). Cestone et al. (2018) state that it is much cheaper for firms to allocate labour resources within firms than it is from the external market.

2.3.6. Empirical efforts to address endogeneity problems

The existing economics, finance and accounting literature emphasizes endogeneity issues, namely the empirical challenge of isolating the effect of employee treatment on firm performance from other concurrent effects and the possibility of reverse causality (e.g. Bae et al., 2011; Ben-Nasr & Ghouma, 2018; Fauver et al., 2018). We examine some methodologies in current published empirical studies that try to address these concerns. Table 2 summarises the results in terms of Two-stage Least Squares (2SLS) instrumental variable (IV) approach and difference-in-difference (DID) analysis.

In the literature, the 2SLS IV approach is mostly used to solve for endogeneity concerns (e.g. Fauver et al., 2018; Mao & Weathers, 2019). Moreover, using industry level data to construct an employee treatment index IV is a popular method. For example, Ben-Nasr and Ghouma (2018) use the industry average of the ratio of total labour and related expenses over total employees as an instrument for their independent variable (the excess employee welfare). Some cross-country studies use country level data as the instrument in further robustness tests. For example, Sun et al. (2020) use the average value workforce environment index (WEI) within a

country and year. Due to the limited data in specific markets, some papers try to use the lagged value of firm-specific historical average of employee treatment scores, or employee related expenses as potential instruments to overcome the lack of industry or country level data (e.g. Huang et al., 2019; Ghaly et al., 2015). In addition, Chen et al. (2016) employ the geographic asset segmentation and pension expenses per employee (lagged by five years) as instruments for employee treatment, since Landier et al. (2009) show that geographically dispersed firms are less employee friendly compared to less dispersed firms. Chen et al. (2019) contract the average employee treatment of neighbouring firms as instruments.

Taking advantage of regulatory changes in political regimes, some papers use DID analysis to address endogeneity issues. For example, Dessaint et al. (2017) use Employment Protection Legislation (EPL) reform in 21 OECD countries to design the DID test in their studies about employment protection and firm takeovers. Lin et al. (2018)'s study of employee representation and financial leverage, employs the German law on codetermination in 1976, which grants employees a direct voice in the firm, to develop the DID test and examine how leverage changes in reaction to the shock.

Table 2.2. Endogeneity solutions -- 2SLS IV approach and DID tests

Panel A	**2SLS IV approach**
Title (Year)	**IV(s)**
Are employee-friendly workplaces conducive to innovation? (2016)	1. Implied Contract is a dummy variable equal to one if the firm is headquartered in a state that has the implied-contract exception and zero otherwise. 2. ln (UI benefits), is the natural logarithm of state-level unemployment insurance (UI) benefits.
Be nice to your innovators: Employee treatment and corporate innovation performance (2016)	1. The proportion of assets of a firm's geographic segments. 2. Pension expense per employee lagged by five years
Employee Welfare and Stock Price Crash Risk (2018)	The industry average of the ratio of total labour and related expenses over total employees
Employee quality and audit fee: evidence from China (2020)	The local government's annual input into education
Does it pay to treat employees well? International evidence on the value of employee-friendly culture (2018)	1. Masculinity – a dimension of culture that represents a preference in society for achievement, heroism, assertiveness, and material rewards for success; its opposite, Femininity, stands for a preference for cooperation, modesty, caring for the weak and quality of life

	2. Indulgence – stands for a society that allows relatively free gratification of basic and natural human drives related to enjoying life and having fun.
Employee treatment and firm innovation (2019)	The Non-compete enforceability index
Employee treatment and corporate fraud (2020)	Collective bargaining and union coverage at the industry level
Do Countries Matter More in Determining the Relationship Between Employee Welfare and Financial Performance? (2020)	Country level employee treatment index (ETI)
Employee treatment and firm leverage: A test of the stakeholder theory of capital structure (2011)	1. The 5-year (10-year) lagged value of pension and retirement expenses per worker 2. The industry-level wage rate as measured by total labour and related expenses divided by total employees across firms in the same industry
Employee-friendly acquirers and acquisition performance (2013)	1. A dummy variable that equals 1 if the acquirer's headquarters is in a state with strong family leave laws 2. The percentage of female employees in the acquirer's industry
Cash holdings and employee welfare (2015)	1. Firm-level (10-years) lagged pension and retirement expenses 2. Industry-level wage rates
Do firms hedge with foreign currency derivatives for employees? (2019)	1. The industry-level employee treatment score 2. The firm-specific historical average of employee treatment scores lagged one, two, and three years
Do employee-friendly firms invest more efficiently? Evidence from labour investment efficiency (2020)	1. 5-year lagged value of pension and retirement expenses per worker and industry-level wage rate as measured by total labour and related expenses divided by total employees across firms in the same industry 2. state-level employee friendliness and industry-level employee friendliness
The impact of employee friendly practices on dividend payments: Evidence from emerging economies (2021)	The industry average of the ratio of employee wage expenses to total employees
Employee treatment and its implications for bondholders (2019)	The average employee treatment of neighbouring firms
Workforce environment and audit fees: International evidence (2020)	1. The country-year mean of workforce environment index 2. The country-industry mean of workforce environment index
Employee effort and earnings management (2022)	The lagged value of the log of working hours (LWH)
Employee relations and stock price crash risk: Evidence from employee lawsuits (2022)	1. The interaction term between LA_INT2016 (labour intensity of each firm as the number of employees divided by total assets) and AFTER (takes a value of 1 if the year is after 2016, and 0 otherwise, to reflect the external policy shock), which implies that the higher the initial labour intensity level, the greater the deterrent effect of the measures 2. maternity insurance coverage (MAINC) in the province where the firm is located
The impact of declined social insurance contribution rate on enterprise total factor productivity: Evidence from China (2023)	The average social security payment rate of the same industry in the same prefecture level city excepted firms themselves as the instrumental variable
Panel B	**DID tests**
Title (Year)	**Shock/Policy (Year)**

Employment protection and takeovers (2017)	Employment Protection Legislation (EPL) reforms from 21 Organisation for Economic Co-operation and Development (OECD) countries took place from 1988 - 2005
Employee representation and financial leverage (2018)	The introduction of the law on codetermination in 1976 in German
Labor unemployment insurance and firm cash holdings (2018)	The introduction of unemployment insurance benefit data from the US Department of Labor's "significant provisions of State UI Laws" from 1981 to 2010
Do Family Firms Invest More than Nonfamily Firms in Employee-Friendly Policies? (2020)	Exploiting family firm status changes due to (sudden) deaths of founding family members in the U.S. for the period 1996 - 2010
Corporate governance of controlling shareholders and labour employment decisions: Evidence from a parent board reform in China (2022)	A pilot board reform conducted by the State-owned Assets Supervision and Administration Commission in the central state-owned enterprises in China from 2003-2019
Employee relations and stock price crash risk: Evidence from employee lawsuits (2022)	The measures implemented by the Ministry of Human Resources and Social Security of China aim at curbing labour related violations from 2014 to 2016
Labor cost and stock price crash risk: Evidence from China (2023)	The implement of "Social Insurance Law" in China in 2011

In additional to the 2SLS-IV approach and DID tests, in consideration of timing effects, a change regression is used in many papers (e.g. Macias & Pirinsky, 2015; Chen et al., 2016; Fauver et al., 2018). One of the earliest examples of the change analysis setting in employee treatment studies is Bae et al. (2011), who conduct regressions of the change in leverage over a 3-year period on the change in the Employee Treatment Index performance variables around the event (being named in the Fortune list) to address the endogeneity problem.

Other solutions to endogeneity problems such as Propensity Score Matching (PSM) (e.g. Francis et al., 2019; Darrough et al., 2019) and generalized method of moments (GMM) (e.g. Bae et al., 2011) are also employed.

2.4. Determinants of employee treatment

In this section, we review the literature on policies and factors that can improve employee wellbeing. First, we analyse the impact of government laws and regulations on employee protection, particularly from the perspective of the political environment. Then, we briefly examine employee psychological factors that may have an impact on individual wellbeing.

Finally, we analyse how firm level characteristics contribute to greater employee wellbeing.

2.4.1. Legal and regulatory protection

In general, labour market regulation provides employees with enhanced bargaining power over employers in contemporary enterprises (Deakin et al., 2007); examples are right-to-work laws and wrongful dismissal laws in the US (Chen et al., 2019). Previous studies show that legal protection of employees' employment improves their working ability, which in turn improves firm performance.

According to Acharya et al. (2013), labour market regulation is often driven by political considerations. For example, the dramatic decline in labour market regulation in the United Kingdom in the 1980s coincided with the election of Conservative governments committed to deregulating the labour market. The return of a Labour government in 1997 led to a revival of regulation of Britain's labour market. Similarly, evidence shows that countries with longer histories of left-leaning governments tend to have stricter labour regulation (Botero et al., 2004). When a firm goes bankrupt, United States bankruptcy laws give labour a higher priority on claims than creditors in terms of protection (Chen et al., 2019).

Saint-Paul (2002) argues that beside the political role of labour protection, the motivation for employment protection legislation is also closely related to economic growth. Normally political support for laws that grant employees greater protection from dismissal should be greater during periods of slow economic growth since employees are worried about losing their jobs (Acharya et al., 2013).

Takeover protection law can be seen as a provision that supports and protects the firm-level strategy of investing in intangible assets so that the firm can feel confident when investing in human capital such as employees (Knoeber, 1986; Lambert & Larcker, 1985). Wang et al. (2016) find that with an increase in takeover protection, managers have greater job security, thus encouraging them to make a strategic investment in human capital. When takeover protection

is weak, managers who are threatened by the risk of takeover may be less inclined to invest in employee wellbeing and prefer a strategy of accumulating a higher level of tangible assets, even if that strategy may not be in the best long-term interests of company shareholders (Shleifer & Summers, 1988).

2.4.2. Employee psychological factors

While compensation is an important component of employee treatment, it is not only the quantity of compensation, but also the compensation distribution method that matters for employee wellbeing. Unfair distribution behaviour fails to achieve the purpose of motivating employees, and thus negatively affects the behaviours of employees, and firm performance.

In addition, employees are only motivated by monetary incentives up to a certain point, beyond which are non-pecuniary incentives, such as fair treatment and satisfaction at work (Mao & Weathers, 2019; Cerasoli et al., 2014). Recent theories incorporate psychological factors into the theoretical framework of firm compensation distribution strategies (e.g. Gerhart et al., 2009). According to Larkin et al. (2012), the literature acknowledges the critical value of employee psychological factors such as wage fairness (Fehr & Gachter, 2000), non-pecuniary benefits (Mas & Moretti, 2009), social preference (Bandiera et al., 2005), and teamwork framework (Hamilton et al., 2003).

2.4.3. Firm level characteristics

We conclude Section 4 by focusing on firm level characteristics that contribute to greater employee wellbeing.

2.4.3.1 Firm leadership

According to Sarwar et al. (2020), moral leadership in relation to employee treatment is positively related to employee engagement and firm performance. Abdelmotaleb and Saha (2019) find that ethical culture increases the emotional experience of employees and increases employee wellbeing. In particular, ethical leadership is recognized as one of the key factors

enabling an organization to develop an employee-friendly environment.

Several studies have examined the effect of CEO specific characteristics on the firm's employee treatment policy and the overall wellbeing of employees. Wiggenhorn et al. (2016) find that powerful CEOs, defined in terms of a high pay disparity between the CEO and top management, have more positive relationships with employees, as evidenced by more involvement with employees and better health and safety conditions. Yonker (2017) finds executives' preference for divisions of companies near their hometowns is demonstrated by the fact that when companies downsize their operations, these departments suffer fewer layoffs and pay cuts. A recent study by Liu (2021) finds that firms with female CEOs are more employee-friendly, as they experience significantly fewer labor lawsuits. This is consistent with previous findings that female leadership is more stakeholder-oriented (Adams & Funk, 2012) and more sensitive to ethical issues (Cumming et al., 2015). In fact, according to the upper echelons theory (Han et al., 2022; Hambrick & Mason, 1984), there are many characteristics of top executives, such as demographic characteristics, life experiences, ideology, and personalities, which can predict their firms' strategic choices. This suggests a potential direction for future research on the determinants of employee treatment.

2.4.3.2 Ownership

Finally, we examine the impact of firm ownership on employee treatment. Research has mainly focused on two different forms of ownership, namely family firms and state-ownership enterprises (SOEs).

Family enterprises have been shown to be better at managing stakeholders and to have more loyal labour forces (Davis & Donaldson, 1997; Lansberg, 1983). In addition, family businesses do better in terms of providing workers' insurance (Mueller & Philippon, 2011; Ellul et al., 2018), which leads to increased incentives for employees to work and higher returns on investment.

Employee treatment in family firms has the following characteristics. First, many studies suggest that, compared to non-family firms, family owners tend to have a relatively long-term perspective due to an interest in continuity, driven by inheritance motivations (Anderson & Reed, 2003; Muller & Philippon, 2011). The commitment to long-term investment of family owners in employees can help improve employees' perception of the firm's credibility, which leads to reduced employee turnover and improved ability to motivate employees (La Porta et al., 1997; Edmans, 2011). Second, as long-term controlling shareholders, family owner-managers face less short-term market pressure and less management short-sightedness than non-family business managers (Kang & Kim, 2020). Third, family owner-managers are better informed about their companies than non-family managers because they often serve on management teams or boards of directors (Anderson et al., 2012). Last but not least, due to the active supervision of controlling shareholders, family firms have fewer management agency conflicts than non-family firms (Fahlenbrach, 2009; Li & Srinivasan, 2011). Other research has also shown that family owner-managers care about the reputation of their companies, so they are less likely to breach implicit contracts. This reputation concern encourages the family owner-managers to maintain a positive reputation among employees and avoid adversarial labour relations (Mueller & Philippon, 2011; Ellul et al., 2018).

In theory, as SOEs are owned by the government, their employee protection is normally of a high standard. According to Rein et al. (1997) and Botchway and Asiedu (2020), employees in SOEs have better job security and more benefits such as allowances, health care, medical insurance and pensions, than employees in the private sector. A reason for this is that the SOE's human resource management and employee performance is more in the public spotlight (Sanusi, 2016). On the other hand, bureaucratic work patterns in SOEs due to government ownership result in less efficient internal controls and less transparent goal setting (Sanusi, 2016; Sutiyono, 2007).

As an example, Chinese SOEs have to hire more workers and bear more welfare costs than private firms because employment and social stability are important goals of local government (Lin et al., 1998; Liao et al., 2009). They experience great pressure and intervention from governments to maintain employment and welfare, since China has the largest population in the world (Liao et al., 2009; Xu, 2011). It is widely known in China that SOEs offer generous benefits and a wide range of services to their employees (Zhou, 2004). According to Hu (1997), SOEs contributed 80% of the total expenditure on social security in 1993, since more than 34% of the SOE's total costs are employee insurance and nonmonetary benefits. In addition, SOEs generally provide employees with a wide range of welfare benefits and services. They often have their own staff apartments, hotels, schools for children of employees, hospitals, and recreation facilities. In terms of employee protection, according to Tong et al. (2018), a 2011 survey by China's National Bureau of Statistics indicates that 91.3% of SOEs signed employment contracts with employees, compared with 46.9% of private firms. However, the operation of SOEs often needs to be consistent with government policies, which can also create negative impacts. For example, one issue is the requirement to retain excess staff, resulting in higher operating costs and lower productivity. Dong and Putterman (2003) analyse a sample of 681 Chinese SOEs and find 73% of the firms employ redundant staff. This excessive overstaffing leads to widespread underperformance, with over 40% of SOEs losing money in the mid-1990s (Lin et al., 1998).

2.5. Conclusion and future research directions

Based on an extensive review of 148 papers, this present study deepens current understanding of the theoretical and empirical aspects of employee treatment. Possible directions for future research are briefly discussed in this section.

First, we have discussed some of the determinants of better employee treatment, including laws and regulations, employee psychological factors, and firm level characteristics. However, there

are other potential determinants that may be important. For example, there is a great deal of literature on the impact of top executive characteristics on firm decisions, based on the upper echelon theory, but there is less research that focuses on how CEO characteristics affect employee policy and in particular employee wellbeing. In addition, board interactions may also affect corporate employee policies. Also some firm external factors, such as climate change and fintech, could also impact employee wellbeing and are worthy of further investigation.

Second, with skill mismatches and shortages of employees becoming more serious in the current labour market (Brunello & Wruuck, 2021), a company's ability to attract and retain skilled and high-performing employees to meet job requirements is becoming an important factor in firm success. However, there is little evidence from previous studies on employee turnover, and it would be interesting to test whether the turnover of employees in key positions of a firm has a significant impact on firm performance and reputation.

Finally, the global spread of COVID-19 also provides possible avenues for future research on employee treatment. The impact of COVID-19 on human capital will be profound and lasting. In addition to forcing employees to work from home and telecommute, there have been psychological effects on employees. How to minimise or reduce the negative impact of pandemic on employees and firm performance would be another worthwhile area for investigation.

2.6. Appendix

Related empirical papers on employee treatment in the finance field

Focus	Year	Title	Journal	Employee Treatment Measurement(s)
Firm Performance	2005	Employee Relations and the Likelihood of Occurrence of Corporate Financial Distress	Journal of Business Finance & Accounting	KLD
	2006	When Labor Has a Voice in Corporate Governance	Journal of Financial and Quantitative Analysis	The fraction of labour voted shares
	2009	Labor and Corporate Governance: International Evidence from Restructuring Decisions	Journal of Finance	International Country Risk Guide
	2011	Does the stock market fully value intangibles? Employee satisfaction and equity prices	Journal of Financial Economics	BC 100 List
	2011	Labor-Friendly Corporate Practices: Is What is Good for Employees Good for Shareholders?	Journal of Business Ethics	BC 100 List & KLD
	2012	Feeling Good by Doing Good: Employee CSR-induced Attributions, Job Satisfaction, and the Role of Charismatic Leadership	Journal of Business Ethics	Job Satisfaction Questionnaire
	2012	The Link Between Job Satisfaction and Firm Value, With Implications for Corporate Social Responsibility	Academy of Management Perspectives	BC 100 List
	2014	Employee satisfaction, labour market flexibility, and stock returns around the world	National Bureau of Economic Research	BC 100 List & OECD's Employment Protection Legislation index & The Fraser Institute’s Economic Freedom of the World database
	2015	Employees and the market for corporate control	Journal of Corporate Finance	KLD

	2016	Are employee-friendly workplaces conducive to innovation?	Journal of Corporate Finance	BC 100 List & KLD
	2016	Be nice to your innovators: Employee treatment and corporate innovation performance	Journal of Corporate Finance	KLD
	2018	Employee Welfare and Stock Price Crash Risk	Journal of Corporate Finance	ASSET4 Thomson Reuters
	2018	Does it pay to treat employees well? International evidence on the value of employee-friendly culture	Journal of Corporate Finance	ASSET4 Thomson Reuters
	2018	Doing Well by Making Well: The Impact of Corporate Wellness Programs on Employee Productivity	Management Science	Survey Data From LaundryCo
	2018	Employee Protection and Corporate Innovation: Empirical Evidence from China	Journal of Business Ethics	The 8th nationwide survey of private firms
	2019	Employee treatment and firm innovation	Journal of Business Finance & Accounting	BC 100 List & KLD
	2019	Employee Wellbeing, Productivity, and Firm Performance	Saïd Business School Research Papers	Gallup survey
	2019	The Impact of Corporate Welfare Policy on Firm-Level Productivity: Evidence from Unemployment Insurance	Journal of Business Ethics	KLD
	2020	Employee treatment and corporate fraud	Economic Modelling	KLD
	2020	Do Countries Matter More in Determining the Relationship Between Employee Welfare and Financial Performance?	International Review of Finance	ASSET4 Thomson Reuters
	2021	Employee Flexibility, Exogenous Risk, and Firm Value	Journal of Financial and Quantitative Analysis	KLD & BC 100 List

	2021	Do stakeholder relationships matter? An empirical study of exploration, exploitation and firm performance	Management Decision	KLD & Compustat
	2022	Workplace safety accident, employee treatment, and firm value: Evidence from China	Economic Modelling	Manually collect firm workplace safety accident announcements and their event dates (January 2007 to June 2020) from the Cninfo website
	2022	Employee relations and stock price crash risk: Evidence from employee lawsuits	International Review of Financial Analysis	CSMAR & Manually collected data from China Judgements Online
	2023	The Value of Employee Satisfaction in Disastrous Times: Evidence from COVID-19	Review of Finance	MioTech
	2023	Labor cost and stock price crash risk: Evidence from China	Finance Research Letters	CSMAR
	2024	Employee benefits and company performance: Evidence from a high-dimensional machine learning model	Management Accounting Research	2,50,000 employee reviews from Kununu.com, a website similar to Glassdoor.com that offers employees a portal to rate their employer and review their work conditions
Firm Decisions	2010	Human Capital, Bankruptcy, and Capital Structure	Journal of Finance	Market wage contract & The optimal compensation policy
	2010	Employee well-being, firm leverage, and bankruptcy risk	Journal of Banking and Finance	KLD
	2011	Employee treatment and firm leverage: A test of the stakeholder theory of capital structure	Journal of Financial Economics	KLD
	2013	Labor unemployment risk and corporate financing decisions	Journal of Financial Economics	Annual issues of the US Department of Labor's ''Significant Provisions of State UI Laws"
	2013	Employee-friendly Acquirers and Acquisition Performance	Journal of Financial Research	KLD
	2015	Employee rights and acquisitions	Journal of Financial Economics	The state right-to-work statute indicator
	2015	Cash holdings and employee welfare	Journal of Corporate Finance	KLD
	2015	Labor Protection and Leverage	Review of Financial Studies	Employment Protection Legislation indicator produced by the OECD

	2016	Labor unemployment insurance and earnings management	Journal of Accounting and Economics	United States Bureau of Labor
	2017	Employment protection and takeovers	Journal of Financial Economics	Labor Statistic
	2017	Employee treatment and the choice of liquidity: lines of credit versus cash holdings	Applied Economics Letters	Employee treatment index values in MSCI database
	2018	Employee representation and financial leverage	Journal of Financial Economics	Hoppenstedt GmbH database
	2018	The Effect of Cultural Similarity on Mergers and Acquisitions: Evidence from Corporate Social Responsibility	Journal of Financial & Quantitative Analysis	KLD
	2018	Human capital relatedness and mergers and acquisitions	Journal of Financial Economics	The OES industry occupation data and the Compustat Industry Segment database
	2018	Labor unemployment insurance and firm cash holdings	Journal of Corporate Finance	US Department of Labor's “Significant Provisions of State UI Laws”
	2018	Employee turnover likelihood and earnings management: evidence from the inevitable disclosure doctrine	Review of Accounting Studies	Compustat & The U.S. Bureau of Labor Statistics Local Area Unemployment Statistics Series
	2019	Do firms hedge with foreign currency derivatives for employees?	Journal of Financial Economics	KLD
	2019	M&As, Employee Costs, and Labor Reallocation	SSRN Working Paper	RAIS collected by the Brazilian Ministry of Labor
	2020	The Political Economy of Labor Employment Decisions: Evidence from China	Management Science	CCER
	2020	Do employee-friendly firms invest more efficiently? Evidence from labour investment efficiency	Journal of Corporate Finance	KLD, BC100 List & ASSET 4
	2021	The impact of employee friendly practices on dividend payments: Evidence from emerging economies	Journal of Business Research	ASSET4 Thomson Reuters
	2021	Employee Cash Profit-Sharing and Earnings Management	European Accounting Review	KLD

	2022	Employee effort and earnings management	Global Finance Journal	Data from the Occupational Safety and Health Administration in U.S.
	2023	Labor cost and corporate tax avoidance	Journal of Economic Behaviour & Organization	The minimum wages disclosed by local governments in China
Relation to other stakeholders	2019	Employee Treatment and Contracting with Bank Lenders: An Instrumental Approach for Stakeholder Management	Journal of Business Ethics	KLD
	2019	Employee treatment and its implications for bondholders	European Financial Management	MSCI ESG STATS
	2020	Workforce environment and audit fees: International evidence	Journal of Contemporary Accounting and Economics	Thomson Reuters ESG
	2020	Employee quality and audit fee: evidence from China	Accounting & Finance	Annual reports
Determinant of employee wellbeing	2009	How Does Innovation Affect Worker Well-being?	Working Paper	Workplace Employment Relations Survey 2004
	2016	Does stock price informativeness affect labour investment efficiency?	Journal of Corporate Finance	The efficiency of investment in labour, follow Pinnuck and Lillis (2007) two-step approach
	2016	Powerful CEOs and employee relations: evidence from corporate social responsibility indicators	Journal of Economics & Finance	KLD
	2016	The influence of corporate social responsibility on employee satisfaction	Management Decision	Survey data
	2017	Do Managers Give Hometown Labor an Edge?	Review of Financial Studies	The U.S. Census Bureau's Longitudinal Business Database
	2018	Political promotion and labour investment efficiency	China Economic Review	Employment and education data from annual reports
	2019	A multiple attribute decision making approach in evaluating employee care strategies of corporate social responsibility	Management Decision	Interview data

	2020	Corporate governance and employee treatment: evidence from takeover defences	Journal of Economics and Finance	The National Labor Relations Board
	2020	Do Family Firms Invest More than Nonfamily Firms in Employee-Friendly Policies?	Management Science	KLD & BC 100 List
	2021	Air pollution and employee treatment	Journal of Corporate Finance	Hexun & CNRDS & Kanzhun APP
	2021	CEO gender and employee relations: Evidence from labour lawsuits	Journal of Banking and Finance	Labor lawsuits from the National Labor Relations Board
	2021	Religious founders and employee welfare	Accounting & Finance	The ninth Chinese Private Enterprise Survey (CPES) in 2010
	2021	Do controlling shareholders expropriate employees? Evidence from workplace fatalities in China	Pacific-Basin Finance Journal	SAWS's accident enquiry website
	2021	Corporate social responsibility, employee engagement, well-being and the task performance of frontline employees	Management Decision	Survey data
	2022	Corporate governance of controlling shareholders and labour employment decisions: Evidence from a parent board reform in China	Economic Modelling	Annual reports
	2022	Credit Stimulus and Corporate Excess Employees	SSRN Working Paper	Annual Survey of Industrial Firms
	2022	Do women on boards affect employee benefits? Evidence from the global microfinance industry	Economics Letters	Annual reports
	2023	Design of employee pension benefits model and China's pension gender gap	Global Finance Journal	The Ministry of Human Resources and Social Security of China

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STATEMENT OF CONTRIBUTION

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

Student name:	Junshi Chen
Name and title of main supervisor:	Professor Jing Chi

In which chapter is the manuscript/published work?	Chapter Three

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CHAPTER THREE

ESSAY ONE

This chapter presents the first essay of the thesis, which explores the relationship between employee medical welfare and firm productivity.

Organisational medical welfare and firm productivity: Evidence from China

Abstract

This paper investigates the impact of employee medical welfare on firm productivity in China, offering new insights into how organizational caregiving affects firm outcomes. Unlike prior studies that rely on policy variation or ESG raking based indicators, we use actual firm-level medical welfare expenditure data from Chinese listed companies to measure the real financial commitment to employee health and present strong evidence that employee medical welfare significantly increases firm productivity. Our results propose a novel mechanism - psychological security - drawing on the ethics of care and weak protection, to explain how medical insurance enhances employee safety and, in turn, improves productivity. The evidence shows that this effect is more pronounced for firms with more low-skilled employees, firms with low R&D intensity and non-state-owned firms, where employees' sense of security is weak. We also show that regional medical facilities have a moderating effect through which employee medical welfare affects productivity. In addition, we find that firms with better employee medical welfare had stronger stock performance and higher firm value during the spread of the COVID-19 virus, underscoring the strategic role of employee health support in crisis preparedness and long-term value creation.

Keywords: Employee medical insurance, ethics of care, psychological safety, firm productivity

JEL classification: I31, J24, J28, M14

"Health and human capital - an engine for economic growth"

- Joshua Graff Zivin and Matthew Neidell

3.1. Introduction

Human capital can be viewed as a strategic source of competitive advantage for modern firms that drive value creation (Tsolmon & Ariely, 2020). However, existing finance literature on employee-related benefits has largely concentrated on monetary compensation (e.g., Akerlof, 1990; Kong et al., 2020; Jiang et al., 2019) or on aggregated employee treatment measures derived from environmental, social, and governance (ESG) rating frameworks (Wang et al., 2021). While ESG-based metrics are useful proxies for assessing firm performance in relation to sustainability, they can be problematic due to reliance on voluntary disclosure and potential inconsistencies in reporting (Long et al., 2024). Consequently, these measures may not accurately reflect actual firm investment in employee wellbeing. In this context, we argue that using firms' actual expenditures on employee offers a more direct and behaviourally grounded indicator of organisational commitment to employee treatment. Unlike US firms, Chinese listed companies are mandated to disclose detailed information on employee compensation and insurance. Using disclosed financial data also helps avoid the selection bias often present in earlier US studies that relied on surveys.

The COVID-19 pandemic, as a global public health crisis, has underscored the importance of examining medical welfare as part of corporate finance research. Despite this, empirical studies investigating how does employer-provided health-related benefits shape firm outcomes remain limited. Medical insurance, as part of employee welfare, is a non-monetary investment distinct from direct compensation or equity incentives. Unlike monetary benefits, medical welfare cannot be easily converted into cash and tends to be especially valuable to vulnerable employees (Fairlie et al., 2011). Since it does not generate immediate financial returns, medical welfare serves as a form of organisational caregiving, making it a suitable proxy for testing the

caregiving framework proposed by Vijayasingham et al. (2018), which focuses on care-based organisational practices.

In China's social security framework, commonly referred to as five insurances and one housing fund, is a compulsory scheme covering employees. It consists of pension, medical, unemployment, work-related injury, and maternity insurance, alongside a housing provident fund jointly contributed by employers and employees to support employee lives. The cost of employee insurance required by the government is significant, these non-salary costs to employers are equivalent to nearly 40% of an employee's salary (Nielsen & Smyth, 2008). As such, it is important to assess whether and how firms are rewarded for this substantial caregiving. The Chinese public health insurance system comprises two primary programs: the Urban Employee Basic Medical Insurance (UEBMI) and the Urban-Rural Resident Basic Medical Insurance (URRBMI). UEBMI is firm-based and designed for employees, while URRBMI is government-subsidized and targets unemployed urban residents and rural farmers (Li et al., 2024). UEBMI generally offers higher premiums and more generous benefits than URRBMI (Han, 2012; Li & Tian, 2020). This paper focuses on UEBMI, which aims to provide accessible and affordable medical care. Under this system, all enterprises must register with the local Bureau of Human Resources and Social Security (BHRSS) and make regular financial contributions (Gao et al., 2012). These contributions are deposited into individual medical accounts, which employees can use when sick. Given the limited development of China's private health insurance market which is characterized by information asymmetry and difficulties in claims settlement (Li et al., 2012b), UEBMI plays a crucial role. As reported by the fifth National Health Services Survey in 2013[2], commercial private insurance accounts for less than 7% of total health coverage nationwide, underscoring the significance of employer-based medical insurance (Li & Tian, 2020).

Despite the legal requirement, enforcement of employer contributions to health insurance is weak, and evasion is common (Feng et al., 2013). The China Enterprise Social Insurance White Paper (2018)[3] shows significant variation in listed firms' payments, with only 27% meeting or exceeding official standards. Nonetheless, employer investment in health insurance can contribute to firm-level human capital and corporate value by fostering healthier employer–employee relationships and mitigating employee health risks (Albuquerque et al., 2019). From an ethics of caregiving perspective, some firms, particularly state-owned enterprises, are willing to go beyond minimum standards, offering extended coverage and reimbursement for serious illnesses and expensive medications (He & Nolen, 2019). In contrast, others limit contributions to minor illnesses, leaving employees to bear substantial financial burdens in the case of major health events such as cancer.

This study focuses on examining the effect of employee medical welfare on firm productivity, as productivity is considered a more reliable indicator of firm performance in the context of employee treatment (Barth et al., 2015). While investments in employee welfare may lead to higher engagement and loyalty in the short term, they also involve increased costs. Consequently, traditional accounting-based performance measures may not fully capture the long-term effects of such investments (Sheng et al., 2022). The existing evidence on this relationship remains mixed. Li et al. (2024) find that higher employer contributions to medical insurance enhance firm value by improving productivity. In contrast, Huang et al. (2025) report that increased medical insurance investment are associated with lower total factor productivity. They suggest that this negative effect may be due to a reduction in employees' disposable income, which in turn discourages productivity at the firm level in the Chinese context. Our main results present evidence of a strong positive relationship between employee medical welfare and firm productivity, indicating that treating employees well in terms of medical welfare is an effective way to increase firm productivity; these findings are consistent with the

stakeholder theory (Titman, 1984), that employees are important value-relevant partial contributors to the firm (Chen et al., 2016). Our baseline regression results still hold after a series of robustness and endogeneity checks.

While our baseline results are consistent with those in Li et al. (2024), we further provide evidence to explain the mechanisms through which employee medical welfare affects firm productivity, by performing several heterogeneity analyses. The organisational caregiving model highlights that ethical care in the workplace can enrich the work lives of employees (Vijayasingham et al., 2018); and psychological safety theory (Edmondson & Mortensen, 2021) argues that employees' psychological safety plays an important role in workplace effectiveness (Edmondson & Lei, 2014) and employee engagement (Ge, 2020). We argue that medical welfare is different from compensation or bonus incentives; rather it can be viewed as an example of organisational caregiving that enhances the work lives of employees and provides them with a sense of security, which boosts their work engagement and effectiveness (Edmondson & Lei, 2014). Thus, we divide our sample based on ultimate controllers of the firm, employee skills and R&D intensity. The results show that the effect of medical welfare incentives is more pronounced for non-state-owned firms, firms with more low-skilled employees, firms with low R&D intensity, where employees' sense of security is weak.

Furthermore, we use the number of hospital beds to proxy local medical development level following Yin et al. (2018) and Hu and Huang (2004). The empirical tests show that medical insurance has a greater impact on productivity when local medical facilities are well developed. We also examine the effect on firm value enhancement of better employee medical treatment. We develop a two-stage regression approach and find that productivity enhances firm market value when the firm provides better employee medical welfare. Finally, we conduct what we believe is the first analysis of the impact of employee medical welfare on firm stock

performance and value during the period of COVID-19 in China. Following Shan and Tang (2023) and Broadstock et al. (2021), we construct an event study and estimate various cumulative abnormal returns (CARs) around the Wuhan lockdown on 23 January 2020. We find employee medical welfare in 2019 is positively and significantly related to market adjusted return on 3 February 2020 (the first trading day after the Wuhan lockdown), CARs with different estimation windows, and firm Tobin's Q during the years 2020 and 2021 when COVID-19 was spreading.

The novelty of this paper lies in several areas. While Li et al. (2024) explore the impact of employer medical insurance contributions on corporate value using a policy reform as a natural experiment, our study offers a broader and deeper perspective on the role of employee medical welfare in corporate performance. First, we depart from proxy-based or policy-driven measures by using firms' actual medical welfare expenditures to capture the real, direct financial commitment to employee health, which provides a more granular and behaviourally grounded measure of organisational caregiving. Second, our paper uniquely focuses on the underlying mechanisms, proposing a novel psychological security channel rooted in the ethics of care and weak protection theory. We theorize and empirically demonstrate that medical welfare enhances employee wellbeing, which in turn improves engagement and productivity, especially in contexts where people's job security is weak. Third, our analysis is more comprehensive in scope. Beyond productivity, we assess the impact of medical welfare on firm value and resilience to external shocks, as evidenced by firms' stock performance during the COVID-19 outbreak. This highlights the strategic importance of employee medical care not only in day-to-day operations but also in organizational crisis management.

This study contributes to existing literature in a number of ways. First, in the context of rising labour costs and increasing obligations for employee social insurance in China (Li et al., 2012a; Nielsen & Smyth, 2008), our paper offers timely insights into how firms can align with the

national policy agenda of "common prosperity," as emphasised in the Fifth Plenary Session of the 19th Central Committee of the Communist Party of China (2020). While such policy ambitions often raise concerns about firm burden, our findings demonstrate that investment in employee medical welfare, a key component of social insurance, can simultaneously support employee wellbeing and enhance firm productivity and value. By illustrating this dual benefit, our results provide empirical support for government efforts to strengthen labour protections and expand regional healthcare infrastructure.

Second, existing studies generally focus on employee compensation or employee treatment as a whole (e.g. Dai et al., 2017; Bae et al, 2011). However, employee health and safety are significant ethical, social and economic concerns for the firm and society (Wu et al., 2023) and to our knowledge, we are the first to use medical welfare information in the financial statements to measure employee care. Consistent with stakeholder theory, organisational caregiving theory (Vijayasingham et al., 2018) and psychological safety theory (Kahn, 1990), we find employee medical welfare as a care tool contributes to higher productivity. While our findings are consistent with recent evidence by Li et al. (2024), who show a positive relationship between firms' medical insurance contributions and corporate value via improved productivity and efficiency, our study provides a deeper understanding of the underlying mechanism, namely, the role of psychological security, especially in the case of low-skilled groups, thus stimulating their work engagement and efficiency. Thus, as well as extending the current theoretical background in relation to employee treatment in corporate finance, our research enriches the field of business ethics research in relation to employee care and wellbeing.

Finally, drawing on the foundational work of Shan and Tang (2023), who pioneer the empirical link between employee satisfaction and firm resilience during the COVID-19 pandemic, this study extends the literature by examining employee medical welfare as a distinct and measurable dimension of organisational caregiving to enhance firm resilience in organizational

crisis management. While their research highlights the strategic value of workforce sentiment in navigating systemic crises, our analysis complements and deepens this perspective by focusing on firms' medical insurance expenditure, which is an actionable and policy-relevant investment in employee wellbeing. To the best of our knowledge, our paper provides the first empirical investigation into the relationship between employee medical welfare and firm resilience during the COVID-19 crisis. By adopting a labour-oriented framework, we demonstrate that medical welfare expenditure not only contributes to operational productivity but also enhances a firm's adaptive capacity in the face of exogenous shocks. These findings contribute to the emerging discourse on corporate crisis management by offering evidence that employee-centric welfare strategies constitute a vital component of firm resilience infrastructure.

The paper is organized as follows. Section 2 discusses literature and hypothesis development. Section 3 outlines the sample and variables. Section 4 presents the main empirical results, tests to deal with endogeneity concerns and some robustness tests. Channel tests are discussed in Section 5. Section 6 presents some additional tests that examine the moderating effect of medical facilities, the relationship of employee medical welfare to firm value, and the impact of employee medical welfare during COVID-19. Section 7 concludes the paper.

3.2. Literature review and hypothesis development

In finance studies, the agency theory suggests that higher employee benefits and improved workplace environments can be seen as a targeted strategy by management to cover up misconduct (Fama & Jensen, 1983; John et al., 2015). Employees as beneficiaries are less likely to become potential whistleblowers, since such actions would be at the expense of their own interests (Dyck et al., 2010). More specifically, some studies show that the increase in employee insurance welfare is a constraint for firm productivity (Dyreng & Maydew, 2018). First, the

increase in insurance costs, known as the ‘employment tax’, has a constraining effect on investment in innovation, increasing the pressure on cash and hindering firms' growth prospects (Acharya et al., 2014; Bai et al., 2020). Second, excessive friendly treatment of employees induces 'welfare sickness', which breeds laziness and a decline in employees' work effort (Akerlof & Yellen, 1990).

In contrast, according to the stakeholder theory, high standards of employee welfare may improve firm productivity. Good employee treatment will increase employees' trust in the company and thus enhance their motivation (Ben-Nasr & Ghouma, 2018). Gupta and Krishnamurti (2020) argue that employee wellbeing is one of the main sources of productivity improvements in modern firms. Existing literature suggests that firm specific investment in employee insurance can alleviate employees' worries in life and effectively motivate employees, resulting in a positive effect on firm efficiency and productivity (Alimov, 2015).

As early as 1960, Schulz points out that the cost of labour health care is an element of human capital investment. The job lock hypothesis argues that the risk of losing health insurance benefits is a reason for an employee to remain in a job (Cooper & Monheit, 1993). By offering medical welfare, the firm could attract employees to establish a long-term employment relationship (O’Brien, 2003). However, due to the unavailability of data, the majority existing studies on health care or health insurance use survey data.

Research finds that organisational protection boosts employees' faith in the organisation, which helps them to maintain superior performance in the face of challenges (Loh et al., 2019). In recent studies, such as Vijayasingham et al. (2018), it is argued that organisational care assists in the achievement of positive outcomes that are of value to a firm’s stakeholders. Vijayasingham et al. (2018) discuss how organisations can use an ethics of care perspective to enrich the work lives of employees with a chronic illness by means of “organisational caregiving”. Firms providing better employee medical welfare is another example of ethical

caregiving behaviour. Consistent with the model of organisational caregiving, we suggest that the firm's care for employees through the provision of medical welfare may foster their sense of safety, enhance their organisational experience and therefore increase firm productivity.

With respect to China, the health insurance market is not well developed (Suo & Wanyan, 2017), and many employees rely heavily on the welfare coverage provided by their employers to increase security (Gao et al., 2012). The employer-provided medical welfare can make employees feel that they are insured to a certain extent which results in higher organisation loyalty and productivity; this is also consistent with the psychological safety theory (Kahn, 1990). Based on the above arguments, we propose the following hypothesis:

Hypothesis 1. Employee medical welfare has a positive impact on firm productivity.

The psychological safety theory (Kahn, 1990) argues that psychological safety enables employees to establish trust in organisations. Since the theory was proposed, there has been empirical research demonstrating the benefits of psychological safety. Baer and Frese (2003) find that psychological safety is an important moderator of the relationship between innovation investment and outputs, because there must be an environment where people feel safe to share ideas. Studies also find psychological safety plays a role in workplace effectiveness (Edmondson & Lei, 2014) and leads to more employee engagement (Ge, 2020). Corporate safety culture is a goal promoted by management to reduce employees' risk apprehension and increase their safety awareness as a way of gaining their allegiance (Silbey, 2009).

Healthcare resources per capita in China are limited because of the very large population base (Chen et al., 2014), and therefore employee medical welfare can potentially provide employees with a sense of safety (Guest, 2017). However, there is also an unequal distribution of and access to healthcare resources and sense of safety in China (Yu et al., 2019). For example, first, SOEs usually have additional governmental and noneconomic objectives such as social

stability compared to the value maximization objectives of private firms (Rein, 1997; Liao et al., 2009). Therefore, it is a common phenomenon that Chinese SOEs offer better job benefits such as housing, education and allowances to their employees, the so-called “iron rice bowl”, compared to non-SOEs (Jiang & Kim, 2015).

Second, people with more working skills and social capital have more access to better healthcare resources than those without social power (Zhou et al., 2014). Meanwhile, those with higher education and higher incomes are more willing and have the capacity to purchase comprehensive health insurance on their own (Schoen et al., 2010). Pan et al. (2013) also argue that medical insurance has a greater positive effect on employees with lower levels of education in China. At the firm level, many studies note that R&D-intensive firms have more skilled labour (Chen et al., 2016), as one of the important drivers of firm innovation is human capital (Kong et al., 2020). When human capital is not evenly distributed, the impact of employee medical care may vary.

Finally, the sense of security could vary among regions. Low fertility is a growing concern in China. Studies have found that feelings of insecurity have a negative impact on fertility (Alderotti et al., 2021). Consistent with the organisational caregiving model (Vijayasingham et al., 2018) and the psychological safety theory (Kahn, 1990), we would expect the impact of employee health benefits on productivity to be stronger among employees in non-SOEs, in firms with high proportions of lower educated and skilled employees and in firms located in low birth rate regions, who have a lower sense of safety and security. Therefore, we propose the following hypothesis:

Hypothesis 2. The positive relationship between employee medical welfare and firm productivity is more pronounced when employees’ sense of psychological safety is weak.

3.3. Data and variables

3.3.1. Data

Our sample includes all non-financial Chinese listed firms on the A-share markets from 2011 to 2020. We collect data from a variety of sources. First, we construct our independent variable, employee medical welfare (EMW), from the Winds database. Employee medical expenses are disclosed in the financial statement notes as part of the detailed breakdown of employee compensation payable. Other employee information such as compensation and employee numbers is also retrieved from the Winds. Second, we obtain information on executives' compensation, firm-level financial and corporate governance data, stock returns of firms and industry information from the Chinese Stock Market and Accounting Research Database (CSMAR). Third, we get information on regional green areas, GDP and medical facilities from the National Bureau of Statistics of China (NBSC). Fourth, we download the employee treatment score from Hexun database, a leading corporate social responsibility (CSR) scoring system in China. Finally, we use the Resset database in China for other data such as employee education information.

The detailed definitions of all variables in this study are shown in the Appendix. We exclude firms from the financial services industry and those with missing financial information. All continuous variables are winsorized at the 1st and 99th percentiles to mitigate outlier effects on our results. Our final sample consists of 13,605 firm-year observations.

3.3.2. Variable definitions

3.3.2.1. Total factor productivity (TFP)

The total factor productivity (TFP) is a widely used proxy for firm-level productivity. It can be viewed as the efficacy of firm's transformation of total input into outcomes. To construct the variable, we follow Faleye et al. (2013) and Giannetti et al. (2015) and assume the firm's outputs are generated by the Cobb-Douglas production function of the firm:

$Y_{it}=AL_{it}^{\alpha}K_{it}^{\beta}$ (1)

where Y_{it} is net sales for firm i in period t, L_{it} is the number of employees, K_{it}, is net property, plant, and equipment, for firm i during year t, and A, a, and β are parameters. Then, we employ residuals from estimation of the natural log transformation of Cobb-Douglas function as firm-level total factor productivity within its industry in a given year. The previous employee studies in finance normally use this method to predict firm productivity (e.g. Dai et al., 2017)[5].

3.3.2.2. Employee medical welfare (EMW)

Our main explanatory variable is the logarithm of employee medical welfare (*LnEMW*), which is measured as the natural logarithm of medical insurance expenditure per employee obtained from the Winds database. For robustness, similar to Kong et al. (2020), we also employ the adjusted logarithm of employee medical welfare ($LnEMW_{adjusted}$) as another independent variable. To calculate adjusted employee medical welfare, we take the firm's employee medical insurance expenditure and divide by the median expenditure of a given industry and year. We then take the natural logarithm of the adjusted value, following Kong et al. (2020).

3.3.2.3. Control variables

Following prior studies, our regression models include a number of characteristics that may affect firm productivity. First, we control the characteristics of the firm. Specifically, we control firm size (*Firm Size*) and firm age (*Firm Age*) following Dai et al. (2017). To control the operating performance and growth opportunities, we use return on assets (*ROA*) and Tobin's Q (*Tobin's Q*) as proxies, following Faleye et al. (2013). We also control R&D intensity (*R&D/TA*) in the regression. Because financial constraints and capital structure may impact firm productivity, we also include a financial constraint index (*SA*) and leverage ratio (*Leverage*), following Kong et al. (2020). The SA index was first constructed by Hadlock & Pierce (2010) and is calculated as -0.737 * *Ln (Assets)* + 0.043 * *Ln (Assets)*^{2} – 0.04 * *Firm Age.* As corporate governance may also affect firm productivity, we construct a dummy variable *SOE*, which

equals to one if a firm's ultimate controller is the state, otherwise zero. Previous studies have shown that Chinese SOEs experience great political pressure from the governments to pursue employment and other noneconomic objectives (Bai et al., 2006), which results in over-employment and high agency costs. Following Dai et al. (2017), we also control for employee compensation (*Compensation*) and managerial ability (*MA*)[14] that may affect productivity. In addition, as the board characteristics and ownership structure of firms have a great influence on firm decisions and performance (Wang et al., 2021b), we control the number of board members (*Board Size*), board independence (*Board Independence*) and the largest shareholding (*Concentration*). Furthermore, we include each province's annual GDP growth (*GDP Growth*) to control external economic conditions. Details of the control variables are provided in the Appendix.

3.3.3. Sample distribution

Table 3.1 shows the sample distribution of our main independent variables: employee medical welfare (*EMW*) and industry-year adjusted employee medical welfare ($EMW_{adjusted}$) across years and industries.

Table 3.1. Sample distributions

	EMW	EMW-adjusted
Panel A.		
Employee medical welfare across years		
Year		
2011	2555.574	1.212
2012	3195.256	1.229
2013	3793.585	1.262
2014	3254.926	1.191
2015	3602.675	1.184
2016	3937.922	1.187
2017	4311.674	1.209
2018	4728.991	1.165
2019	4932.037	1.206
2020	4550.118	1.229
Panel B.		
Employee medical welfare across industries		

Industry		
Agriculture, Forestry, Animal Husbandry, and Fishery	2613.253	0.959
Mining	6053.203	1.225
Manufacturing	3566.323	1.203
Electricity, Gas and Water	7511.572	1.199
Construction	5379.525	1.198
Wholesale and Resale Trade	4878.422	1.270
Transportation	5811.981	1.048
Information Technology	5958.464	1.169
Real estate	5896.725	1.018
Leasing and Business Services	5587.339	1.184
Scientific Research and Services	6491.509	1.101
Public Facilities Management	4804.085	1.301
Health and Social Service	3526.391	1.040
Culture, Sports and Entertainment	6784.959	1.136
Comprehensive	4186.378	1.191

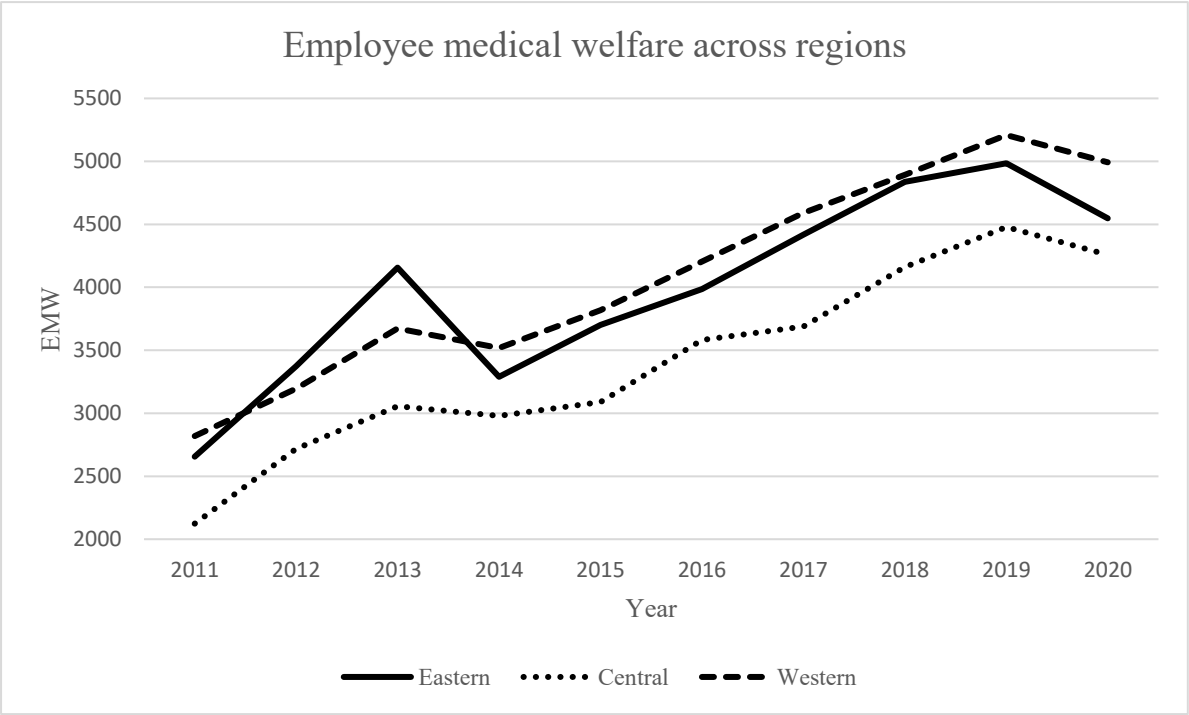
Panel A shows the yearly distribution of the annual average employee medical welfare expenditure. From 2011 to 2019, we can notice a clear increasing trend, which indicates the gradual development of China's employee protection system. It is worth noting that compared to 2013, EMW in 2014 declined, due to the amendment of the China Labor Contract Law which took effect in 2013. This law forced many firms that had previously avoided paying employee insurance to begin paying insurance fees for their employees, which results in an increase in our sample size and a decrease in the average employee medical welfare. More significantly, the EMW in 2020 was RMB4,550.12, a decrease of almost 8% compared to 2019. This indicates the COVID-19 pandemic had a significant impact on the performance of listed firms in China, as well as on the welfare of their employees in 2020.

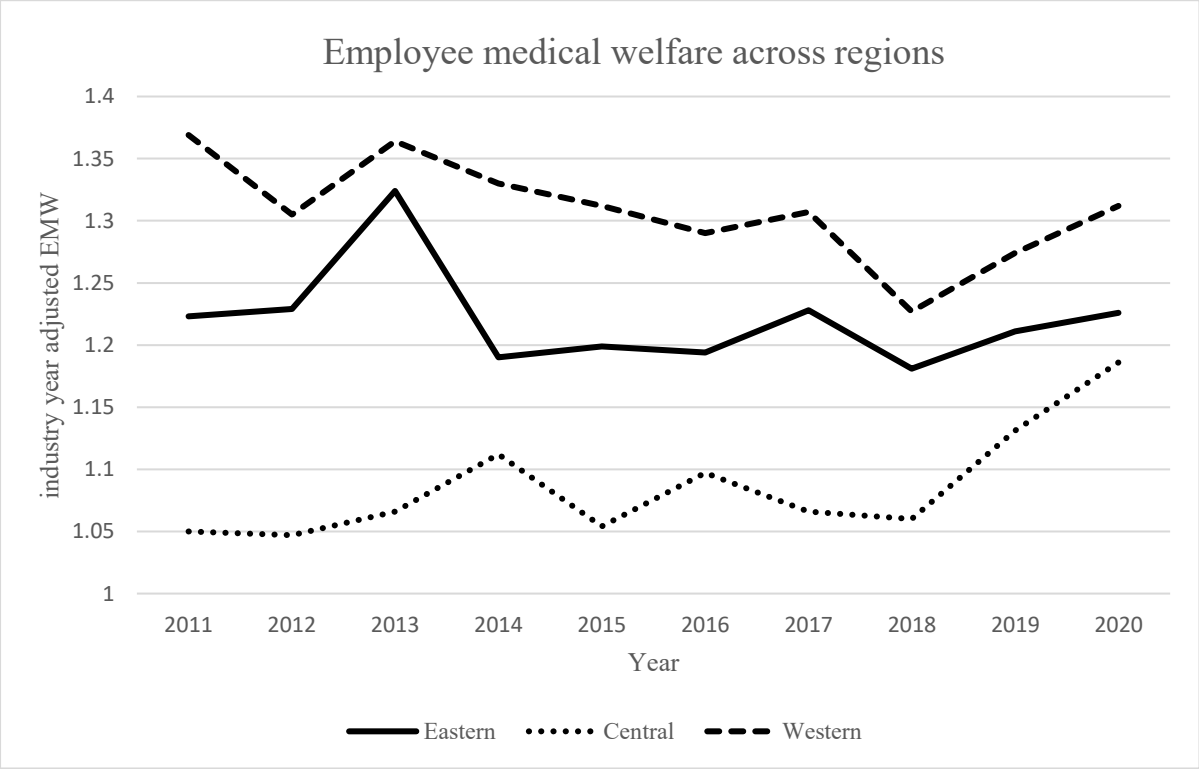
Panel B reports the average employee medical welfare distribution at the industry level using the one-digit China Securities Regulatory Commission (CSRC) industry code. The medical treatment of employees reflects significant differences among industries. The higher employee medical benefits are mainly concentrated in the energy and high-tech industries. First, industries like electricity, gas and water are mostly state-owned companies (SOEs), which have higher employee welfare standards compared with non-SOEs (Zhou, 2004). Second, scientific

research and services industries have a large number of highly educated and highly skilled people. Companies often raise their treatment standards to attract employees to work for them, which is consistent with the efficiency wage theory (Kong et al., 2020).

Figure 3.1 shows the regional distribution of the annual average employee medical welfare expenditure. We divide our sample into the Eastern, Central and Western regions according to the classification issued by the Chinese government[7]. We find that the more economically developed Eastern region has an advantage in terms of medical welfare at the beginning of the sample period but has been gradually overtaken by the Western region in more recent years. This reflects the Chinese government policy preference for welfare subsidies and fiscal transfer payments that promote the development of the West (the Great Western Development Programme), because of the backward economic development and harsh natural environment of this region (Jia et al., 2020). Another finding is that benefits from the implementation of the policy of common prosperity (Kakwani et al., 2022) in the Central region has accelerated in recent years and the gaps among regions are narrowing year by year.

Figure 3.1. Employee medical welfare by year and region





This figure presents the mean of employee medical welfare (EMW) and adjusted EMW by year and region.

3.3.4. Descriptive statistics

Table 3.2 reports the summary statistics of our sample. The *EMW* ranges from RMB401 to

RMB17,532. The mean and median of EMW are only RMB4,229 and RMB3,374, with a standard deviation of RMB2,998. This result demonstrates that firm expenditure on employee medical welfare is quite low on average and still needs improvement. The average TFP is 0.017 in our sample, which is better than the comparable result of 0 in Giannetti et al. (2015) and -0.012 in Dai et al. (2017). In terms of control variables, the average firm size is 22.347, the average leverage ratio is 41%, and the average ROA is 5.2%. The average board size is 9 members, nearly 38% of whom are independent directors. This composition structure complies with CSRC standards. To sum up, the control variable statistics in our sample are similar to those in previous Chinese studies (e.g. Yu & Chi, 2021).

Table 3.2. Summary statistics

VARIABLES	(1) Obs.	(2) Mean	(3) Std. Dev.	(4) Min	(5) Median	(6) Max
TFP	13,605	0.017	0.270	-1.604	0.001	2.235
EMW	13,605	4,229	2,998	400.943	3,374	17,532
LnEMW	13,605	8.130	0.678	5.994	8.124	9.772
$LnEMW_{adjusted}$	13,605	-0.003	0.624	-2.867	-0.004	2.101
Firm Size	13,605	22.347	1.249	19.972	22.167	26.305
Firm Age	13,605	2.851	0.314	1.946	2.890	3.466
Leverage	13,605	0.410	0.190	0.059	0.404	0.862
SA	13,605	-4.393	0.234	-4.393	-3.832	-3.122
Tobin's Q	13,605	2.099	1.310	0.851	1.685	8.446
ROA	13,605	0.052	0.044	-0.016	0.042	0.213
R&D/TA	13,605	0.022	0.019	0.000	0.019	0.099
SOE	13,605	0.314	0.464	0.000	0.000	1.000
Compensation	13,605	1.124	0.507	0.229	1.000	6.355
MA	13,605	0.531	0.286	0.100	0.500	1.000
Board Independence	13,605	0.377	0.056	0.200	0.364	0.714

Board Size	13,605	2.125	0.198	1.386	2.197	2.890
Concentration	13,605	0.337	0.143	0.088	0.317	0.748
GDP Growth	13,605	0.079	0.052	-0.250	0.084	0.299

This table presents summary statistics for main variables in our samples. All variables are defined in the Appendix.

Most of the correlations between variables are between -0.30 and 0.30. We also run the VIF test and the highest and mean VIF of our sample is 5.55 and 2.01. Overall, the correlations and VIF results do not indicate any serious multicollinearity problems[8].

3.4. Main results

3.4.1. Baseline model

We conduct the following regression to investigate the influence of employee medical welfare on firm productivity in our baseline model:

$$Firm\ Productivity_{i,t} = \alpha + \beta_1 LnEMW_{i,t}\ (or\ LnEMWadjusted_{i,t}) + \beta_2 Firm\ Size_{i,t} + \beta_3 Firm\ Age_{i,t} + \beta_4 Leverage_{i,t} + \beta_5 SA_{i,t} + \beta_6 Tobin's\ Q_{i,t} + \beta_7 ROA_{i,t} + \beta_8 R\&D/TA_{i,t} + \beta_9 SOE_{i,t} + \beta_{10} Compensation_{i,t} + \beta_{11} MA_{i,t} + \beta_{12} Board\ Independence_{i,t} + \beta_{13} Board\ Size_{i,t} + \beta_{14} Concentration_{i,t} + \beta_{15} GDP\ Growth_{i,t} + Industry\ FE + Year\ FE + \varepsilon_{i,t} \quad (4)$$

The key independent variables are *LnEMW* and $LnEMW_{adjusted}$. The measurement of firm productivity is total factor productivity (*TFP*). We include a set of control variables and also include both industry fixed effects and year fixed effects in our baseline regressions.

Table 3.3 shows the baseline results. In all the model specifications, the coefficients of *LnEMW* and $LnEMW_{adjusted}$ are positive and significant, meaning that employee medical welfare is positively associated with TFP. These results support Hypothesis 1, that employee medical welfare contributes to high firm level productivity, which are consistent with the stakeholder theory and the organisational caregiving theory. In addition, regarding the control variables, consistent with Kong et al. (2020), the coefficients of ROA and leverage are mostly

significantly positive. Also, firms with higher employee compensation and higher managerial ability have higher levels of productivity, similar to findings in Dai et al. (2017).

In consideration of regional effects and unobservable firm specific characteristics, we introduce different fixed effects to ensure the robustness of our findings. We first introduce industry fixed effects, year fixed effects and province fixed effects at the same time in our model. Additionally, we include firm fixed effects and year fixed effects. Results are shown in Panel B of **Table 3.3** and are consistent with baseline findings.

Table 3.3. Baseline Results

Panel A. Baseline

VARIABLES	(1) *TFP*	(2) *TFP*
LnEMW	0.039***	
	(6.076)	
$LnEMW_{adjusted}$		0.038***
		(6.017)
Firm Size	-0.021***	-0.021***
	(-4.795)	(-4.782)
Firm Age	0.018	0.018
	(0.645)	(0.642)
Leverage	0.144***	0.144***
	(5.427)	(5.413)
SA	0.036	0.036
	(0.946)	(0.945)
Tobin's Q	-0.004	-0.004
	(-1.277)	(-1.272)
ROA	1.976***	1.974***
	(18.747)	(18.729)
R&D/TA	1.795***	1.798***
	(6.317)	(6.326)
SOE	0.008	0.008
	(0.794)	(0.817)
Compensation	0.057***	0.057***
	(6.737)	(6.735)
MA	0.218***	0.218***
	(15.767)	(15.772)
Board Independence	-0.138*	-0.137*
	(-1.951)	(-1.949)
Board Size	0.033	0.033
	(1.492)	(1.494)
Concentration	0.002	0.003
	(0.083)	(0.096)
GDP Growth	0.023	0.023
	(0.383)	(0.386)
Constant	-0.094	0.202

		(-0.610)		(1.368)
Observations		13,605		13,605
Industry FE		Yes		Yes
Year FE		Yes		Yes
Adjusted R^2		0.2383		0.2382

Panel B. Other fixed effects

	(1)	(2)	(3)	(4)
VARIABLES	TFP	TFP	TFP	TFP
LnEMW	0.033***		0.020***	
	(4.775)		(4.119)	
$LnEMW_{adjusted}$		0.032***		0.011**
		(4.709)		(2.062)
Constant	-0.011	0.232	-0.109	0.036
	(-0.072)	(1.536)	(-0.285)	(0.099)
Observations	13,605	13,605	13,605	13,605
Control	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	No	No
Province FE	Yes	Yes	No	No
Firm FE	No	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.2468	0.2468	0.6827	0.6823

The sample consists of 13,605 firm-year observations between 2011 and 2020. The dependent variable is the firm's total factor productivity (*TFP*). *LnEMW* is the natural logarithm of the average employee medical expenditure in that year. $LnEMW_{adjusted}$ is the natural logarithm of the relative medical welfare per employee adjusted by industry in the same year. All control variables are defined in the Appendix A1. The *t*-statistics in parentheses are calculated from the robust standard errors clustered at the firm level. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.4.2. Endogeneity

Our baseline results may be affected by endogeneity issues; we conduct a series of tests including a PSM test and an IV test. PSM is employed to address sample selection bias, as firms that offer higher medical benefits may differ systematically from those that do not. For example, larger firms or state-owned enterprises may be more likely to offer generous medical benefits and also tend to have higher productivity due to other structural advantages. PSM helps mitigate this by matching firms with similar observable characteristics, thus improving the comparability between treated and control groups (i.e., firms with high versus low levels of medical welfare). Another core endogeneity issue arises from reverse causality: more productive firms may be more capable and willing to invest in better employee medical welfare, rather than medical welfare itself leading to higher productivity. This creates a potential upward bias in the estimated effect of medical welfare on productivity. To further address concerns

about causal interpretation, an instrumental variable strategy is implemented later in the analysis.

3.4.2.1. PSM estimation

Following Bizjak et al. (2011), we develop the PSM approach after converting the continuous EMW variable into a binary indicator based on the industry year median split. Our matching procedure relies on a one-to-one neighbour matching of propensity scores without replacement, using a caliper of 0.01, which is estimated by a probit regression of the binary dummy variable on a set of firm control variables. The balanced test results are consistent with pairwise comparisons of the covariates on which the matching is performed before and after the matching process (Kong et al., 2020). Specifically, the results show no statistical differences across any of the firm characteristics after the PSM[9], suggesting that firms in the matched sample are completely comparable. After the PSM, we rerun our baseline regressions. Results are shown in **Table 3.4**, which indicate that employee medical welfare has a significantly positive impact on TFP.

Table 3.4. PSM regression results - Matched sample regressions

	(1)	(2)
VARIABLES	*TFP*	*TFP*
LnEMW	0.032***	
	(4.352)	
$LnEMW_{adjusted}$		0.026***
		(3.361)
Constant	-0.153	0.104
	(-0.772)	(0.521)
Observations	6,882	6,292
Control	Yes	Yes
Industry FE	Yes	Yes
Year FE	Yes	Yes
Adjusted R^2	0.2401	0.2399

This table reports the result after matching. We rerun the baseline regression using the matched sample. All control variables are defined in the Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.4.2.2. 2SLS IV analysis

We perform a 2SLS IV analysis to further address endogeneity concerns. We employ two instrumental variables. First, previous literature discusses the positive impact of regional green

areas on environmental conditions, indicating that more green area contributes to better living environments for human beings (Georgi & Dimitriou, 2010). Bowler et al. (2010) find that the natural environment benefits human health, by reducing the probability of getting sick (Oosterbroek et al., 2023). Thus, we introduce our first instrumental variable *Green*, which is measured as the average green area per capita of a given year and province, using data obtained from the NBSC[10]. Second, air pollution is associated with an increase in medical insurance (Chen & Chen, 2020; Liao et al., 2023). Moreover, Wang et al. (2021b) find that air pollution results in a significant increase in firms' expenditure on employee treatment, as a way of attracting and retaining skilled employees. Thus, we adapt the second instrumental variable, air quality index (*AQI)*, which is calculated as the natural logarithm of the average daily AQI (the concentration level of six atmospheric pollutants, namely, SO_2, NO_2, PM10, PM2.5, CO, and O_3) of a given year and city. The higher the AQI, the heavier the air pollution the city has.

We first regress *LnEMW* and *LnEMWadjusted* on two instrumental variables, namely *Green* and *AQI*. As expected, we find more green spaces create a better environment, which reduces the burden of health insurance expenditure (Georgi & Dimitriou, 2010; Oosterbroek et al., 2023). In terms of *AQI*, *it* is positively related to both *EMW* and adjusted *EMW,* and the coefficients are statistically significant at the 1% level. The result shows that heavy air pollution increases a firm's burden in terms of employee medical expenditure. The first stage F statistics are 626.270 and 616.600 for *LnEMW* and $LnEMW_{adjusted}$ respectively, which are significantly larger than the critical value of 10 suggested by Staiger and Stock (1994), indicating that our instrumental variables are not weak. The Anderson LM statistic of the Anderson canonical correlations test is significant at the 1% level, suggesting that the model is not under-identified. The Hansen J statistic p value is significantly larger than 0.1, which indicates that there is not an over-identification problem in our model. The second stage results are shown in Columns (3) to (4) of **Table 3.5**. The coefficients of *LnEMW* and $LnEMW_{adjusted}$ all remain significantly

positive, which is consistent with the baseline results.

Table 3.5. Instrumental variable 2SLS regression

	First stage		Second stage	
	(1)	(2)	(3)	(4)
VARIABLES	*LnEMW*	$LnEMW_{adjusted}$	*TFP*	*TFP*
Green	-0.031***	-0.031***		
	(-11.467)	(-11.438)		
AQI	0.447***	0.442***		
	(13.587)	(13.486)		
LnEMW			0.103***	
			(4.042)	
$LnEMW_{adjusted}$				0.104***
				(4.041)
Constant	4.838***	-2.832***	-0.426**	0.344**
	(15.345)	(-9.006)	(-1.998)	(2.136)
Observations	12,953	12,953	12,953	12,953
Adjusted R^2	0.5453	0.4662	0.2294	0.2288
Control	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Cragg-Donald Wald F value (for Weak identification test)	626.270***	616.600***		
Anderson LM statistic (for Under identification test)	252.816***	250.048***		
Hansen J statistic p value (for Over identification test)	0.880	0.875		

This table reports the results of the 2SLS regression with instrumental variable. *Green* is the average green area per capita of a given year and province. *AQI* is ambient air pollution measured as the natural logarithm of the average daily AQI of a given year and city. All variables are defined in Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.4.3. Other robustness tests

3.4.3.1. Alternative dependent variables

In our baseline regression in Eq. (4), we use the total factor productivity as the proxy of firm productivity. Following past papers (Faleye et al., 2013; Dai et al., 2017; Kale et al., 2019), we introduce logarithm of sales per employee (*LnSPE*), logarithm of net profits per employee (*LnNPE*), the forward value of TFP (TFP_{t+1}) and new estimation of TFP using OP method as alternative proxies for productivity. Using these different dependent variables, we repeat the main regression in Eq. (4). The results in **Table 3.6** are broadly consistent with our baseline results.

Table 3.6. Robustness tests - alternative dependent variables

VARIABLES	(1) *LnSPE*	(2) *LnNPE*	(3) TFP_{t+1}	(4) TFP_{OP}	(5) *LnSPE*	(6) *LnNPE*	(7) TFP_{t+1}	(8) TFP_{OP}
LnEMW	0.160***	0.142***	0.028***	0.034***				
	(8.958)	(6.170)	(3.761)	(4.852)				
$LnEMW_{adjusted}$					0.158***	0.137***	0.028***	0.034***
					(8.791)	(5.933)	(3.749)	(4.747)
Constant	9.385***	6.439***	0.079	1.735***	10.613***	7.521***	0.295	1.997***
	(24.727)	(13.469)	(0.413)	(10.025)	(29.347)	(16.360)	(1.617)	(12.044)
Observations	13,605	13,605	9,375	13,605	13,605	13,605	9,375	13,605
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.5420	0.6212	0.1613	0.4848	0.5417	0.6210	0.1613	0.4847

This table shows the results based on the alternative dependent variables. They are the natural logarithm of sales per employee (*SPE*), the natural logarithm of net profits per employee (*NPE*), the one-year forward value of total factor productivity (TFP_{t+1}) and TFP estimation under OP method (TFP_{OP}). All variables are defined in the Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.4.3.2. Evidence from firm external caregiving

We focus on firm medical welfare in our study, which is a form of internal organizational caregiving. We also examine corporate donations in order to measure firm's external caring behaviour. Donations are recognized as a form of caregiving behaviour for business organizations (Liedtka, 1996). By analyzing both internal (EMW) and external (donation) caregiving behaviour, I aim to provide a more holistic view of how firms treat various stakeholders and how these behaviours relate to productivity outcomes. Following Deng et al. (2023), we use the donation index from Huazheng ESG database as the measurement of firm's external caregiving performance.

Table 3.7 presents the results, which show that donations are positively and significantly related to TFP with two different estimation methods. We also use the forward value of TFP and find the relation holds, which indicates that the positive effect of organisational external caregiving on TFP is sustained.

Table 3.7. Robustness tests – alternative independent variables

VARIABLES	(1) *TFP*	(2) TFP_{t+1}	(3) TFP_{op}	(4) TFP_{opt+1}
Donations	0.023***	0.017*	0.026***	0.022*
	(2.613)	(1.665)	(2.639)	(1.957)
Observations	13,605	9,375	13,605	9,375

Control	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.2346	0.1593	0.4832	0.4355

This table presents regression results on how organisational external caregiving affects the firm productivity. The independent variable is the donation index from Huazheng ESG database. All variables are defined in the Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.4.3.3. Is welfare always beneficial to firm productivity: evidence from the U-curve test

Existing literature presents some arguments against the use of employee benefits. For example, Akerlof and Yellen (1990) argue that excessive welfare can breed employee laziness. In addition, when an excessive insurance payment ratio conflicts with the equilibrium point of current profits, this cost is passed on to employees, in the form of more work tasks and appraisal targets, to the detriment of their productivity (Hamaaki & Iwamoto, 2008).

To provide further evidence for our baseline results, we develop the U-curve test by introducing the square term of employee medical welfare (EMW^2). **Table 3.8** reports the results of the test. We introduce three different combinations of fixed effects, consistent with our baseline and robustness tests, and find an inverse U-curve between employee medical welfare and TFP, which indicates that employee welfare could also reduce firm productivity after a certain point. However, we find the turning point[11] is around RMB9,600, which is well outside the range of the majority of our sample. Only about 8% of total observations lie after the turning point, meaning that employee medical welfare still contributes to high productivity for the vast majority of Chinese firms. However, this test result proves that the balance of investment in employee treatment needs to be carefully considered by management.

Table 3.8. Robustness tests - Does welfare always matter (evidence from U-curve test)

VARIABLES	(1) *TFP*	(2) *TFP*	(3) *TFP*
U-curve turning point	9,762	9,565	9,620
EMW	0.205***	0.176***	0.152***
	(5.675)	(4.555)	(5.177)
EMW^2	-0.105***	-0.092***	-0.079***
	(-4.689)	(-4.042)	(-4.855)
Constant	0.175	0.214	0.028

	(1.189)	(1.421)	(0.127)
Observations	13,605	13,605	13,605
Control	Yes	Yes	Yes
Industry FE	Yes	Yes	No
Firm FE	No	No	Yes
Province FE	No	Yes	No
Year FE	Yes	Yes	Yes
Observations after turning point	794	841	823
Adjusted R^2	0.2381	0.2468	0.6730

This table presents OLS regression results for the U-curve effects of employee medical welfare on firm productivity. The dependent variable is the firm's total factor productivity. The independent variables are employee medical welfare and its square value. Robust *t*-statistics are reported in parentheses. All control variables are defined in the Appendix. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.5. Mechanism tests – The role of psychological safety

As discussed above, medical welfare is different from compensation or bonus incentives, as it cannot be cashed in. Instead, medical insurance provides care and security in terms of healthy living. According to the psychological safety theory (Kahn, 1990), employees with sufficient organisational protection have their feeling of safety enhanced. Tests of the input-process-output (IPO) model illustrate that psychological safety plays an important role in boosting employee engagement (West & Anderson, 1996) and workplace effectiveness (Edmondson & Lei, 2014). Therefore, we infer employee psychological security represents a mechanism through which employee medical welfare affects firm productivity. We expect that the impact of medical insurance on firm productivity is more pronounced in firms where employees' sense of security is weak. We employ ownership, skilled employee ratios and R&D intensity as specific variables to test this mechanism.

3.5.1. Ownership

Compared with non-SOEs, SOEs offer better job benefits and welfare for their employees such as housing, education and allowances (Rein, 1997; Jiang & Kim, 2015; Zhou, 2004), as in contrast to a private company's value maximization goals, SOEs have additional social stability and social development goals (Bai et al., 2006; Liao et al., 2009). Therefore, we suggest medical welfare is likely to be more attractive to employees in non-SOEs, where the average

employee welfare is lower. We divide our sample of firms into SOEs and non-SOEs based on the ultimate controller of the firm. We rerun our baseline regressions and the results in panel A of **Table 3.9** provide evidence that employee medical welfare has a strong impact on firm productivity in non-SOEs.

3.5.2. Skilled employee ratios

In China, people with more work capacity and social capital will have more connections to access better healthcare resources, and studies have shown that the positive effects of health insurance are greater for those with less education and skills (Zhou et al., 2014; Pan et al., 2013). We infer that medical insurance is less practical protection for highly skilled employees than for low-skilled workers. Thus, we should expect a stronger impact of employee medical welfare on productivity in firms with more low-skilled employees. We collect employee education information from the Winds and Resset database and define skilled labour as employees who have a bachelor's degree or higher. Following Dai et al. (2017), we divide our sample into two groups based on whether the number of skilled employees in a firm is higher than the sample median of the percentage of skilled employees in a firm within a same year and same industry. The empirical results are shown in **Table 3.9** panel B and support the argument that the positive impact of employee medical welfare on productivity is more pronounced in firms with more low-skilled employees, who lack a sense of safety and would tend to value welfare and care more highly.

3.5.3. R&D intensity

Many studies show that R&D-intensive firms have more skilled labour (Chen et al., 2016). Following Kong et al. (2020), we divide our sample into two sub-samples based on the sample median of R&D intensity at the industry and year level. We rerun the baseline regression and panel C of **Table 3.9** reports the results. We find a stronger impact of employee medical welfare

on firm productivity in low R&D intensive firms, which is consistent with our previous findings that medical insurance is more important for low-skilled employees, who have less sense of safety and need more support from employers.

Overall, the subsample analyses suggest that the positive impact of employee medical welfare on productivity is stronger in non-SOE firms, firms with a large percentage of low-skilled employees, and firms with less R&D intensity, where the employee's sense of safety is lower. These findings support the existence of a psychological security mechanism and therefore support Hypothesis 2.

Table 3.9. Mechanism tests – The role of psychological safety

Panel A: SOE vs non-SOE

	SOE	**SOE**	**Non-SOE**	**Non-SOE**
	(1)	(2)	(3)	(4)
VARIABLES	*TFP*	*TFP*	*TFP*	*TFP*
LnEMW	-0.002		0.029**	
	(-0.290)		(2.653)	
$LnEMW_{adjusted}$		-0.006		0.015**
		(-0.935)		(2.236)
Constant	0.448	0.441	-0.219	-0.006
	(0.609)	(0.623)	(-0.398)	(-0.012)
Observations	4,275	4,275	9,330	9,330
Control	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.6887	0.6887	0.6724	0.6718

Panel B: Skilled employee ratio

	High	**High**	**Low**	**Low**
	(1)	(2)	(3)	(4)
VARIABLES	*TFP*	*TFP*	*TFP*	*TFP*
LnEMW	0.001		0.033***	
	(0.107)		(5.699)	
$LnEMW_{adjusted}$		-0.012		0.029***
		(-1.287)		(4.189)
Constant	0.656	0.687	-0.058	0.173
	(1.426)	(1.625)	(-0.201)	(0.607)
Observations	6,778	6,778	6,780	6,780
Control	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.7013	0.7014	0.6817	0.6814

Panel C: R&D intensity

	High	**High**	**Low**	**Low**

VARIABLES	(1) *TFP*	(2) *TFP*	(3) *TFP*	(4) *TFP*
LnEMW	-0.003		0.037***	
	(-0.149)		(3.481)	
$LnEMW_{adjusted}$		-0.010		0.031***
		(-0.614)		(3.333)
Constant	0.541	0.534	-0.431	-0.174
	(0.904)	(0.936)	(-0.668)	(-0.268)
Observations	6,809	6,809	6,796	6,796
Control	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.6955	0.6957	0.6650	0.6645

This table reports results of subsample tests. All variables are defined in the Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.6. Additional tests

Last, we present three tests that expand on our previous results by examining the moderating effect of local medical facilities, the relationship of employee medical welfare to firm value, and the impact of COVID-19.

3.6.1. The moderating effect of local medical facilities

A great deal of medical literature identifies timeliness of access to medical care as a key factor in safeguarding patient health and developed local medical facilities guarantee access to timely medical care (e.g. Xiang et al., 2020). Therefore, we believe that the ability to access healthcare and medical treatment timely with sound local medical facilities is a key factor in determining the usefulness of medical welfare and its positive impacts on firm productivity (Weinick et al., 2000). We collect information on hospital beds per 10,000 people (*BED*) from National Bureau of Statistics of China (NBSC) as a proxy for the regional medical facilities level, following Hu and Huang (2004). We create the interaction term between *LnEMW* and *BED* in our model following the same method used in Wang et al. (2021b). The results in column (2) of **Table 3.10** show that the coefficient on the interaction term between *LnEMW* and *BED* is positive and significant. Overall, the empirical tests indicate that employee medical welfare improves firm productivity when local medical facilities are well developed.

Table 3.10. The moderating effect of local medical facilities on the EMW and TFP relationship

VARIABLES	(1) *TFP*	(2) *TFP*
LnEMW	0.020***	-0.148**
	(4.119)	(-2.240)
BED		-0.283**
		(-2.057)
LnEMW*BED		**0.043****
		(2.558)
Constant	-0.109	0.925*
	(-0.285)	(1.691)
Observations	13,605	13,605
Control	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes
Adjusted R^2	0.6827	0.6729

This table investigates the moderating effect of medical facilities, measured as hospital beds per 10,000 people. All variables are defined in the Appendix A. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.6.2. What do increased employee medical welfare and productivity do to shareholder value?

Our previous results suggest that employee medical welfare increases firm productivity. However, what does this increased productivity do to shareholder value? We use a two-stage regression approach to test whether increased productivity caused by employee medical welfare has a positive impact on firm value. We first generate the fitted value of our two main independent variables (*LnEMW* and $LnEMW_{adjused}$) using Eq. (4). The results for the first stage regressions are presented in columns (1) and (3) of **Table 3.11**. Columns (2) and (4) of Table **3.11** report the second stage results. We find that the two fitted terms are both positively and significantly related to Tobin's Q, which indicates that high productivity caused by better employee medical welfare enhances firm value.

Table 3.11. EMW, productivity and firm value

VARIABLES	(1) TFP	(2) Tobin's Q	(3) TFP	(4) Tobin's Q
LnEMW	0.038***			
	(6.042)			
$Fitted_1$		1.280*		
		(1.922)		
$LnEMW_{adjusted}$			0.038***	
			(5.984)	
$Fitted_2$				1.256*

				(1.875)
Constant	-0.154	13.536***	0.174	13.583***
	(-1.021)	(20.216)	(1.177)	(20.257)
Observations	13,605	13,605	13,605	13,605
Control	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adjusted R^2	0.2381	0.4110	0.2380	0.4109

This table presents coefficients from regressions of how employee medical welfare affects the firm value when it increases the firm productivity. The dependent variable is the firm value, measured by *Tobin's Q*. Different from the baseline regression, we exclude *Tobin's Q* from control variables in all four models here. All variables are defined in the Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.6.3. Employee medical welfare and firm resilience during COVID-19

We believe an important impact of employee medical welfare is not only in terms of firm productivity, but also in terms of firm resilience, particularly in circumstances of great uncertainty. Resilience, mostly discussed in the psychological literature, reflects the ability to maintain a stable psychological equilibrium (Bonanno, 2004). Luthans (2002) defines it as "the developable capacity to rebound or bounce back from adversity, conflict, failure or even positive events, progress and increased responsibility" (p.702). Firm resilience can be viewed as the firm's ability to adjust to adversity, but research on resilience is lacking at the institutional level (Krley, 2022).

The COVID-19 pandemic has left a large number of companies in operational difficulties, posing a huge challenge to firm resilience. Therefore, we conduct an analysis of employee medical welfare in relation to firm stock performance and firm value during the pandemic. Following Shan and Tang (2023) and Yang and Yang (2021), we construct an event study and estimate cumulative abnormal returns (CARs) for 3-, 5-, and 11-trading day windows around the Wuhan lockdown on 23 January 2020. The earliest appearance of patients with the onset of the outbreak in Wuhan has been traced back to 8 December 2019 and the outbreak gradually gained more attention[12]. We choose an estimation window of 1 February to 30 November 2019 to ensure a reasonable calculation of the CARs. We control for a series of firm level characteristics following Broadstock et al. (2021) in the regression analysis. We also control

for the employee treatment score from the Hexun database, as Broadstock et al. (2021) find the social score (including employees) of the ESG index is negatively related to firm stock performance during COVID-19.

Table 3.12 reports the results of the event study. We find employee medical welfare in 2019 is positively and significantly related to market adjusted return on 3 February 2020 (the first trading day after the Wuhan lockdown) and CARs with 3-, 5-, and 11-trading day windows around the event. We also find that the Hexun employee treatment score is negatively related to stock returns on 3 February and CAR [-1,1], which is consistent with previous findings (Broadstock et al., 2021), indicating that employee-friendly firms may furlough staff during the crisis to steer a socially responsible course of action, resulting in high-cost pressures (Bartsch et al., 2020). We further explore the importance of medical welfare by employing Tobin's Q as the dependent variable and find that firms with higher employee medical welfare and care expenditure had better firm value during the years 2020 and 2021 when COVID-19 was spreading in China.

Table 3.12. Employee medical performance under uncertainty (evidence from COVID-19)

VARIABLES	(1) *Return on Feb 3rd*	(2) *CAR [-5,5]*	(3) *CAR [-1,1]*	(4) *CAR [-2,2]*	(5) *Tobin's Q_{2020}*	(6) *Tobin's Q_{2021}*
$LnEMW_{adjusted2019}$	0.003***	0.009**	0.010***	0.009***	0.173***	
	(2.650)	(2.065)	(3.749)	(2.993)	(3.259)	
$LnEMW_{adjuseted2020}$						0.163***
						(3.201)
Firm Size	0.002**	0.008***	0.011***	0.011***	-0.269***	-0.315***
	(2.333)	(3.472)	(7.483)	(6.422)	(-9.817)	(-10.528)
Firm Age	0.003	0.001	0.002	0.000	-0.136	-0.146
	(0.939)	(0.155)	(0.385)	(0.051)	(-1.222)	(-1.231)
Leverage	-0.002	-0.010	-0.011	-0.011	-0.170	-0.558***
	(-0.336)	(-0.564)	(-0.997)	(-0.868)	(-0.856)	(-2.633)
ROA	0.021	0.131**	0.219***	0.169***	11.916***	11.108***
	(1.126)	(2.246)	(5.620)	(3.801)	(10.679)	(9.040)
SOE	-0.003	-0.023***	-0.016***	-0.021***	-0.021	-0.021
	(-1.627)	(-3.522)	(-3.941)	(-4.488)	(-0.298)	(-0.270)
Hexun	-0.003***	0.001	-0.003**	-0.002	0.121***	0.118***
	(-4.279)	(0.633)	(-2.035)	(-1.043)	(4.418)	(3.949)
Constant	-0.047***	-0.174***	-0.269***	-0.255***	7.739***	9.194***
	(-3.243)	(-3.163)	(-8.175)	(-6.546)	(12.276)	(12.826)

Observations	2,592	2,592	2,592	2,592	2,151	2,456
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.0761	0.0667	0.0934	0.0771	0.2858	0.2444

This table provides the results on relationship between employee medical welfare and stock market reaction during the COVID-19 outbreak period. Return on Feb 3rd is the market adjusted return on the 3rd of February 2020 (the first trading day after Wuhan lockdown). *CAR[-1,1]*, *CAR[-2,2]* and *CAR[-5,5]* refer to three-, five- and eleven-day cumulative abnormal stock returns centering on Feb 3rd, 2020, based obtained using a standard market model. $EMW_{adjusted}$ is the natural logarithm of the relative medical welfare per employee adjusted by industry in the same year. We control for firm level characteristic following Broadstock et al. (2021). All variables are defined in the Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and* denote significance level at the 1%, 5%, and 10% levels, respectively.

3.7. Conclusion

This study investigates the impact of employee medical welfare on firm productivity in China. Using data from 2011 to 2020, we find employee medical welfare significantly increases firm productivity. After addressing issues of endogeneity, the relationship remains the same. Moreover, the relationship is more pronounced for non-state-owned firms, firms with more low-skilled employees and low R&D intensity, and firms in low birth rate regions where employees lack psychological safety and need greater protection. We further show that the level of regional medical development has a moderating effect with respect to the relationship between employee medical welfare and productivity. Our results are robust to a variety of model specifications and alternative measures. Our study provides empirical evidence that establishing care as an organisational value, through the provision of employee medical welfare, fosters a sense of safety among employees which, in turn, has a positive impact on firm productivity.

In addition, we conduct the first study of employee medical welfare and its impact on firm resilience during the COVID-19 pandemic. We find that firms with higher employee medical welfare in 2019 had better stock performance when the COVID-19 virus suddenly spread in early 2020. Also, firms providing better employee medical welfare had higher firm value in 2020 and 2021. These findings with respect to COVID-19 indicate that employee welfare can effectively increase firm resilience in the face of great uncertainty.

3.8. Appendix

A1. Variable definition

Variable	Definition
TFP	We employ residuals from estimation of the natural log transformation of Cobb-Douglas function and obtain the measure as firm-level total factor productivity, following Giannetti et al. (2015).
LnSPE	The natural logarithm of sales per employee.
LnNPE	The natural logarithm of net profits per employee.
LnEMW	Employee medical welfare, which is the natural logarithm of medical insurance expenditure per employee.
$LnEMW_{adjusted}$	The adjusted employee medical welfare, which is the natural logarithm of employee medical insurance expenditure divided by the median expenditure of a given industry and year.
Firm Size	The natural logarithm of total assets of a firm.
Firm Age	The natural logarithm of listing age of a firm.
Leverage	Total debt divided by total assets.
SA	Financial constraint index computed as in Hadlock and Pierce (2010). The SA index is calculated as $-0.737 * Ln(Assets) + 0.043 * Ln(Assets)^2 - 0.04 * Firm\ Age$. The higher the SA score, the lower the financial constraint the firm faces.
Tobin's Q	The ratio of market value and book value of total assets.
ROA	Return on assets, measured as net income divided by total assets.
R&D/TA	The ratio of R&D expense to total assets
SOE	Dummy variable equal to 1 if the firm is state-owned, and 0 otherwise.
Compensation	The average employee compensation divided by the median compensation of a given industry and year, following Kong et al. (2020).
MA	Managerial ability, the proxy of the ability of the managerial team, which is constructed following Demerjian et al. (2012).
Board Independence	The number of independent directors as a percentage of the total number of directors on the board.
Board Size	The natural logarithm of the total number of directors on the board.
Concentration	Top one shareholding, which is the largest shareholding.
GDP Growth	The annual GDP growth rate in a province during the fiscal year.
Green	The average green area per capita of a given year and province.
AQI	Air quality index, which is the natural logarithm of the average daily AQI (the concentration level of six atmospheric pollutants, namely, SO_2, NO_2, PM_{10}, $PM_{2.5}$, CO, and O_3) of a given year and city following Wang et al. (2021b). The higher AQI, the heavier air pollution city has.
Skilled Employee ratio	The proportion of skilled labour, which is the number of employees who have a bachelor's degree or higher divided by the total number of employees in a firm, following Kong et al. (2020).
Bed	The natural logarithm of number of beds in medical institutions per 10,000 persons in a given province and year, following Hu and Huang (2004).
Return on Feb 3rd	The market adjusted return on the 3rd of February, the first trading day after the Wuhan lockdown on Jan 23rd, 2020.
CAR [-1,1]	The cumulative abnormal return over the 3- trading day window around the Wuhan lockdown.

CAR [-2,2]	The cumulative abnormal return over the 5- trading day window around the Wuhan lockdown.
CAR [-5,5]	The cumulative abnormal return over the 11- trading day window around the Wuhan lockdown.
Hexun	The employee treatment index obtained from HEXUN CSR database.
Donation	Index of firm's social responsibility-related donations from Huazheng ESG database

A2. Balanced tests after PSM

Panel A. Balanced tests after PSM using LnEMW

Variable	Sample	Treated	Control	%bias	t-statistics	p>t
Firm Size	Unmatched	22.628	22.065	46.3	26.98	0.000
	Matched	22.203	22.245	-3.4	-1.52	0.128
Firm Age	Unmatched	2.886	2.815	22.8	13.27	0.000
	Matched	2.858	2.862	-1.4	-0.60	0.545
Leverage	Unmatched	0.427	0.393	18.1	10.54	0.000
	Matched	0.399	0.404	-2.7	-1.14	0.256
SA	Unmatched	-3.826	-3.805	-8.9	-5.18	0.000
	Matched	-3.829	-3.831	0.8	0.35	0.729
Tobin's Q	Unmatched	2.041	2.157	-8.9	-5.18	0.000
	Matched	2.140	2.134	0.5	0.18	0.854
ROA	Unmatched	0.050	0.055	-10.6	-6.18	0.000
	Matched	0.053	0.052	0.4	0.18	0.855
R&D/AT	Unmatched	0.023	0.021	10.2	5.96	0.000
	Matched	0.023	0.022	0.5	0.22	0.829
SOE	Unmatched	0.453	0.176	62.5	36.46	0.000
	Matched	0.266	0.300	-7.8	-3.19	0.001
Compensation	Unmatched	1.333	0.914	90.6	53.05	0.000
	Matched	1.050	1.046	0.8	0.47	0.637
MA	Unmatched	0.518	0.543	-8.7	-5.07	0.000
	Matched	0.521	0.522	-0.2	-0.09	0.931
Board Independence	Unmatched	0.378	0.375	4.3	2.52	0.012
	Matched	0.376	0.377	-3.2	-1.36	0.175
Board Size	Unmatched	2.142	2.111	17.0	9.89	0.000

	Matched	2.120	2.121	-0.4	-0.17	0.864
Concentration	Unmatched	0.353	0.322	21.9	12.75	0.000
	Matched	0.326	0.328	-1.2	-0.51	0.608
GDP Growth	Unmatched	0.076	0.081	-10.8	-6.27	0.000
	Matched	0.079	0.078	1.4	0.60	0.547

Panel B. Balanced tests after PSM using $LnEMW_{adjusted}$

Variable	Sample	Treated	Control	%bias	t-statistics	p>t
Firm Size	Unmatched	22.540	22.153	31.3	18.27	0.000
	Matched	22.222	22.265	-3.5	-1.47	0.141
Firm Age	Unmatched	2.866	2.836	9.6	5.60	0.000
	Matched	2.849	2.853	-1.0	-0.41	0.679
Leverage	Unmatched	0.420	0.400	10.7	6.23	0.000
	Matched	0.399	0.403	-2.5	-0.98	0.325
SA	Unmatched	-3.815	-3.816	0.2	0.09	0.927
	Matched	-3.821	-3.824	1.4	0.56	0.575
Tobin's Q	Unmatched	2.116	2.082	2.7	1.55	0.122
	Matched	2.131	2.112	1.5	0.57	0.570
ROA	Unmatched	0.050	0.054	-9.2	-5.39	0.000
	Matched	0.052	0.051	3.0	1.19	0.234
R&D/AT	Unmatched	0.023	0.021	8.8	5.14	0.000
	Matched	0.022	0.022	-2.6	-1.07	0.284
SOE	Unmatched	0.454	0.175	63.1	36.81	0.000
	Matched	0.269	0.312	-9.8	-3.81	0.000
Compensation	Unmatched	1.355	0.893	102.5	59.79	0.000
	Matched	1.054	1.053	0.3	0.15	0.879
MA	Unmatched	0.519	0.542	-8.0	-4.64	0.000
	Matched	0.524	0.518	2.4	0.98	0.327
Board Independence	Unmatched	0.377	0.376	0.9	0.51	0.608
	Matched	0.375	0.376	-1.8	-0.73	0.463
Board Size	Unmatched	2.143	2.107	18.2	10.63	0.000
	Matched	2.122	2.125	-1.7	-0.68	0.494
Concentration	Unmatched	0.352	0.322	21.5	12.53	0.000

	Matched	0.330	0.331	-0.8	-0.31	0.760
GDP Growth	Unmatched	0.076	0.081	-10.5	-6.14	0.000
	Matched	0.079	0.078	0.8	0.34	0.731

This table reports the balanced test result after matching. Our matching procedure relies on a one-to-one nearest neighbor matching of propensity scores without replacement. Panel A shows the results when using *LnEMW* as the independent variable. Panel B shows the results when using $LnEMW_{adjusted}$ for robustness. All variables are defined in Appendix A1.

Endnotes[9]

1. Existing literature normally uses KLD score or B&C 100 List in the U.S. and Hexun in China to measure employee treatment (e.g. Wen et al., 2021). KLD rates employee relationships with firms using these categories: employee involvement, cash profit-sharing, union relations, retirement benefits, health and safety and workforce reductions. B&C 100 List is compiled from two sources, with two-thirds of the score coming from an employee survey and the remaining one-third from the Institute's evaluation of factors in four firm areas: credibility, respect, fairness, and pride/camaraderie. In the Chinese market, Hexun CSR rating evaluates CSR employee activities of all Chinese listed firms based on their CSR reports, as well as annual financial reports, in respect to employee income and training, work safety and caring.
2. http://www.nhc.gov.cn/mohwsbwstjxxzx/s8561/201610/9f109ff40e9346fca76dd82cecf419ce.shtml
3. https://baike.baidu.com/item/%E4%B8%AD%E5%9B%BD%E4%BC%81%E4%B8%9A%E7%A4%BE%E4%BF%9D%E7%99%BD%E7%9A%AE%E4%B9%A6/18516159?fr=aladdin
4. https://www.12371.cn/special/19jwzqh/
5. We also estimate TFP using OP method following Guo et al. (2023) as alternative proxies in robustness test.
6. Managerial ability index (*MA*) is the measure of managerial ability based on the efficiency with which managers generate revenues, first introduced by Demerjian et al. (2012). In the first step, data envelopment analysis (DEA) is used to estimate relative firm efficiency by evaluating their inputs relative to their output. The output is net sales.

[9] This essay employs EndNote for referencing, as the use of footnotes for certain points would occupy considerable space within the chapters and could detract from the clarity and overall presentation of the paper.

The inputs include the cost of goods sold (*COGS*); selling and administrative expenses (*SG&A*); property, plant and equipment (*PPE*); operating lease (*OpsLease*); goodwill (*Goodwill*); and other intangible assets (*OtherIntan*). DEA forms an efficient frontier and firm efficiency is estimated based on the following optimization:

$$max_y \theta = \frac{Sales}{v_1 COGS + v_2 SG\&A + v_3 PPE + v_4 OpsLease + v_5 R\&D + v_6 Goodwill + v_7 OtherIntan} \quad (2)$$

where firm efficiency, θ, takes the value between zero and one. Firms operating on the efficient frontier have a θ of one. A smaller value of θ indicates lower firm efficiency. As θ is also influenced by both firm-specific factors and management characteristics, the firm-specific factors are removed from the firm efficiency measure in the second step. The regression model is shown below:

$$Firm\ Efficiency_{i,t} = \beta_0 + \beta_1\, Ln(Total\ Assets)_{i,t} + \beta_2 MarketShare_{i,t} + \beta_3 PositiveFreeCF_{i,t} + \beta_4 Ln(Age)_{i,t} + \beta_5 BusinessSegmentConcertration_{i,t} + \beta_6 ForeignCurrencyIndicator_{i,t} + Year\ Indicators_{i,t} + \varepsilon_{i,t} \quad (3)$$

where *ln(Total Assets)* is the natural logarithm of total assets of firm *i* in year *t*; *MarketShare* is the percentage of sales in a firm *i* in year *t*; *PositiveFreeCF* is a dummy variable equals 1 if firm *i* has a non-negative free cash flow in year *t* and 0 otherwise; *Ln(Age)* is the natural logarithm of firm age since establishment in year *t*; *BusinessSegmentConcertration* is the ratio of the sum of squared segment sales to squared total sales for firm *i* in year *t*; *ForeignCurrencyIndicator* is a dummy variable equals 1 if firm *i* has foreign operations in year *t* and 0 otherwise. The residual of Eq. (3) captures managerial ability. To mitigate extreme observations, we use the decile ranks of *MA* according to the year and industry, following Dai et al. (2017).

7. http://5isxw.com/show-12789.html
   http://www.gov.cn/govweb/test/2006-02/24/content_209896.html
   http://www.stats.gov.cn/xxgk/sjfb/zxfb2020/202105/t20210519_1817690.html
8. Results can be provided on request.
9. Results are presented in Appendix A2. For our 14 control variables, only SOE is significant in the matched sample, but this result is common in the Chinese studies (e.g., Jin et al., 2023; Li et al., 2019) and there is no significant influence on our results.
10. This data is only available at the provincial level from NBSC.
11. For quadratic function, the turning point = (−1/2) (coeff- (EMW)/coeff- (EMW^2))
12. https://zhidao.baidu.com/question/2125808114240339507.html

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CHAPTER FOUR

ESSAY TWO

This chapter introduces the second essay of the thesis, which explores the impact of financial technology on corporate employee treatment.

Does digital finance adoption impact corporate employee treatment? Evidence from China

Abstract

This study investigates the impact of digital finance, the integration of traditional financial services with modern information technology, on corporate employee treatment. While prior research has highlighted the influence of digital finance on firm operations and external financing, its effects on internal stakeholder outcomes remain underexplored. Using firm level data from China, our study presents robust evidence that digital finance significantly improves employee treatment. Specifically, digital finance can effectively reduce firms' financial constraint and improve information transparency, thereby enabling firms to offer better treatment to their employees. Further heterogeneity analysis reveals that the positive relationship is more prominent in firms located in the regions with lower marketization levels and severe air pollution, indicating that disadvantaged firms are taking advantage of digital inclusive finance to attract employees in a competitive market. Last, we find digital finance promotes corporate digital transformation and increases the proportion of high-skilled workers within firms, underscoring the importance for employees to invest in skills that are increasingly valued in a digitally enabled economy. Overall, this study deepens our understanding of the role of financial technology in corporate employee treatment strategy and is a timely addition to the current literature.

Keywords: Digital finance, employee treatment, financial constraint, information transparency

JEL classification: G30, J30, O33, I31

4.1. Introduction

Technology and humanity are timeless topics in today's world (Leonhard, 2016). Digital finance (DF), as an emerging integration of various digital technologies, has experienced rapid development in recent years. Given the development of digital technology is an inevitable trend and has strong externalities, how DF influence human capital in firms via, in particular, employee treatment, warrants further investigation. We believe the study of DF and its relationship with employee treatment enriches the literature relating to employee wellbeing and is of particular interest to economists and managers who are concerned with how new finance technology affects human capital and reshapes the labour market.

Finance researchers have found that DF influences corporate decisions and performance in multiple ways, including improving financial performance (Wu & Huang, 2022), reducing carbon emission intensity (Lu et al., 2023), reducing bankruptcy risk (Ji et al., 2022), and encouraging risk-taking behaviours such as green innovation (Tian et al., 2022). Since DF operates as a macro-level indicator, its impact on firm behaviour can be studied while minimizing endogeneity concerns, making it a widely adopted variable in corporate finance research (e.g., Mu et al., 2023; Ji et al., 2022). However, whether and how DF affects firm strategy with respect to employee treatment is unclear.

The relationship between DF and employee treatment can be theoretically explained through both positive and negative mechanisms. On the positive side, drawing on the resource-based view (Barney, 1991), DF can enhance employee treatment by easing firms' financing constraints and improving information transparency (e.g. Ji et al., 2022; Sun et al., 2023). Reduced financing constraints allow firms to allocate more resources toward employee welfare programmes, while improved transparency fosters stronger trust and engagement between management and employees. From the perspective of technological enablement and

organisational change theory (Cascio & Montealegre, 2016), DF also acts as a catalyst for broader digital adoption (Wu & Huang, 2022), enabling process optimisation, better decision-making, and more inclusive management practices that strengthen employee treatment as part of a strategic approach to sustaining human capital advantages.

Conversely, a negative pathway is also plausible. The efficiency gains enabled by DF adoption may lead to technology-driven substitution of labour (Carpenter et al., 2019), reducing the need for certain roles and thus weakening employees' bargaining power. Additionally, as firms reallocate resources to prioritise technological investment and competitive positioning, employee welfare initiatives may receive lower priority (Schein, 2010). Organisational culture and strategic focus may also shift toward performance metrics and shareholder returns, potentially crowding out employee-oriented considerations (Li et al., 2024). These dynamics suggest that while DF has the potential to foster better employee treatment under resource-rich and inclusive strategies, it could also weaken employee treatment when the dominant logic emphasises cost efficiency and rapid technological scaling.

To investigate the relationship between DF and employee treatment, we conduct empirical analysis based on the Chinese market. China is an ideal setting for this study for the following reasons. First, China is a world-leading country in its telecom and internet construction. The new DF technology is gradually becoming an integral part of China's financial system (Mu et al., 2023), and significant heterogeneity exits in DF across space and time. Taking advantage of the DF ranking framework published by Peking University, we can easily measure the development level of DF in Chinese cities. Second, China has the world's second largest population and a huge labour market. In recent years, the former "factory of the world" has been actively optimising and upgrading its industrial structure for sustainable development. The Fifth Plenary Session of the 19th Central Committee of the Communist Party of China in 2020 emphasized that common prosperity is an important feature of Chinese-style

modernization. Instruments to implement this policy, such as income and employee treatment, and its determinants need further investigation.

To construct corporate employee treatment measures, we employ three proxies, which are Huazheng employee safety index, average employee compensation and Hexun employee scores[10]. The employee health and safety score from Huazheng is an indicator from the social category in the ESG raking system. The score is based on the company's plans to reduce employee safety accidents, accident and health trends and related factors, reflecting the company's effort in relation to employee wellbeing in terms of employment safety and health. Following previous research (Dai et al., 2017), we calculate average employee compensation as the total salary expenses for all employees minus the total salary paid to management, divided by the total number of ordinary employees[11]. The employee index from Hexun.com offers comprehensive rating of all listed Chinese firms in terms of employee treatment performance (Wang et al., 2021). We capture city level development of DF using the DF index published by the Peking University which has been widely used in many empirical studies (e.g. Dou et al., 2023).

We use panel data of 12,421 observations from 2011 to 2020 to examine the relationship between DF and employee treatment in China. Our main results indicate a significant and positive relationship between DF and employee treatment. The result is robust to adding forward values of employee treatment measures and to adapting sub-categories of the DF index in the ranking system. Following previous studies (Kong et al., 2020; Ouyang et al., 2024), we also employ the propensity score matching approach and entropy balancing approach in the robustness tests and the baseline findings still hold.

[10] The last two measures are for robustness checks, given space limitation.
[11] Ordinary employee means total number of employments minus management people.

To address potential endogeneity concerns from reverse causality, where firms with more employee-friendly practices may contribute to local DF facilities and infrastructure and thereby bias upward the estimated effect of digital finance on employee treatment, we adopt a two-stage least squares (2SLS) approach with two instrumental variables (IVs). The first IV follows Zhu et al. (2023) and uses the geographical distance from a firm's city to Hangzhou, the birthplace of Alipay and a central hub for DF development in China. Because geographical distance is time-invariant, we follow Zhang et al. (2020) and construct a time-varying IV by interacting the distance with the national average DF index (excluding the specific city), capturing exogenous variation in DF exposure across cities and over time. The second IV builds on Chen and Zhang (2021) and reflects the role of communication infrastructure in DF development. It is defined as the number of fixed-line telephones per 100 people in 1984 multiplied by the number of Internet users in each city in the previous year. This interaction combines a historical proxy for infrastructure readiness with a time-varying measure of digital adoption, providing a credible source of exogenous variation in DF. In the first-stage regressions, both instruments are significantly related to the DF index: cities further from Hangzhou tend to have lower DF development, and DF growth is positively associated with stronger historical communication infrastructure and greater Internet use. The second-stage results remain consistent with the baseline findings, confirming the robustness of the positive relationship between DF and employee treatment after addressing endogeneity.

Furthermore, to shed light on the mechanisms underlying the relationship between DF and employee treatment, we examine two potential ones emphasised in prior literature (Ji et al., 2022; Mu et al., 2023), which are alleviating financial constraints and improving information transparency. Our analysis reveals that the positive impact of DF on employee treatment is concentrated in financially constrained firms and in those with lower transparency, suggesting

that DF promotes more employee-oriented practices by easing resource limitations and reducing information asymmetry.

We also conduct a series of heterogeneity tests. Results indicate the positive impact of DF on employee treatment differs depending on a number of factors. We find the positive effect is prominent in firms located in regions with lower marketization levels and regions with server air pollution. These firms can be viewed as disadvantaged firms in a competitive market and DF increases the ability for such firms to provide better treatment for employees, to compensate for working in them. Also the effect is more pronounced in state-owned-enterprises (SOEs), firms with more board independence, firms with higher managerial ability and firms with lower CEO power, indicating that government support and good corporate governance are indispensable factors in promoting DF's positive impact on employee treatment policies. Last, we examine how DF development affects firms' employment structures and find that DF leads to a trend of corporate digital transformation and increases demand for high skilled labour. This shift reflects a growing demand for skilled labour as financial technology develops, underscoring the importance of investing in human capital for both individual career advancement and organizational competitiveness.

The novelty of this paper is as follows. Whereas the existing economics and finance literature has primarily focused on the effects of DF on labour-related outcomes such as the labour income share (e.g., Chen et al., 2023; Yang et al., 2023), labour structure (e.g., Dou et al., 2023; Li et al., 2024), and labour investment efficiency (Wang et al., 2024), much less attention has been paid to how DF affects employee treatment, which constitutes a fundamental aspect of firms' internal stakeholder relations. Employee treatment reflects not only compensation and welfare but also broader considerations of fairness, working conditions, and long-term commitment, all of which are essential for sustaining firm competitiveness and social

responsibility. By shifting the focus from macro-level labour market indicators to micro-level employee well-being, our study aims to filling an important gap in the literature.

This paper makes three main contributions. First, it advances the understanding of how DF benefits firms through the dual mechanisms of alleviating financing constraints and enhancing information transparency. By easing access to external capital while subjecting firms to greater scrutiny from investors and regulators, DF simultaneously shapes both the capacity and the motivation for firms to adopt more responsible labour practices. This highlights the dual role of financial technology in strengthening socially responsible corporate behaviour and extends the scope of financial research to incorporate employees as critical internal stakeholders.

Second, we provide new evidence on the inclusive role of DF in supporting disadvantaged firms. By mitigating institutional and environmental disadvantages faced by firms in highly polluted or less market-oriented regions, DF reduces systemic barriers and promotes more equitable participation in economic development. This contribution underscores the developmental significance of DF as an instrument of inclusive finance, highlighting its potential to narrow inequalities in corporate opportunities and strengthen the sustainability of economic growth. Moreover, we emphasize that under an advanced DF environment, sound corporate governance practices remain essential in translating these advantages into improved employee-related policies.

Third, we document the impact of DF development on corporate digital adoption and employment structure. Our results show that greater DF adoption is associated with deeper corporate digital transformation and a rising share of high-skilled workers, reflecting a complementary relationship between technological advancement and employee upskilling. This finding aligns with the view expressed by Simon Johnson and Daron Acemoglu, recipients of the 2024 Nobel Prize in Economic Sciences, in their book *Power and progress: Our*

thousand-year struggle over technology and prosperity (2023) that technological forces are inexorable and the appropriate response is to invest in future-relevant skills. In this way, our study demonstrates that DF is not only a driver of reduced financing frictions and improved transparency but also a transformative force reshaping labour structures and human capital development in the digital economy.

The remainder of paper is as follows. Section 2 reviews relevant literature and develops our hypotheses for the study. In section 3, we discuss our research design. We present the main empirical results and several robustness checks in Section 4. Further analyses and findings are discussed in section 5. Section 6 concludes the paper.

4.2. Literature review and hypothesis development

Recent literature has linked the development of DF to a wide range of economic consequences, such as stimulating household consumption (Li et al., 2020), increasing women's entrepreneurship and bargaining power (Han et al., 2023), industrial structure upgrading (Ren et al., 2023) and strengthening regional economic resilience (Yu et al., 2023; Yang et al., 2024). With respect to firms, DF provides more digital resources and sustainable services for firms (Li et al., 2023), enabling firms to easily achieve more sustainable financial services, to increase information transparency with suppliers and reduce operational risk (Guo et al., 2023). In addition, DF has broadened the boundaries of financial services through modern information technology, thereby reducing transaction costs of financial institutions, and improving the overall efficiency of the financial system (Wu et al., 2022). These factors benefit firms a great deal by easing financial constraints (Li et al., 2023). However, how DF development affects employee treatment has been less well investigated.

On the one hand, DF may have a positive impact on employee treatment. Drawing on the resource-based view (Barney, 1991), DF constitutes a strategic resource that is inclusive,

inimitable and non-substitutable, enabling firms to overcome capital market frictions. By facilitating more efficient access to external financing, diversifying funding sources, and lowering transaction costs (Mu et al., 2023), DF can effectively ease financial constraints, thereby allowing firms to allocate greater resources toward employee welfare, skills development, and workplace enhancements. Furthermore, in line with the technological enablement and organizational change perspective (Cascio & Montealegre, 2016), the development of DF enhances information transparency by digitizing financial transactions and expanding data availability. Improved information transparency reduces asymmetries between management and employees (Akerlof, 1982). Under increased external monitoring, firms face stronger incentives to maintain a positive reputation and demonstrate compliance with social responsibility standards. As a result, they are more likely to improve employee treatment. Hence, DF functions not only as a financial enabler but also as an informational and organizational catalyst that supports a shift toward more employee-oriented management practices.

On the other hand, there may exist a negative relationship between DF and employee treatment. First, although DF may ease financial constraints (Li et al, 2023), the additional financial slack is not necessarily channelled towards employee-related investments. Consistent with resource-based view, firms often redirect such resources to activities with more immediate and measurable returns, including technological upgrading, market expansion, and shareholder remuneration (e.g. Ji et al., 2023; Carpenter et al., 2019), thereby diminishing the allocation available for long-term commitments to employee welfare. Second, the large-scale adoption of DF may signal a broader strategic reorientation towards efficiency maximization and return optimization. Such a shift can reshape organizational norms and values, embedding a performance-centric culture that reduces the salience of employee treatment and wellbeing as strategic objectives (Schein, 2010). Third, the integration of DF into core operations is

frequently accompanied by automation and process digitization, which substitute for routine labour, compress staffing levels, and intensify work demands on remaining employees (Li et al., 2024).

Based on the discussion and analysis above, we propose two competing research hypotheses:

H1a: DF enhances corporate employee treatment.

H1b: DF reduces corporate employee treatment.

4.3. Research design

4.3.1. Sample

This paper employs a sample of A-share listed firms in China's Shanghai and Shenzhen markets from 2011 to 2020. We exclude firms from financial industries, and special treatment firms to mitigate survivorship bias. After removing observations with missing data, the final sample consists of 12,421 firm-year observations for 2,680 unique firms. All the continuous variables are winsorzied at the 1st and 99th percentiles to mitigate outlier effects on our results. Detailed definitions of all relevant variables in the study are reported in Appendix A1.

4.3.2. Variable selections

4.3.2.1 Measure of employee treatment

The main explanatory variable is employee treatment (*ET*), and we employ the employee safety scores from the Huazheng ESG database. The health and safety score from Huazheng is an indicator from the social category, which is based on the company's disclosure on reducing employee safety accidents and reflects the firm's approach in terms of employee safety and health. The reason we choose Huazheng ESG ranking is because it performs well in terms of updating frequency and calculation accuracy and has been widely used in existing corporate ESG performance studies (e.g. Zhang et al., 2023; Fang et al., 2023). In terms of updating

frequency, Huazheng updates quarterly, while other ESG ratings are typically updated semi-annually or annually. Also Huazheng adopts integrated semantic analysis and natural language process intelligent algorithms, which make scores more accurate (Zhang et al., 2023).

Second, we use average employee compensation (*Compensation*) and Hexun employee treatment score (*ES*) as alternative measures of employee treatment. Following previous studies (e.g. Chang et al., 2015; Dai et al., 2017; Dong et al., 2020), we use the total labour wage of a firm minus the total wage of all its top executives, directors, and supervisors to calculate the total wage of ordinary employees. We then calculate the average employee compensation by using the total wage divided by the total number of ordinary employees. The ES index is sourced from Hexun.com, a leading financial information platform in China that has published CSR scores and rankings for all listed Chinese firms since 2010. A key advantage of Hexun's data is its comprehensive coverage, avoiding the sample selection bias seen in other CSR ratings like RKS, which only include firms that voluntarily disclose CSR reports (Wang et al., 2021).

4.3.2.2. Measure of digital finance development

Based on previous studies (Dou et al., 2023; Guo et al., 2023a), we capture city level development of DF using the DF index published by the Digital Finance Research Centre of Peking University. DF is a comprehensive measure that captures the development of digital finance in China across dimensions such as coverage, depth of use, and degree of digitalization (Mu et al., 2023).

4.3.2.3. Control variables

Following previous literature on DF and employee treatment (Edmans, 2011; Zhang et al., 2020a; Chen & Zhang, 2021), we control firm-level variables including company size (*Firm Size*), firm age (*Firm Age*), debt ratio (*Leverage*), and the largest shareholding (*Concentration*).

We also include the ratio of market value to book value of total assets (Tobin's Q) (*Q*), return on assets (*ROA*) and sales growth rate (*Growth*). We include a dummy variable indicating whether a firm is controlled by the government (*SOE*). As for corporate governance, following Wang et al. (2021) we control the number of independent directors to the total number of directors on the board (*Independence*), the number of directors (*Board Size*), power of CEO (*Duality*), as well as the changing rate of employee numbers in a firm (*EmChange*). Finally, considering macroeconomic factors may have an influence on a firm's employment policy, we include the development of marketization (*Marketization*), the regional unemployment rate (*Unemployment*) and the provincial annual GDP growth rate (*GDP Growth*). The firm-level financial and corporate governance data and industry information is obtained from the Chinese Stock Market and Accounting Research Database (CSMAR). Other macroeconomics data is retrieved from National Bureau of Statistics of China (NBSC).

4.3.3. Model specification

To test our main hypothesis, the OLS regression model is designed as follows:

$$Employee\ Treatment_{i,t} = \alpha + \beta_1 DF_{i,t} + \beta_2 Firm\ Size_{i,t} + \beta_3 Firm\ Age_{i,t} + \beta_4 Leverage_{i,t} + \beta_5 Concentration_{i,t} + \beta_6 Q_{i,t} + \beta_7 ROA_{i,t} + \beta_8 Growth_{i,t} + \beta_9 SOE_{i,t} + \beta_{10} Independence_{i,t} + \beta_{11} Board\ Size_{i,t} + \beta_{12} Duality_{i,t} + \beta_{13} EmChange_{i,t} + \beta_{14} Marketization_{i,t} + \beta_{15} Unemployment_{i,t} + \beta_{16} GDP\ Growth_{i,t} + \sum \text{Industry FE} + \sum \text{Province FE} + \sum \text{Year FE} + \varepsilon_{i,t} \quad (5)$$

4.4. Empirical results

4.4.1. Sample distribution

This section discusses the sample distribution of our main dependent variables, employee treatment (*ET*). Table 4.1 shows the sample distribution of employee treatment across provinces and industries.

Table 4.1. Sample distributions

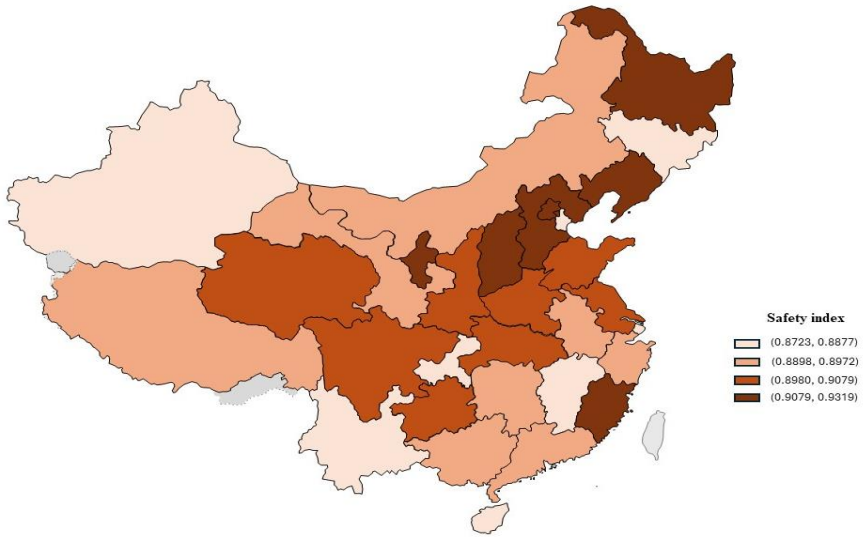
	Employee Treatment
Panel A. Employee treatment across provinces	
Provinces	
Hainan	0.872
Xinjiang	0.873
Jilin	0.877
Chongqing	0.880
Tianjin	0.880
Yunnan	0.886
Jiangxi	0.887
Shanghai	0.888
Gansu	0.890
Tibet	0.890
Inner Mongolia	0.891
Anhui	0.893
Guangdong	0.893
Zhejiang	0.895
Hunan	0.896
Guangxi	0.897
Shaanxi	0.898
Sichuan	0.899
Hubei	0.901
Jiangsu	0.903
Henan	0.904
Qinghai	0.908
Shandong	0.908
Guizhou	0.908
Liaoning	0.908
Heilongjiang	0.911
Beijing	0.913
Hebei	0.915
Fujian	0.921
Ningxia	0.925
Shanxi	0.932
Panel B. Employee treatment across industries	
Industry	
Transportation	0.712
Agriculture, Forestry, Animal Husbandry, and Fishery	0.780
Public Facilities Management	0.888
Construction	0.893
Manufacturing	0.895
Comprehensive	0.907

Mining	0.915
Information Technology	0.922
Real Estate	0.923
Leasing and Business Services	0.930
Health and Social Service	0.965
Scientific Research and Services	0.969
Electricity, Gas and Water	0.976
Wholesale and Resale Trade	0.977
Culture, Sports and Entertainment	0.997

This table presents the mean of average safety index by province and industry separately.

In panel A, we see that there are some differences in employee treatment between regions. To illustrate this further, we draw a heat map for each province using their average numbers during the sample period. Figure 4.1 shows the average employee safety index in each province. The darker the colour, the better the safety treatment of firms. Overall, Panel A and Figure 1 imply large variations in the key dependent variable across different regions.

Figure 4.1. Employee treatment index prefecture-level map of China



Panel B of Table 1 reports the treatment distribution at the industry level using the one-digit CSRC industry code. The panel reflects significant differences between industries. The better employee treatment is mainly concentrated in the energy and high-tech industries. In explanation of this, first, industries like electricity, gas and water are mostly SOEs, which have

higher employee welfare standards compared with non-SOEs (Zhou, 2004). Second, scientific research and services industries employ many highly educated and highly skilled people. Companies often raise their treatment standards to attract employees to work for them, which is consistent with the efficiency wage theory (Wang et al., 2021).

4.4.2. Summary Statistics

Table 4.2 reports the sample descriptive statistics. Consistent with previous literature (e.g. Mu et al., 2023; Ren et al., 2023). we divide the original DF index by 100 to make data comparable. The average DF index is 2.414 with a standard deviation of 0.534, indicating the development of DF still varies greatly from city to city. For the employee treatment index, the minimum and maximum value are 0.352 and 1. The average annual employee compensation ranges from RMB43,059 to RMB394,736. In terms of control variables, the average leverage ratio is 40.9%, and the average ROA is 5.2%. The average board size is 9 members and nearly 38% of board members act as independent directors. This composition structure complies with the China Securities Regulatory Commission (CSRC) standards. The average increase in employee numbers in our sample is 11%. Overall, the distribution of the control variable statistics in our sample is consistent with previous Chinese studies (e.g. Wang et al., 2021).

Table 4.2. Summary statistics

Variables	Obs.	Mean	Std.	Min	50%	Max
DF	12,421	2.414	0.534	0.952	2.476	3.216
ET	12,421	0.901	0.093	0.352	0.901	1.000
Compensation	12,421	126,470	64,095	43,059	109,883	394,736
ES	12,421	2.209	2.545	0.000	1.470	13.430
Firm Size	12,421	22.363	1.260	20.166	22.167	26.305
Firm Age	12,421	2.851	0.316	1.946	2.890	3.466
Leverage	12,421	0.409	0.190	0.062	0.402	0.851
Concentration	12,421	0.335	0.143	0.088	0.315	0.721
Q	12,421	2.112	1.317	0.854	1.698	8.353
ROA	12,421	0.052	0.044	0.001	0.042	0.213
Growth	12,421	0.188	0.385	-0.419	0.226	2.445
SOE	12,421	0.323	0.468	0.000	0.000	1.000

Independence	12,421	0.376	0.054	0.333	0.364	0.571
Board Size	12,421	2.126	0.198	1.609	2.197	2.708
Duality	12,421	0.281	0.449	0.000	0.000	1.000
EmChange	12,421	0.108	0.345	-0.421	0.030	2.280
Marketization	12,421	9.609	1.518	4.862	9.746	11.934
Unemployment	12,421	2.949	0.700	1.300	3.000	4.220
GDP Growth	12,421	0.079	0.045	-0.071	0.082	0.202

This table presents summary statistics for main variables in our samples. All variables are defined in the Appendix A1.

4.4.3. Correlation analysis

Table 4.3 shows the correlation matrix and VIF test for independent variables. Most of the correlations reported are between -0.30 and 0.30. Both the correlations and VIFs show there is no significant evidence of multicollinearity.

4.4.4. Baseline results

Table 4.4 reports the baseline results of Eq. (5), which utilize regression models to explore the relationship between DF and employee treatment. We display all the control variables and include industry, province and year-fixed effects. In all model specifications, the coefficients of digital finance (*DF*) are positive and statistically significant at the 5% level; this supports our hypothesis H1a, namely, that DF is positively associated with employee treatment. Regarding the control variables, our findings demonstrate that large firms and SOEs have better employee-friendly treatment. Overall, the regression results for the control variables are consistent with prior studies (e.g. Ji et al., 2022).

Considering there is likely to be a lag between the DF's impact and the implementation of the firm policy and the firm's performance, we follow Wang et al. (2021) and take the one-year forward value of our treatment measurement. We present the results in the column (3) of Table 4.4. Consistent with our baseline findings, the coefficients of *DF* are still positive and statistically significant at the 5% level, which indicates our baseline results are robust.

Table 4.3. Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	VIF
1.DF	1.000																1.52
2.Firm Size	0.064	1.000															1.93
3.Firm Age	0.280	0.115	1.000														1.20
4.Leverage	-0.017	0.551	0.119	1.000													1.73
5.Concentration	-0.063	0.222	-0.093	0.096	1.000												1.15
6.Q	-0.062	-0.387	-0.072	-0.336	-0.082	1.000											1.35
7.ROA	0.061	-0.090	-0.042	-0.369	0.058	0.347	1.000										1.42
8.Growth	-0.001	0.017	-0.0570	0.041	-0.032	0.033	0.1879	1.000									1.39
9.SOE	-0.129	0.379	0.156	0.294	0.264	-0.168	-0.1948	-0.093	1.000								1.47
10.Independence	0.070	0.021	-0.020	0.001	0.057	0.028	-0.0057	-0.015	0.031	1.000							1.50
11.Board Size	-0.128	0.265	0.064	0.166	0.034	-0.121	-0.0456	-0.022	0.265	-0.543	1.000						1.69
12.Duality	0.087	-0.171	-0.091	-0.124	-0.047	0.086	0.0810	0.044	0.287	0.119	-0.191	1.000					1.13
13.EmChange	-0.053	0.023	-0.078	0.019	-0.021	0.023	0.1252	0.497	0.0860	0.000	-0.025	0.045	1.000				1.35
14.Marketization	0.449	-0.088	0.045	-0.087	-0.047	0.042	0.1034	-0.0056	0.222	0.041	-0.130	0.141	0.018	1.000			1.32
15.Unemployment	-0.209	-0.042	0.085	0.018	-0.021	0.012	-0.0279	-0.019	0.055	-0.049	0.039	-0.057	-0.016	-0.144	1.000		1.14
16.GDP Growth	-0.128	-0.036	-0.116	0.002	0.013	-0.029	0.0022	0.050	0.004	-0.002	0.011	0.026	0.028	-0.039	-0.211	1.000	1.09

This table displays the correlation statistics of main variables. All variables are defined in the Appendix. The VIFs are also calculated, and results show that there is no multicollinearity issue in our model.

Table 4.4. Baseline results

Variables	(1) ET	(2) ET	(3) ET_{t+1}
DF	0.013**	0.014**	0.018**
	(2.387)	(2.214)	(2.244)
Firm Size		0.002*	0.003**
		(1.924)	(2.123)
Firm Age		0.000	-0.002
		(0.016)	(-0.583)
Leverage		0.001	-0.000
		(0.068)	(-0.027)
Concentration		-0.004	-0.009
		(-0.448)	(-1.062)
Q		0.000	-0.000
		(0.020)	(-0.062)
ROA		-0.038	-0.039
		(-1.546)	(-1.443)
Growth		-0.001	0.000
		(-0.416)	(0.096)
SOE		0.006**	0.009**
		(2.738)	(2.781)
Independence		-0.039***	-0.047**
		(-3.945)	(-2.761)
Board Size		-0.003	-0.005
		(-0.895)	(-0.903)
Duality		-0.003	-0.002
		(-1.651)	(-0.699)
EmChange		-0.000	0.003
		(-0.020)	(1.199)
Marketization		-0.002	-0.003
		(-0.656)	(-1.082)
Unemployment		-0.004*	-0.002
		(-1.749)	(-0.543)
GDP growth		-0.035*	-0.047**
		(-2.046)	(-2.484)
Constant	0.868***	0.883***	0.880***
	(79.703)	(23.250)	(27.424)
Observations	12,421	12,421	8,594
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Adj. R^2	0.178	0.180	0.865

The sample consists of 12,421 firm-year observations between 2011 and 2020. The independent variable is the city level digital finance index. *ET is* firm employee treatment index, which is obtained from Huazheng ESG database. All control variables are defined in the Appendix A1. The *t*-statistics in parentheses are calculated from the robust standard errors clustered at the city level. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

4.4.5. Mechanism tests

While the baseline regressions establish a positive association between DF and employee treatment (ET), understanding the underlying mechanism is critical. Prior studies suggest that

DF may influence firm behaviour through multiple pathways, including alleviating financial constraints and improving information transparency (e.g. Ji et al., 2022; Mu et al., 2023). However, the relative importance of these mechanisms remains unclear, particularly in the context of employee treatment. Therefore, we conduct mechanism tests by stratifying firms based on financial constraint and information transparency levels to empirically examine how these factors moderate the impact of DF on employee treatment.

Tables 4.5 and 4.6 present the results of the mechanism tests. Table 4.5 divides firms into high and low financial constraint subsamples based on the Kaplan-Zingales (KZ) index and Whited-Wu (WW) index. The results indicate that DF significantly enhances employee treatment in firms facing high financial constraints, whereas the effect is insignificant for firms with low constraints. These findings suggest that DF primarily benefits employee treatment when firms are financially constrained, consistent with the view that DF alleviates resources limitations and enables greater investment in employee welfare.

Table 4.5. Mechanism tests: Easing financial constraints

Panel A. KZ index

	High Constraint	Low Constraint
	(1)	(2)
Variables	ET	ET
DF	0.036***	-0.007
	(3.527)	(-0.491)
Constant	0.900***	0.869***
	(15.822)	(14.108)
Observations	6,252	6,169
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.174	0.191

Panel B. WW index

	High Constraint	Low Constraint
	(1)	(2)
Variables	ET	ET
DF	0.013*	0.015
	(1.800)	(1.325)
Constant	0.785***	0.974***
	(15.480)	(15.804)
Observations	6,255	6,166

Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.208	0.165

Table 4.5 reports the results of mechanism tests exploring whether the impact of DF on employee treatment operates through the alleviation of financial constraints. Firms are divided into subsamples based on the Kaplan-Zingales (KZ) index and the Whited-Wu (WW) index to capture differences in financial constraint levels. All variables are defined in the Appendix A1. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

Table 4.6 examines the information transparency mechanism, using firm-level transparency rating from CSMAR and disclosure quality index from Huazheng. We find that the effect of DF on employee treatment is significantly positive in firms with lower transparency while the impact is insignificant for firms with higher transparency. This indicates that DF contributes more to employee investment in contexts where information asymmetry is greater, supporting the mechanism that DF enhances internal and external information flows, reduces asymmetry, and fosters better and more timely employee treatment.

Table 4.6. Mechanism tests: Addressing information asymmetry

Panel A. Information transparency level

	High	Low
	(1)	(2)
Variables	ET	ET
DF	-0.008	0.019**
	(-0.482)	(2.372)
Constant	0.849***	0.895***
	(9.335)	(19.929)
Observations	2,801	9,620
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.185	0.181

Panel B. Information disclosure level

	High	Low
	(1)	(2)
Variables	ET	ET
DF	-0.006	0.019**
	(-0.189)	(2.750)
Constant	0.880*	0.844***
	(2.109)	(20.541)
Observations	1,848	10,573
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes

Year FE	Yes	Yes
Adj. R^2	0.205	0.176

This table reports the results of mechanism tests exploring whether the impact of DF on employee treatment operates through the improvement of information transparency. Firms are divided into subsamples based on the information transparency rating from CSMAR database and the information disclosure quality index from Huazheng database to capture differences in information transparency levels. All variables are defined in the Appendix A1. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

Overall, these results provide robust empirical evidence that the positive influence of DF on employee treatment operates through easing financial constraints and improving information transparency, highlighting the dual financial and informational pathways through which DF promotes more employee-oriented practices.

4.4.6. Robustness tests

We next conduct a series of tests to ensure our results are robust.

4.4.6.1. Sub-categories of DF

In the baseline regression, we proxy digital finance by using the total DF index of city-level data. According to previous literature (e.g. Li et al., 2020), DF is a multi-dimensional concept, and therefore our paper not only examines the impact of the total index of DF on employee treatment but also uses the sub-category indices in the regression analysis. The ranking system of the DF index consists of three second-level indices, which are the index of coverage breadth (*Coverage*), the index of usage depth (*Depth*) and the index of degree of digitization (*Digit*). The breadth of coverage is reflected in the number of Alipay accounts owned and the number of bank cards per capita on the mobile phone applications. Coverage measures how widely DF is used. Depth of use measures the actual usage of online financial services such as online payment, insurance, investment, credit loans and investigation services. Degree of digitization focuses on the higher mobility, affordability and convenience of digital financial services.

Panel A of Table 4.7 presents the results for the impact of DF on employee treatment using the different dimensions of the DF index. We find both depth and usage contribute to better employee safety.

4.4.6.2. Propensity score matching

Next, we apply a propensity score matching (PSM) approach after converting the contiuno8ir DF variable into a binary indicator based on city-year median split (Rosenbaum & Rubin, 1983). Our matching procedure relies on a one-to-one neighbor matching of propensity scores without replacement, which is estimated by a probit regression of the binary dummy variable on a set of control variables. The balanced test results are consistent with pairwise comparisons of the covariates on which the matching is performed before and after the matching process (Kong et al., 2020). Specifically, the results show no statistical differences across any of the firm characteristics after the PSM, suggesting that firms in the matched sample are comparable. The balanced test results after PSM are reported in Appendix A2. The post-matching results shown in panel B of Table 4.7 indicate that DF positively affects employee treatment, which is consistent with baseline results

4.4.6.3. Entropy balancing

Next, we conduct the entropy balancing (EB) approach (Hainmueller, 2012). This approach aims to reweight a dataset such that the covariate distributions in the reweighted data satisfy a set of conditions; this is useful for creating balanced samples with a binary treatment where the control group data can be reweighted to match the covariate moments in the treatment group (Hainmueller & Xu, 2013). We divide the sample into treatment and control firms based on median value of city level DF index in a year. We present the results after matching consistent with the approach in Ouyang et al. (2024). Appendix A3 shows the balance tests. Before EB, the treatment firms are significantly different from the control firms along all dimensions,

excluding leverage. After EB, the control and treatment groups become similar with differences equal to zero, suggesting that the matching is effective. The second column of Panel B in Table 4.7 reports the regression results obtained using the stacked matched sample, which are consistent with the baseline findings that DF promotes better employee treatment.

Table 4.7. Robustness tests

Panel A. Sub-categories of DF

	(1)	(2)	(3)
Variables	ET	ET	ET
Coverage	0.010**		
	(2.199)		
Usage		0.018**	
		(2.524)	
Digitalization			-0.001
			(-0.200)
Constant	0.887***	0.880***	0.896***
	(23.498)	(23.248)	(23.014)
Observations	12,421	12,421	12,421
Control	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Adj. R^2	0.180	0.181	0.180

Panel B. Matched sample regression

	PSM	EB
	(1)	(2)
Variables	ET	ET
DF	0.018**	0.022**
	(2.237)	(2.190)
Constant	1.035***	0.928***
	(10.745)	(13.720)
Observations	3,910	12,421
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.097	0.159

This table shows the robustness results obtained by introducing Sub-categories of DF index in Panel A. Robust *t*-statistics are reported in parentheses. We rerun the baseline regression after PSM using the matched sample, and rerun the baseline regression after EB using the balanced sample and present the results in Panel B. All control variables are defined in the Appendix A1. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

4.4.7. Endogeneity – 2SLS

Our baseline results may be affected by endogeneity issues. First, potential omitted variables may affect firm policies on employee treatment. Second, even though we adapt the city level data as an independent variable, causality problems may also exist. To address these issues, we use an instrumental variable (IV) and a two-stage least square (2SLS) regression to reproduce the baseline estimation. Previous literature has shown that geographical distance of the company from Hangzhou is a good IV for DF (e.g. Mu et al., 2023; Yu et al., 2023). Hangzhou, the capital of the economically developed province of Zhejiang, is located in the eastern region of China. Hangzhou is the birthplace and headquarters of Alipay, which is a typical DF company and a leader in DF development. Thus, Hangzhou is recognized as the centre of DF technology in mainland China and has many IT and DF talents. However, distance does not change over time, which invalidates the second-stage estimation as an instrumental variable. Therefore, following Zhang et al. (2020b), we interact the instrumental variable with the mean of the DF index at the national level (except for the specific city of the observation) as a new instrumental variable (*IV-Distance*) with time-varying effects.

In addition, given the well-documented link between communication infrastructure and the development of digital finance, we follow the approach of prior studies, such as Chen and Zhang (2021), and introduce a second instrumental variable (*IV-Intel***)**, to further address potential endogeneity concerns. *IV-Intel* is constructed as the product of the number of Internet users in a given city in year *t–1* and the number of fixed-line telephones per 100 people in that city in 1984. By interacting a time-varying component (Internet users) with a time-invariant historical infrastructure proxy, *IV-Intel* captures exogenous variation in digital finance development that is plausibly uncorrelated with unobserved determinants of firm-level employee treatment, satisfying the relevance and exclusion restrictions required for a valid instrument.

We first regress index of city level digital finance (*DF*) on our *IV-Distance*. As expected, IV-*Distance* is negatively related to *DF* index, and the coefficients are statistically significant at the 1% level, implying that the further away from the centre of DF, the lower the level of DF development. Results are presented in Panel A of Table 4.8. The first stage F statistic is 1503.658, which is significantly larger than the critical value of 10 suggested by Staiger and Stock (1994), indicating that *Distance* is a not weak IV. The second stage results are shown in the column (2) of Panel A. The coefficient of *DF* remains significantly positive, which is consistent with the baseline results.

Panel B of Table 4.8 reports an F-value of 2718.507 for *IV-Intel*, indicating that the instrumental variable is sufficiently strong. Column (1) presents the results of the first-stage regression, showing a significantly positive relationship between the *IV-Intel* and *DF*. This suggests that the development of DF is closely affected by the widespread adoption of fixed-line telephone and internet technology, as expected. The second-stage results, displayed in Column (2), indicate that the coefficient of DF remains significantly positive at the 1% level, consistent with the baseline findings. Overall, our 2SLS IV analysis results support our baseline finding that DF improves employee treatment within firms.

Table 4.8. Endogeneity check – Instrumental variable approach

Panel A. Distance to Hangzhou as instrumental variable

	(1)	(2)
Variables	DF	ET
IV-Distance	-0.017***	
	(-13.400)	
DF		0.074**
		(2.059)
Constant	0.982***	0.831***
	(8.477)	(14.408)
Observations	12,421	12,421
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.939	0.024
Cragg-Donald Wald F statistic	1503.658	

Panel B. Internet users and fixed-line telephones in 1984 as instrumental variable

Variables	(1) DF	(2) ET
IV-Intel	0.126***	
	(6.551)	
DF		0.065***
		(2.894)
Constant	-0.425*	0.838***
	(-1.729)	(15.775)
Observations	12,421	12,421
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.944	0.025
Cragg-Donald Wald F statistic	2718.507	

This table reports the results of the 2SLS regression with instrumental variables. The instrumental variable in panel A, *Distance*, is calculated as the interaction term between the mean of the DF index at the national level (except for the specific city) and the distance to Hangzhou city. Panel B uses the interaction term between the number of Internet users in *t-1* and the number of fixed-line telephones per 100 people per city in 1984 as instrumental variable. All variables are defined in Appendix A1. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

4.4.8. Alternative measure of employee treatment

In this section, we further confirm the validity of our measure of employee treatment by introducing two alternative measures to replace primary *ET* index – average employee compensation (*Compensation*) and employee treatment score (*ES*) retrieved from Hexun CSR ranking database.

We first rerun the baseline regression using compensation and ES scores and report the results in Table 4.9 Panel A. It is clear to see that DF contributes to higher employee compensation and ES scores. Then, we follow previous robustness check by taking forward value of compensation and ES, and we can see the results from the Panel B that the positive relations between DF and compensation still hold. Panel C presents the results for the impact of DF on employee treatment using the different dimensions of the index. We find all the sub-indices including coverage breath, depth of usage and level of digitization have positive impacts on employee compensation. Last, the PSM method, the Entropy Balancing match and the IV-2SLS test are all conducted, and Panel D and Panel E show the baseline regression is robust.

Table 4.9. Alternative measures of employee treatment

Panel A. DF and employee compensation and ES

Variables	(1) Compensation	(2) Compensation	(3) ES	(4) ES
DF	0.362***	0.360***	0.966***	0.987***
	(7.507)	(7.872)	(4.332)	(4.754)
Firm Size		0.089***		0.464***
		(10.832)		(12.785)
Firm Age		0.010		0.029
		(0.467)		(0.240)
Leverage		-0.143***		-0.091
		(-3.961)		(-0.434)
Concentration		-0.002		-0.399*
		(-0.039)		(-1.735)
Q		0.036***		0.066**
		(8.624)		(2.541)
ROA		0.528***		4.851***
		(4.173)		(6.269)
Growth		0.090***		0.049
		(9.524)		(0.771)
SOE		0.138***		0.529***
		(7.120)		(5.916)
Independence		0.111		0.977
		(0.924)		(1.415)
Board Size		-0.032		0.165
		(-0.817)		(0.744)
Duality		-0.001		-0.017
		(-0.036)		(-0.262)
EmChange		-0.173***		0.040
		(-15.900)		(0.534)
Marketization		-0.007		0.198***
		(-0.853)		(2.768)
Unemployment		0.018		-0.192*
		(0.984)		(-1.795)
GDP growth		0.042		-0.067
		(0.543)		(-0.103)
Constant	10.872***	8.838***	2.668***	-9.827***
	(155.443)	(39.902)	(5.191)	(-8.494)
Observations	12,421	12,421	12,421	12,421
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.350	0.434	0.157	0.218

Panel B. Forward looking

Variables	(1) $Compensation_{t+1}$	(2) ES_{t+1}
DF	0.378***	0.937***
	(7.399)	(4.299)
Constant	8.963***	-6.376***
	(35.706)	(-4.932)
Observations	8,594	8,594
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes

Adj. R^2			0.399		0.208	
Panel C. Sub-categories of DF						
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Compensation	Compensation	Compensation	ES	ES	ES
Coverage	0.262***			0.696***		
	(7.069)			(4.260)		
Usage		0.315***			0.718***	
		(6.662)			(3.529)	
Digitalization			0.134***			0.660***
			(3.741)			(3.639)
Constant	8.942***	8.887***	9.021***	-9.522***	-9.568***	-9.620***
	(41.908)	(38.904)	(40.596)	(-8.290)	(-8.212)	(-8.250)
Observations	12,421	12,421	12,421	12,421	12,421	12,421
Control	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.433	0.429	0.423	0.218	0.217	0.217

Panel D. PSM and Entropy Balancing				
	PSM		EB	
	(1)	(2)	(3)	(4)
Variables	Compensation	ES	Compensation	ES
DF	0.401***	1.420***	0.375***	1.248***
	(6.330)	(4.752)	(5.665)	(3.320)
Constant	8.652***	1.035***	8.861***	-9.068***
	(27.010)	(10.745)	(33.474)	(-4.950)
Observations	3,910	3,910	12,421	12,421
Control	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Adj. R^2	0.383	0.097	0.415	0.219

Panel E. Endogeneity				
	IV-Distance		IV-Intel	
	(1)	(2)	(3)	(4)
Variables	Compensation	ES	Compensation	ES
DF	0.605***	2.140***	0.444***	1.296**
	(9.565)	(3.320)	(3.910)	(2.567)
Constant	8.378***	-10.423***	8.529***	-9.700***
	(36.251)	(-8.044)	(35.707)	(-7.959)
Observations	12,421	12,421	12,421	12,421
Control	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
F-value	1503.658		2718.507	
Adj. R^2	0.428	0.204	0.371	0.204

Table 4.9 presents coefficients from regressions of the effect of DF on firms' employee treatment by adapting *Compensation* and *ES*, as alternative measures to replace our primary measure *ET. Compensation* is average employee compensation, measured as the natural logarithm of the total average employee compensations, which calculated as the total salary expenses for all employees minus that of management, divided by the total number of ordinary employees. *ES* is the employee treatment score obtained from Hexun CSR database. Robust *t*-statistics are reported in parentheses. All control variables are defined in the Appendix A1. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

4.5. Further analysis

4.5.1. Heterogeneity tests

To better understand the effect of DF on employee treatment across regions, we examine how the impacts differ subject to regional marketization levels and air pollution levels. In the competitive labour market, firms located in low marketization regions and heavily polluted regions are more disadvantaged in attracting higher-educated and higher-skilled employees compared with those located in regions with better market development and better air quality, since the worse external environment is considered to be negatively related to employees' commitment to firms (Zhang et al., 2020). Similar evidence is found by Wang et al. (2021), who find air pollution significantly enhances employee treatment, as firms headquartered in polluted cities invest more in human capital to compensate for unmet health and safety needs as a result of working in locations with air pollution.

Compared with other resources and technologies, DF has own virtue of inclusiveness (e.g. Guo et al., 2023) which make it easily achievable by firms. Thus, we predict that DF will help companies located in regions with lower market development and severe air pollution to provide better employee treatment. Therefore, we expect the positive relationship between DF and employee treatment to be stronger for these disadvantaged firms. Using the Fan Gang index, which is publicly available and frequently employed in Chinese studies to proxy regional marketization (Wang et al., 2017), we divide our sample into high marketization regions and low marketization regions based on the sample median of the year. As reported in Table 4.10 Panel A, we find that the impact of DF on ET is larger in low marketization regions. Then, following previous studies (Dong et al., 2021), we calculate the city level air quality index based on the concentration level of six atmospheric pollutants[12] and separate our sample into

[12] Detailed composition of pollutants is discussed in the Appendix A1.

high-polluted cities and low-polluted cities. The empirical results are shown in Table 4.10 Panel B and support the argument that the positive impact of DF on ET is more pronounced in firms located in areas with more severe air pollution.

Table 4.10. Heterogeneity analysis – Geographic differences

Panel A. Marketization

	High	Low
	(1)	(2)
Variables	ET	ET
DF	0.008	0.022**
	(0.434)	(2.173)
Constant	0.836***	0.859***
	(34.525)	(28.573)
Observations	6,687	5,734
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.163	0.201
Panel B. Air pollution (AQI)		
	High	Low
	(1)	(2)
Variables	ET	ET
DF	0.016**	0.006
	(2.545)	(0.508)
Constant	0.943***	0.816***
	(21.313)	(12.156)
Observations	6,465	5,956
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.193	0.171

This table reports results of subsample tests in terms of geographic differences, which are *marketization* and *air quality index* specifically. All variables are defined in the Appendix A1. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

We next examine whether firm characteristics influence the positive impact of DF on employee treatment. Specifically, we focus on ownership structure and corporate governance. Table 4.11 reports the heterogeneity analysis for state ownership, board independence, managerial ability and CEO power.

SOEs play a significant role in China and are documented as one of the most important institutional features of the Chinese economy (Wang et al., 2021). Compared with non-SOEs,

SOEs offer better job benefits and treatment for their employees, as in contrast to a private company's value maximization goals, SOEs have additional social stability and social development goals (Zhou, 2004; Bai et al., 2006). We divide our sample of firms into SOEs and non-SOEs based on the ultimate controller of the firm. We rerun our baseline regressions and the results in Panel A of Table 4.11 provide evidence that DF only contributes to better ET in SOEs. It indicates that compared with non-SOEs, SOEs have a stronger incentive to improve employee treatment.

Many scholars have previously tested the role of corporate governance in affecting firm-specific investment and its performance (e.g. Hu et al., 2021; Fan et al., 2024). These influences include internal factors such as board characteristics, managerial efficiency as well as CEO characteristics. In contrast to its impact in relation to, for example, replacing a machine or adapting a new technology in the production process, the agency problem has potentially serious repercussions with respect to employee investment. For example, investments such as improving job conditions and the working environment could be easily manipulated by managers so that it appears to investors that they are ethical leaders, in order to cover up their misconduct (Prior et al., 2008; Ben-Nasr & Ghouma, 2018). Employees as beneficiaries, are less likely to become potential whistle blowers, which may damage shareholders' value in the long run. Therefore, we expect that the positive influence of DF on ET is dependent on good corporate governance.

First, we divide our sample into two sub-samples based on the sample median of the number of independent directors at the industry and year level. We rerun the baseline regression and Panel B of Table 4.11 reports the results. We find a stronger impact of DF on ET in firms with higher board independence. Second, we spilt the sample based on the median of managerial ability at the industry and year level. The managerial ability (MA) is measured by the MA index, first introduced by Demerjian et al. (2012), which is based on the efficiency with which

managers generate revenues[13]. The sub-sample results are reported in Panel C of Table 4.11, and show DF only promotes employee treatment when the MA index is higher. Last, we consider CEO power as an influence on employee-friendly policies. We select the sample based on whether the CEO also serves as the chairman of the board. The regression results shown in Panel D of Table 4.11 indicate that DF contributes to better employee treatment when CEO power in the firm is lower.

Table 4.11. Heterogeneity analysis – ownership and corporate governance

Panel A. State ownership

	SOE	Non-SOE
	(1)	(2)
Variables	ET	ET
DF	0.035***	0.006
	(3.345)	(0.779)
Constant	0.864***	0.864***
	(14.756)	(13.629)
Observations	4,009	8,412
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.429	0.180
Panel B. Board independence		
	High	Low
	(1)	(2)
Variables	ET	ET
DF	0.017***	0.008
	(3.953)	(0.493)
Constant	0.870***	0.812***
	(19.705)	(6.263)
Observations	10,039	2,382
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.168	0.224
Panel C. Managerial ability		
	High	Low
	(1)	(2)

[13] In the first step, data envelopment analysis (DEA) is used to estimate relative firm efficiency by evaluating their inputs relative to their output. The output is net sales. The inputs include cost of goods sold (*COGS*); selling and administrative expenses (*SG&A*); property, plant and equipment (*PPE*); operating lease (*OpsLease*); goodwill (*Goodwill*); and other intangible assets (*OtherIntan*). DEA forms an efficient frontier, and firm efficiency is estimated then. To mitigate extreme observations, we use the decile ranks of *MA* according to the year and industry, following Dai et al. (2017).

Variables	ET	ET
DF	0.021*	0.008
	(2.025)	(0.785)
Constant	0.941***	0.836***
	(15.827)	(25.643)
Observations	7,148	5,273
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.169	0.206
Panel D. CEO power		
	High	Low
	(1)	(2)
Variables	ET	ET
DF	-0.009	0.019*
	(-0.451)	(1.879)
Constant	1.002***	0.836***
	(8.207)	(21.759)
Observations	3,487	8,934
Control	Yes	Yes
Industry FE	Yes	Yes
Province FE	Yes	Yes
Year FE	Yes	Yes
Adj. R^2	0.130	0.200

This table reports results of subsample tests in terms of *state ownership*, and factors of corporate governance, which are *managerial ability, board independence* and *CEO duality*. All variables are defined in the Appendix A1. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

In all, the heterogeneity analysis reveals that the positive effect of DF on employee treatment is influenced by a number of factors. We find this positive relationship is more pronounced in disadvantaged firms, firms with strong government support and firms with good corporate governance.

4.5.2. Corporate digital transformation and demand for high skilled labour

According to human capital theory (Sweetland, 1996), human capital plays a crucial role in enabling firms to adapt and thrive amid technological change (Shrader & Siegel, 2007). In modern firms, skilled employees serve as key drivers of innovation and knowledge transfer, forming the backbone of firms' technological performance (Nelson, 2003; Faems & Subramanian, 2013). Their education and capabilities underpin sustained competitive advantage (Barney, 1991; Warhurst et al., 2004). As a form of technological innovation, DF

accelerates firms' digital adoption, thereby raising the demand for highly educated and skilled labour (Liu & Hou, 2023; Dou et al., 2023). To compete for such talent, firms increasingly adopt employee-friendly policies to enhance participation and reduce turnover, consistent with efficiency wage theory (Akerlof, 1982). Moreover, by easing financial constraints, DF enhances firms' capacity to invest in human capital and improve employment conditions (Mu et al., 2023).

We therefore adapt three mediation measures to test this argument: corporate digital transformation (*DT*), practise of artificial intelligence inside firms (*AI*) and proportion of high-skilled employees (*Skill*). The index of corporate digital transformation (*DT*) is retrieved from the CSMAR database[14]. This index measures the level of DT in the firms; the higher the index, the higher the level of DT. Then, to better capture the firm digitalization relating to human capital, we develop textual analysis in Python on corporate textual disclosures in annual reports to find key words related to artificial intelligence. Consistent with the literature (e.g. Tang et al., 2023), we exclude the "Management Discussion and Analysis" (MD&A) sections of listed firms' annual corporate reports as they mainly disclose firms' strategies and future prospects, not their daily activities. Finally, the total word frequency is calculated and adapted as our proxy of firm practices with respect to artificial intelligence (*AI*). Last, we collect employee education information and define skilled labour (*Skill*) as the proportion of employees who have a bachelor's degree or higher in a firm, following Dai et al. (2017).

To test our conjectures, we conduct the mediation analysis using the approach followed in the finance literature (e.g. Xiong et al., 2021; Wheeler, 2019), namely the Sobel test (Hayes, 2009).

[14] The corporate digital transformation index of Chinese listed firms is derived from CSMAR's Digital Transformation Research Database. The database contains systematic measurements of strategic leadership, technology drive, organisational empowerment, environmental support at the macro level, enterprise digitalisation achievements and applications, which ultimately constructs the evaluation system of the digital transformation index. Using textual analysis to calculate the frequency of words related to digital transformation in listed firms' annual reports is a practical and scientific approach to assessing the extent of corporate digital transformation, currently employed in the literature (e.g. Chen et al., 2023; Tang et al., 2023).

Table 4.12 presents the results in relation to the predictions. First, we rerun the baseline regression and results are reported in the first column of each panel. The effect of DF on three mediation factors are presented in the second column of each panel. Results reveal that DF promotes corporate digital transformation, simulates the practice of artificial intelligence and increases the proportion of high-skilled employees within firms. Then the impact of DF on corporate employee treatment (*ET*) after controlling *DT*, *AI* and *Skill* are tested, and the results are presented in columns (3) in each panel. The coefficients of DF after controlling all three channel variables are still significantly positive but all lower than those without the controls in columns 1, as expected. In addition, the Sobel test is conducted to test the indirect effect of DF on employee treatment through the three variables. The Sobel test statistics are significant across all panels. Overall, the results suggest that DF promotes better corporate employee treatment through the adoption of corporate digital transformation and the increasing demand for high-skilled talents.

Table 4.12. Further test – Trend of corporate digital transformation and increasing demand for high-skilled labour

Panel A. Corporate digital transformation			
	(1)	(2)	(3)
Variables	ET	DT	ET
DF	0.014**	0.073***	0.012**
	(2.214)	(6.162)	(2.139)
DT			0.035***
			(3.803)
Constant	0.883***	-0.041	0.763***
	(23.250)	(-0.629)	(22.677)
Observations	12,421	12,421	12,421
Control	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Indirect effect through DT			0.003
Sobel test for indirect effect			3.661***
Adj. R^2	0.180	0.451	0.181
Panel B. Practice in artificial intelligence			
	(1)	(2)	(3)
Variables	ET	AI	ET

DF	0.014**	0.328***	0.014**
	(2.214)	(3.946)	(2.375)
AI			0.002*
			(1.665)
Constant	0.883***	-0.545	0.598
	(23.250)	(-1.224)	(1.558)
Observations	12,421	12,421	12,421
Control	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Indirect effect through AI			0.001
Sobel test for indirect effect			1.775*
Adj. R^2	0.180	0.203	0.176
Panel C. Demand for high-skilled labour			
	(1)	(2)	(3)
Variables	ET	Skill	ET
DF	0.014**	0.213***	0.012**
	(2.214)	(8.755)	(2.189)
Skill			0.010**
			(2.106)
Constant	0.883***	-0.370***	0.764***
	(23.250)	(-2.920)	(22.648)
Observations	12,421	12,421	12,421
Control	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Indirect effect through Skill			0.002
Sobel test for indirect effect			2.095**
Adj. R^2	0.180	0.433	0.181

This table reports results of the trend of corporate digital transformation, adaption of AI technology and increasing demand for high-skilled employees. All variables are defined in the Appendix. Robust *t*-statistics are reported in parentheses. The symbols ***, **, and * denote significance level at the 1%, 5%, and 10% levels, respectively.

4.6. Conclusion

This paper examines the impact of DF on firm's employee treatment using a panel of Chinese listed firms from 2011 to 2020. Our main results indicate that firms headquartered in a city with better DF development tend to engage in better employee treatment. A series of robustness tests using the PSM and EB approaches, the forward value of employee treatment measurements and the sub-categories of the DF index, show the baseline results remain consistent. To mitigate the endogeneity issue, we use the geographic distance from the firm's

headquarters to Hangzhou, a centre of DF in mainland China, and the historical fixed-line phones users in 1984 to construct two DF's IVs and our main results hold.

We further demonstrate that the positive impact of DF on employee treatment operates through two main mechanisms: the alleviation of firms' financial constraints and the enhancement of information transparency. By easing access to capital and improving the flow of information, digital finance enables firms to allocate more resources toward employee welfare and adopt more transparent, trust-enhancing practices, thereby strengthening their ability to attract and retain talent. Moreover, the positive relationship between DF and employee treatment is more prominent in disadvantaged firms located in the regions with lower marketization levels and regions with severe air pollution, where attracting and retaining talent is more challenging. We also find government support and good corporate governance are important factors that strength the positive relationship.

Finally, we examine the impact of DF development on corporate digital adoption and employment structure. The results show that greater DF adoption is associated with enhanced corporate digital transformation and a higher share of high-skilled workers. This evidence underscores the complementary relationship between technological advancement and workforce upgrading, highlighting the importance of human capital investment for sustaining both firm competitiveness and employee development in the digital economy. Overall, our study provides novel evidence that DF plays a pivotal role in shaping firms' human capital strategies and employee treatment policies, offering important implications for both corporate management and labour market policy.

4.7. Appendix A1. Variable definitions

Variables	Definitions
Independent variable	
DF	The index of digital finance of the city in the year divided by 100.
Dependent variables	
ET	Employee treatment, measured as employee health and safety index of a firm in the year divided by 100, which is obtained from Huazheng ESG database.
Compensation	Employee Compensation, measured as the natural logarithm of the total average employee compensations, which is calculated as the total salary expenses for all employees minus that of management, divided by the total number of ordinary employees following Dong et al. (2020).
ES	Employee score, measured as employee treatment index of a firm in the year, which is obtained from Hexun CSR database.
Control variables	
Firm Size	The natural logarithm of total assets of a firm.
Firm Age	The natural logarithm of listing age of a firm.
Leverage	Total debt divided by total assets.
Concentration	Top one shareholding, which is the largest shareholding.
Q	Tobin's Q, measures as the ratio of market value and book value of total assets.
ROA	Return on assets, measured as net income divided by total assets.
Growth	Annual sales growth rate of a firm.
SOE	Dummy variable equal to 1 if the firm is state-owned, and 0 otherwise.
Independence	The number of independent directors as a percentage of total number of board directors.
Board Size	The natural logarithm of the total number of directors on the board.
Duality	Dummy variable equal to 1 if a firm's CEO is also the chairman of the board, and 0 otherwise.
EmChange	Annual change rate of total number of employees.
Marketization	Fangang marketization index, the higher the index, the higher the marketization of provinces.
Unemployment	The unemployment rate of the province.
GDP Growth	The annual GDP growth rate in a province during the fiscal year.
Other variables	
IV-Distance	Instrumental variable, calculated as the interaction term between the mean of the DF index at the national level (except for the specific city) and the distance to Hangzhou city.
IV-Intel	Instrumental variable, measured as the interaction term between the number of Internet users in year t-1 at the national level and the number of fixed-line phones per 100 people per city in 1984.
KZ index	A measure of financial constraint as per Kaplan and Zingales (1997). A firm with a high KZ index is considered more financially constrained.
WW index	A measure of financial constraint as per Whited and Wu (2006). A firm with a high WW index is considered more financially constrained.
IT	Information transparency, measured as information transparency index of a firm in the year, which is obtained from CSMAR database
ID	Information disclosure, measured as information disclosure index of a firm in the year, which is obtained from Huazheng database
AQI	Air quality index, which is the natural logarithm of the average daily AQI (the concentration level of six atmospheric pollutants, namely, SO_2, NO_2,

	PM_{10}, $PM_{2.5}$, CO, and O_3) for a given year and city. The higher the AQI, the heavier the air pollution the city has.
MA	Managerial ability, the proxy of the ability of the managerial team, which is constructed as per Demerjian et al. (2012).
DT	Index of corporate digital transformation, obtained from CSMAR, the higher the index, the higher level of digital transformation within firm.
AI	Artificial intelligence index, measured as the total frequency of artificial intelligence technology words in the annual report after excluding MD&A content.
Skill	The proportion of skilled labour, which is the number of employees who have a bachelor's degree or higher divided by the total number of employees in a firm.

Appendix A2. Balanced tests after PSM

Variables	Sample	Treated	Control	%bias	bias	*t*-statistics	p>t
Firm Size	Unmatched	22.199	22.323	-10.7		-4.84	0.000
	Matched	22.187	22.191	-0.3	97.0	-0.11	0.915
Firm Age	Unmatched	2.828	2.876	-15.0		-6.81	0.000
	Matched	2.872	2.861	3.4	77.1	1.07	0.283
Leverage	Unmatched	0.403	0.399	2.5		1.13	0.257
	Matched	0.389	0.392	-1.2	50.2	-0.40	0.692
Concentration	Unmatched	0.332	0.323	6.7		3.04	0.002
	Matched	0.323	0.324	-0.5	92.3	-0.17	0.868
Q	Unmatched	2.194	2.077	9		4.08	0.000
	Matched	2.148	2.162	-1.1	87.4	-0.35	0.725
ROA	Unmatched	0.055	0.053	3.1		1.40	0.160
	Matched	0.054	0.056	-2.6	17.2	-0.80	0.426
Growth	Unmatched	0.203	0.187	3.9		1.79	0.073
	Matched	0.198	0.194	0.9	76.3	0.29	0.775
SOE	Unmatched	0.204	0.324	-27.6		-12.54	0.000
	Matched	0.222	0.221	0.2	99.2	0.08	0.939
Independence	Unmatched	0.379	0.372	13.7		6.22	0.000
	Matched	0.373	0.373	0.6	95.6	0.19	0.849
Board Size	Unmatched	2.100	2.136	-18.5		-8.39	0.000
	Matched	2.116	2.119	-1.3	92.8	-0.44	0.663
Duality	Unmatched	0.341	0.258	18.3		8.32	0.000

	Matched	0.312	0.314	-0.4	97.5	-0.14	0.890
EmChange	Unmatched	0.123	0.098	7.3		3.32	0.001
	Matched	0.103	0.107	-1.4	81.3	-0.44	0.659
Marketization	Unmatched	10.431	9.487	79.9		36.31	0.000
	Matched	10.201	10.196	0.4	99.5	0.13	0.894
Unemployment	Unmatched	2.842	3.095	-54.7		-24.85	0.000
	Matched	2.930	2.923	1.6	97.1	0.46	0.644
GDP Growth	Unmatched	0.084	0.077	17.4		7.90	0.000
	Matched	0.086	0.086	-0.3	98.5	-0.09	0.928

Appendix A3. Comparison of means before and after entropy balancing

	Before entropy balancing			After entropy balancing		
Variables	Treatment (n=6,185)	Control (n=6,236)	Diff	Treatment (n=6,185)	Control (n=6,236)	Diff
Firm Size	22.340	22.380	0.040*	22.340	22.340	0.000
Firm Age	2.821	2.880	0.059***	2.821	2.821	0.000
Leverage	0.406	0.412	0.005	0.406	0.407	0.000
Concentration	0.339	0.332	-0.007***	0.339	0.339	0.000
Q	2.183	2.042	-0.141***	2.183	2.183	0.000
ROA	0.054	0.051	-0.003***	0.054	0.054	0.000
Growth	0.196	0.180	-0.015**	0.196	0.196	0.000
SOE	0.273	0.372	0.099***	0.273	0.274	0.000
Independence	0.380	0.372	-0.008***	0.380	0.380	0.000
Board Size	2.108	2.143	0.035***	2.108	2.108	0.000
Duality	0.324	0.238	-0.085***	0.324	0.323	0.000
EmChange	0.123	0.092	-0.031***	0.123	0.123	0.000
Marketization	10.310	8.913	-1.399***	10.310	10.310	0.000
Unemployment	2.709	3.188	0.478***	2.709	2.710	0.000
GDP Growth	0.086	0.073	-0.013***	0.086	0.086	0.000

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CHAPTER FIVE

ESSAY THREE

This chapter introduces the third essay of the thesis, which investigates the impact of digital finance on birth rates within a broader socio-economic context.

How does digital finance impact birth rates: Evidence from China

Abstract

Digital finance (DF), the integration of tradition financial services and new information technology, has been shown to have various impacts in social behaviour. However, how DF affects people's fertility behaviour is still under investigation and worth exploring from the point of view of long-term economic growth. By employing a DF index, publicly available city-level birth rates in 287 Chinese cities, we find DF has a negative influence on birth rates. This finding is supported by endogeneity and several robustness tests. Mechanism tests show DF increases investment opportunities and therefore reduces the need of having children for support in old age. DF increases consumption and possibly individualism and also increases women's economic independence and their opportunity cost of having children, leading to lower birth rates. Given the development of DF is an inevitable trend, we further find that out of the three components of DF index measures, the coverage of DF significantly decreases birth rates, while the higher level of DF development, depth and digitalization, have much less negative impact on birth rates. Finally, this negative impact can be moderated when governments make policy efforts to increase educational and medical resources and provide protection of religion. This paper provides a novel perspective on the influence of DF on social behaviour through DF's direct impact on investments, consumption and income.

Keywords: Digital finance, birth rate, investments, individualism, government policy

JEL classification: D10, G50, J13, O33

"It's not a faith in technology. It's faith in people."

- *Steve Jobs*

5.1. Introduction

With the deep integration of information technology and traditional finance, digital finance (DF) has developed rapidly in recent years, especially in China. This new finance technology is gradually becoming an integral part of China's financial system (Mu et al., 2023). At the same time, the low birth rate and the disappearance of the demographic dividend are becoming serious problems for the Chinese economy (Peng, 2011). Boserup's (1976) theory of the demographic transition emphasizes the crucial importance of endogenous technological shifts in population change. For example, Dettling (2017) finds that high-speed internet use leads to a 4.1 percentage point increase in labour force participation for married women, which in turn shapes fertility decisions. Also, Billari et al. (2020) find that mobile phone acquisition is associated with reductions in family size and reduces the demand for children through role change from family-oriented to career-oriented and preference changes. Given China's serious fertility dilemma and the gradual prevalence of digital financial services, it is important to explore whether financial technology has an impact on birth rates.

DF is the organic integration of traditional finance services and new technology science (Wu, 2023). According to the research report released by the Institute of Digital Finance Peking University, China's DF business has grown by leaps and bounds between 2011 and 2020, with the median value of the provincial DF index at 33.6 in 2011, growing to 214.6 in 2015, and further to 334.8 in 2020. The median value of the DF index at the provincial level in 2020 is 10 times higher than that of 2011, and the index value is growing by 29.1% per year on average. The above statistics show the rapid development trend of DF in China[15].

[15] Data is publicly available from https://idf.pku.edu.cn/yjcg/zsbg/513800.html

Studies have found DF can increase financial service coverage and financial products for investors, thus providing alternative investment opportunities and insurance for households to secure their future (Ji et al., 2021). Also, DF could ease liquidity constraints and boost consumption (Zhu et al., 2023) and possibly increases individual instant satisfaction and adherence to individualistic values (Preston, 1986; Sun & Ryder, 2016). Third, DF is an innovative financial tool that could increase the possibility of people, especially vulnerable groups such as women, benefiting from financial services; and could help women participate in entrepreneurship and financial markets and have access to more financial resources at lower cost, which gives women a stable income and equal status in the family (Han et al., 2023). However, papers have seldomly linked these impacts (the changing economic behaviour of households and family's structure) to further fertility decisions.

Since 1949, China has recognised the importance of population as a factor contributing to productivity, and thus fertility was encouraged. This provided a huge demographic dividend for China's development in the wake of reforms and the opening-up policy (Fang et al., 2018). However, with the emergence of overpopulation, unemployment and related social problems, China began to implement a one-child policy in 1982. In 2015, because of low birth rates, China liberalised its one-child policy and began implementation of the two-child policy. According to the National Bureau of Statistics of China (NBSC), birth rates after the liberalisation of fertility policies were only 12.64‰ in 2017, compared with 16.57‰ in 1997. Recent figures from NBSC have raised even more concerns. Birth rates in 2020 in China were 8.52‰, falling below 10‰ for the first time. In 2022, the natural population growth rate was -0.60‰, turning negative for the first time, and China dropped from first to the second largest country in terms of population. According to the latest data for 2023, the rate continues to fall and has dropped to -1.48‰.

Previous evidence shows that DF improves financial services and products, increases consumption, and increases women's economic independence (e.g. Ji et al., 2021; Liu & Hu et al., 2013; Han et al., 2023), while on the other hand these positive direct economic impacts could potentially negatively impact social behaviours such as birth rates, and therefore harm economic development from a long run perspective. We predict that DF may have a negative impact on birth rates through reduced fertility willingness for the following three reasons.

First, increased investment opportunities could lead to a decrease in the birth rate as there is less need to rely on children as a form of old-age security (Lan et al., 2023). Second, DF increases consumption and individualism, and we suggest this may reduce people's willingness to have children, as predicted by the theory of planned behaviour (Ajzen & Klobas, 2013), as the spread of secular individualism weakens people's long-term planning behaviour including fertility willingness (Luo & Mao, 2014; Sun & Ryder, 2016). Third, as society assigns to women the major responsibility of raising children, fertility is costly to women (Grossbard-Schechtman & Mincer, 2003) and exacerbates inequalities in the family. An increase in time and energy invested in having children reduces the corresponding effort expended on paid work, which has a negative impact on women's career development and reduces their economic independence. DF would give women more opportunity for economic gain and at the same time increase the opportunity cost of women having children. DF provides women with more bargaining power (Han et al., 2023) due to increasing economic independence that enables them to choose to work on career development rather than raising children.

In this study, we develop a model to empirically examine the relationship between DF and birth rates using a panel of data on 287 cities in China. We primarily choose China in our research setting due to the following considerations. First, data availability in China is a huge advantage. Benefiting from the DF index published by the Peking University, we can easily measure the adoption of financial technology at the macro level in China. Second, as one of the fastest-

growing economies in the world, China exemplifies both the rapid rise of DF and the significant decline in birth rates, and many other countries are experiencing one or both of these trends. Studying China provides valuable insights on the relationship between digital finance and fertility trends which may be of interest to other markets, with similar trends of fast development of DF or pronounced decline in birth rates or both; and provide the policy implications. Last but not least, the role of DF in promoting women's economic independence and bargaining power (Han et al., 2023) may change family structures and have significant economic impacts. Similar dynamics may also exist in other countries, especially in emerging economies, where rapid financial digitalization reshapes household structures.

In our paper, we find that DF has a negative effect on birth rates in lagged, current and forward periods. To address potential endogeneity concerns, we introduce the 2SLS-Instrumental Variable (IV) approach. Previous literature has shown that the distance from a given city to Hangzhou is a good IV for DF (e.g. Zhu et al., 2023), as Hangzhou is the birthplace of Alipay, which is a leader in DF development in China. However, distance does not change over time, which invalidates the second-stage estimation as an instrumental variable. Following Zhang et al. (2020b), we therefore interact the instrumental variable with the mean of the DF index at the national level (except for the specific city) as a new instrumental variable with time-varying effects to capture the exogenous variation in DF. Second, given the strong relationship between communication infrastructure and the development of DF (Chen & Zhang, 2021), we use the number of Internet users in year *t-1* times the number of fixed-line telephones per 100 people per city in 1984 as the second IV in the model[16]. The IV-2SLS test results are consistent with our baseline findings.

[16] We thank an anonymous reviewer for this recommendation.

The biggest challenge of this study is to explain how DF could impact birth rates. We explore several potential channels and conduct heterogeneity analysis based on the financial institution coverage and commercial insurance purchases; consumption level and ethnic groups; disposable income level and gender equality. The empirical results show that the baseline negative relationship is more pronounced when financial institutions' coverage and insurance purchased are high, indicating that wider use of financial services and financial products could reduce the need for children to financially support their parents in their old age. Second, DF decreases birth rates more significantly in areas with higher consumption and in non-ethnic minority areas[17]. High consumption could lead to individualism (Ahuvia, 2002) and weaken people's long-term fertility planning, while non-ethnic minority areas are more likely to be affected by individualism, as traditional values are weaker and one-child policy was strictly implemented in these areas. Third, the negative impact of DF on birth rates is more pronounced in more developed areas with a higher disposable income and areas with more gender equality, where women would have more economic independence, a higher opportunity cost for fertility and a stronger voice. In this case, more women would choose to have no or fewer children. The heterogeneity test results further deepen our understanding of the relationship between DF and birth rates and its underlying mechanisms.

Taking advantage of a DF index ranking system, following Ren et al. (2023), we further investigate the different impacts of the sub-categories of DF on birth rates. We find that although DF coverage that represents a significant degree of penetration or popularity significantly decreases birth rates, further development of DF depth and digitalization has a

[17] There are 56 ethnic groups in China, of which the Han group makes up the vast majority, while the remaining 55 ethnic groups account for less than 10 % of the total population and are known as ethnic minorities. The ethnic people mostly live in the western provinces.

less negative impact on birth rates. These findings hint at a positive message that further developments in DF depth and digitalization would not reduce birth rates significantly.

Finally, we explore the factors that could moderate the negative relationship between DF and birth rates, given DF development is a non-stoppable trend. As proposed in the socioeconomic theory, restricted fertility is a means to enhancing children's chances of social upward mobility (Greenhalgh, 1988). Fertility is considered to be a type of investment and families could face high pressures in relation to child-raising (Lin & Kamo, 2015). We provide empirical evidence that the government's efforts to reduce the burden of raising children through increased educational and medical support and to protect people's fertility willingness by protecting religious belief, could moderate the negative effect of DF on birth rates.

The novelty of this paper lies in its comprehensive approach to examining how DF affects birth rates and providing an integrated analysis that bridges policy intervention and cultural dynamics, offering a more holistic understanding of fertility. Close to our study, Xie et al. (2025) use the data obtained from the China Household Finance Survey (CHFS) to study the impact of DF on family size and the age at first childbirth. They find DF has a modest positive impact on the household fertility rate. The variable of fertility is measured as the total number of unmarried children in a household, and they argue that a higher number of unmarried children indicates a greater fertility intensity within the household. While it is valuable to use household survey data in Xie et al. (2025), we question the accuracy of using the number of unmarried children in a household as a measure of fertility intensity. The age of unmarried children varies from 0 to over 30 in general, given the low marriage rate and the delay of the age of entering a marriage in China (Wrenn et al., 2019)[18]. When we investigate the impact of DF, which has

[18] The study "Postponement of Marriage and Childbearing in China during 1990-2020: Trends and Characteristics" examines national census and sampling survey data to explore the patterns of delayed marriage and childbirth. According to the findings, the average age at first marriage in China rose from 22.87 years in 1990

been a new development in the last 15 years, on fertility, the time period of DF development (last 15 years) and number of unmarried children (last 30 years) will not exactly match. The number of unmarried children is affected by the preference of the age of getting married or that of whether to marry or not as well. Therefore, the positive association between DF and the number of unmarried children in a household in Xie et al. (2025) might be an indication of the positive relationship between DF and the age of marriage, rather than that between DF and fertility rate. In addition, Lan et al. (2023) use provincial-level fertility data and find DF leads to higher fertility intentions. However, the variations of provincial-level fertility data are not as rich as city-level fertility data in our study. To our knowledge, we are the first to test the impact of DF on fertility behaviours using city-level birth rates in China. Our approach employs the city-level birth rate data, which we consider to be a more economically meaningful and comprehensive reflection of fertility trends (Gauthier & Hatzius, 1997).

This study contributes to the literature in the following ways. First, as DF continues to evolve rapidly, its influence could extend beyond economic activities to broader social behaviours. Previous evidence shows that DF improves financial services and products, increases consumption, and increases women's economic independence. However, these positive direct economic impacts could potentially negatively influence social behaviours such as birth rates, and therefore harm economic development from a long run perspective. Policy makers need to be aware of the potential challenges related to fast development of DF, and understanding its impact on birth rates is both academically valuable and policy relevant. To the best of our knowledge, we are the first to examine the impact of DF on birth rates at the city level in China.

to 28.67 years in 2020. Additionally, the proportion of unmarried individuals at age 30 grew significantly over the past three decades. While only 4.82% of people remained unmarried at 30 in 1990, this figure surged to 21.75% by 2020, reflecting a notable change in marriage patterns.
https://www.chinadaily.com.cn/a/202310/16/WS652ca3daa31090682a5e8c09.html?utm_source

Our study provides a new perspective for understanding the impact of DF on social behaviour and long-term economic development and is a timely addition to the literature in this field.

Second, though empirical evidence shows DF reduces birth rates, our findings show policies such as increased government investment in healthcare and education recourses and protection of religious belief can mitigate the negative impact of DF on birth rates. Our evidence also shows that the first level of DF development (coverage) has the most negative impact on birth rates, while the further development of DF in terms of depth and digitalization has a much weaker negative impact. Our study highlights the importance of government medical and education support, freedom of religious belief and a shifting policy focus in DF development from coverage to depth and digitization on mitigating the negative impact of DF on birth rates. These findings have impactful policy implications with respect to fertility encouragement and further DF development.

The structure of this paper is as follows. Section 2 reviews the relevant literature and theoretical background and presents the hypotheses. Section 3 introduces the design of the research, including data, sample construction and empirical models. Section 4 describes the empirical results, and we make conclusions and discuss the policy implications of this study and potential future research in Section 5.

5.2. Literature review, theoretical background and hypothesis development

5.2.1. Digital finance and its impacts

Researchers have conducted a large number of studies on DF and its impact (e.g. Wu, 2023; Xiao et al., 2023). At the macro level, Ren et al. (2023) show that DF promotes industrial structure upgrading through innovation, entrepreneurship and the structure of household consumption, for example through more expenditure on services and goods such as healthcare and entertainment. Regional economic resilience (RER) is a hot topic after COVID, that studies

how an economy can cope with external shocks and promote sustainable development (Kass-Hanna et al., 2022). Yu et al. (2023) show that DF not only strengthens local RER but also has a positive impact on neighbouring areas with positive spatial externalities. Moreover, digital technologies can break down geographical boundaries and generate utility spillover across regions. Environmental sustainability is also a characteristic of digital technology; it has been shown that DF decreases air pollution and carbon intensity through the adoption of online services and systems (Wang & Guo, 2022; Lee & Wang, 2022).

In terms of corporate finance, previous literature finds DF to be advantageous in improving firms' ESG performance by mitigating financial constraints within firms in China (Mu et al., 2023). The effect is more pronounced in non-state-owned enterprises (non-SOEs), small-sized firms and firms located in the central and western regions. In terms of firm resilience, Xia et al. (2022) show that firms located in regions with higher levels of DF experienced fewer losses and recovered more quickly from the COVID-19 pandemic, since DF helped firms by facilitating access to external financing and reducing financing costs. Xia et al. (2022) also document the positive effect is more significant in small firms and non-SOEs. Other studies such as Ding et al. (2022) find DF fosters firms' innovation performance by stimulating digital transformation of firms and improving innovation efficiency (Wang & Liu, 2024). DF also diversifies bankruptcy risk by improving firm information transparency and moderating financial leverage (Ji et al., 2022).

While most of DF impacts at the macro level and corporate levels are positive, its impact at the micro level is mixed. On the one hand, there have been many explorations of the impacts of DF at the micro level, such as promoting personal consumption (Li et al., 2020a) and stimulating household online purchases (Zhu et al., 2023). DF provides great convenience for shopping by improving payment convenience and easing credit constraints, which has reshaped an emerging consumer model (Setiawan et al., 2022). More importantly, evidence has been

found that DF could improve household income and encourage investment participation by reducing the cost and expanding the channels of financial services (Ji et al., 2021; Li et al., 2020a). DF can easily overcome the shortage of traditional financial services and effectively penetrate areas where traditional services are under-supplied (Shen & Ren, 2023). A recent study by Han et al. (2023) shows that, because of its inclusiveness, DF can enhance women's bargaining power and alleviate intra-household inequality, because women are able to participate in financial markets at a lower cost and their financial situation is improved. They also show that DF encourages women's entrepreneurial behaviours, which enhance their bargaining power and status. On the other hand, Meng and Xiao (2023) find that taking advantage of DF, consumers' undesirable borrowing and spending behaviours boom, which are negatively associated with their happiness because of the consequent heavy debt burden.

5.2.2. Birth rate and its determinants

The extant literature (e.g. Yang et al., 2022; Lin & Kamo, 2015) finds that birth rates are affected by economic development and levels of education. Also, the increasing participation in the labour market has further intensified the competition for jobs, which in turn erodes people's free time. Increasing competitive pressures and physical pain make child-raising less attractive to the younger generation (Yang et al., 2022). Furthermore, education has a critical impact on fertility, especially for women. With higher education, the price of child-raising increases for women due to higher opportunity costs because of the sacrifice of career development (Lin & Kamo, 2015). Also, when women have more resources, due to higher educational and occupational attainment, they have more income and opportunities, so the appeal and fulfilment of marriage and parenthood is significantly reduced (Blair & Madigan, 2021). In addition, Zhang and Goza (2006) show that the rising proportion of older people has an impact on the fertility choices of newlyweds.

Birth rate levels largely rely on fertility intentions (Ajzen & Klobas, 2013), since the intentions affect a couple's planning process in their life cycle. Luo and Mao (2014) discuss the discrepancy between fertility intention and fertility behaviour in terms of the Theory of Planned Behaviour (TPB), and discover people tend to think rationally and practically when making child-raising decisions in the face of modernization. Attitudes concerning intimate relationships within modernized societies are more likely to reflect developmental idealism and place greater emphasis upon such qualities as prompt individual satisfaction, attention to personal needs, and the expression of self (Blair & Madigan, 2021). Technology also affects birth rates. For example, evidence has been found that internet and mobile phone usages shapes fertility decisions by increasing women's labour market participation (Dettling, 2017; Billari et al., 2020). It is thus reasonable to expect that DF as a new technology may affect people's fertility decisions.

5.2.3. Hypothesis development

On one hand, DF may stimulate fertility and increase birth rates. The information asymmetry theory (Aboody & Lev, 2000) refers to a situation where one party in an economic transaction has more or better information than the other party. This often leads to inefficient outcomes in markets because the less-informed party cannot make fully rational decisions. It helps explain how DF reduces financial uncertainty by improving income and financial services information, potentially influencing household fertility decisions. By lowering barriers to financial information and access, DF can reshape individuals' expectations about future income and economic security. Second, digital platforms make it easier for families to access government subsidies, healthcare support, or maternity benefits. Thus, better information flows reduce the cost and uncertainty associated with accessing these resources, which in turn may increase their willingness to have children and increases overall birth rates in the long run. Lan et al. (2023) find that digital financial inclusion can enhance household income, lower financial service

costs, and ease liquidity constraints. Thus, the cost of child-raising will be decreased, leading to higher fertility intentions, especially for financially disadvantaged families. Therefore, we propose the following hypothesis:

H1a: DF has a positive impact on birth rates.

On the other hand, DF may decrease birth rates for the following reasons. First, DF provides alternative investment opportunities for households trying to secure their future. Taking advantage of DF, households have easier access to financial markets and enjoy the services at a lower cost. Li et al. (2020a) find that DF can help households find better ways to secure themselves financially, such as buying financial products and commercial insurance, as DF breaks down the geographical barriers of the offline mode and improves accessibility to insurance services. Increased financial services and products provided by DF would reduce birth rates, as there is less need to rely on children as a form of old age financial security.

Second, according to the financing constraint theory (Hall et al., 2016), individuals may face limitations in accessing external funds due to information asymmetries, or underdeveloped financial markets. These constraints lead to limited future investment and suboptimal decisions. DF can ease liquidity constraints (Li et al., 2024a) by improving access to credit. However, greater financial flexibility does not always translate into greater economic benefits (Hottenrott & Peters, 2012) and reduced liquidity constraints may over-simulate consumption and alter the household financial planning process, and it can also lead to greater financial burden and risk exposure (Meng & Xiao, 2023). The increased financial and debt burdens due to better financing ability may shift household priorities and discourage childbirth. Also, DF often comes with increased exposure to consumption aspirations (Li et al., 2020a) and potential social comparisons among households. This may raise the perceived cost of childrearing, as parents feel pressure to provide a higher standard of living for their children. In addition, the

excessive intermediate consumption caused by DF would induce a stronger sense of individualism and encourage immediate spending (Karlan & Zinman, 2010), leading to negative feelings about raising children in the long run and therefore lower birth rates.

Third, previous studies find that fertility hinders women's career advancement and financial freedom in the modern world (e.g. Ebenstein, 2010; Grossbard-Schechtman & Mincer, 2003), as they have to give up more working hours and job opportunities in order to raise and care for their children. This further exacerbates the unequal status of women in the family (Cherchye et al., 2009). A recent study by Han et al. (2023) finds that higher DF adoption contributes to higher participation by Chinese women in entrepreneurial endeavours and financial markets and thus improves women's economic strength and bargaining power and alleviates intra-household inequality. As women's career opportunities and participation in the labour market increases, they may forego having children, as raising children incurs high opportunity costs for women's income and social success (Grossbard-Schechtman & Mincer, 2003).

Based on the discussion above, we propose our second hypothesis:

H1b: DF has a negative impact on birth rates.

Relevant literature based on socioeconomic theory suggests that restricted fertility is a means to enhancing children's chances of social upward mobility (e.g. Greenhalgh, 1988). Raising children can be viewed as a type of investment (Lin & Kamo, 2015). As the standard of living rises, the dimension of household investment in children increases, including physical capital such as property, and human capital such as education and health (Bryant, 2007). Moreover, there is a lot of pressure on the couple to become "responsible parents" (Doherty et al., 1998). Previous literature points out that the long-term patterns of economic growth increase the socially constructed "costs" of raising children and the opportunity costs of pursuing a lifetime of responsible parenthood, producing a long-term fertility decline (Preston, 1986).

In addition, studies find that social norms have a significant influence on fertility intentions (Yu & Liang, 2022). The traditional Chinese culture emphasizes harmonious relationships with family compared to individualistic cultures, but regional differences in fertility culture also exist (He et al., 2019; Wang et al., 2022). Studies also find that people with religious beliefs place a higher value on the perpetuation of the family line (Wan et al., 2021).

We contend that government policies aimed at reducing fertility-related stress through enhanced access to educational and medical resources and promoting positive social norms around parenthood can effectively strengthen individuals' intentions to have children.

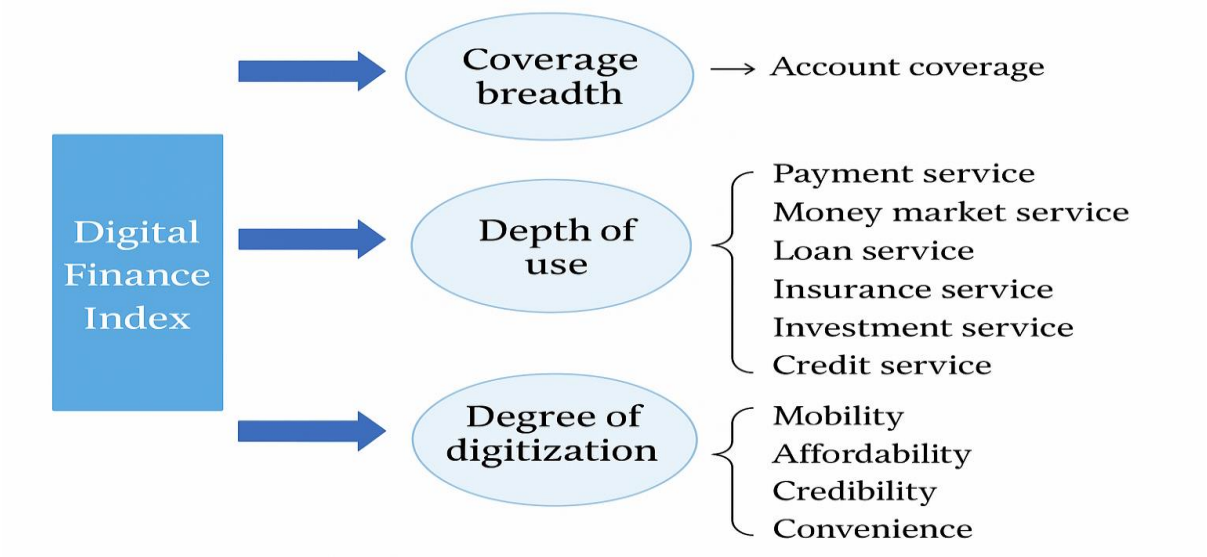
5.3. Research design

5.3.1. Data source, variables and summary statistics

Taking the advantage of the announcement of birth rates of Chinese cities in the 2017-2019 Statistical Yearbook[19], panel data on 287 Chinese cities is used as the basis of the sample. The city level birth rate information is obtained from the Statistical Yearbook of Chinese cities. The main independent variable, the DF index, is published by the Peking University and has been widely used in many empirical studies (e.g. Mu et al., 2023). The ranking system of the DF index consists of three second-level indices, namely the index of coverage breadth (*Coverage*), the index of use depth (*Depth*) and the index of degree of digitization (*Digit*). The breadth of coverage is reflected in the number of Alipay accounts owned and the number of bank cards per capita on the mobile phone applications. Coverage measures how widely DF is used. Depth of use measures the actual use of online financial services such as online payment, insurance, investment, credit loan and investigation services. Degree of digitization focuses on the higher mobility, affordability and convenience of digital financial services. Figure 5.1 depicts the construction of the DF index system.

[19] This city level data is publicly available in these three years.

Figure 5.1. The index system of digital finance



Existing literature finds that economic and social development provides more employment opportunities, which in turn inhibits fertility growth (Myrskylä et al., 2009). As shown in Carré et al. (2017), air pollution also decreases fertility. Martin (1995) uses evidence from 26 demographic and health surveys to show that education enhances women's ability to make reproductive choices and that highly educated women have the lowest fertility intentions. Also, shortage of medical resources and pressure resulting from providing elderly care exacerbates the decline in household fertility rates (e.g. Zhang & Goza, 2006). There is also evidence that children born to unmarried parents are discriminated against in China (Palmer, 1995). Moreover, reducing the cost of financial services and alleviating financial constraints can encourage fertility intentions (Lan et al., 2023). Additionally, the development of DF is influenced by the progress of the digital economy (Chen & Zhang, 2021). Thus, we introduce the following control variables: the level of marketization (*Marketization*), infrastructure level (*Road*), economic development (*GDP*), the rate of unemployment (*Unemployment*), air pollution level (*AQI*), regional education level (*Education*), medical bed facilities (*Bed*), aging population (*Elder*), marital status (*Unmarried*), the coverage of financial institutions (*Institution*), the scale of bank lending (*Loan*), the regional gender ratio (*Gender*) and the level

of development of the digital economy (*Internet*); definitions are provided in Appendix. These variables and other relevant data in the sample are retrieved from NBSC and the China Stock Market & Accounting Research database (CSMAR).

Table 5.1 shows the mean, standard deviation, minimum and maximum value, skewness and kurtosis of the main variables that we use to assess the distribution of the economic data (Andrei et al., 2010). The mean value of birth rate is 12.406‰, which is historically very low, reflecting the negative concepts of fertility of contemporary Chinese couples. The mean level of the DF index is about 2.335, with a standard deviation of 0.230, indicating the development of DF still varies greatly from city to city. The distributions of other control variables are consistent with previous findings (e.g. Shen & Ren, 2023; Han et al., 2023; Yang et al., 2023b). The final sample consists of 822 observations and we winsorize all city-year continuous variables at the 1st and 99th percentiles to mitigate the effect of outliers.

Table 5.1. Summary statistics

Variables	Obs.	Mean	Std.	Min	Max	Skewness	Kurtosis
Birth Rate (‰)	822	12.406	4.236	4.191	25.041	0.683	1.066
DF	822	2.335	0.230	1.935	2.979	0.635	0.384
Marketization	822	0.877	0.041	0.775	0.950	-1.526	8.310
Road	822	2.870	0.391	1.552	3.663	-0.532	1.417
GDP	822	10.577	0.842	8.245	12.165	-0.648	0.602
Unemployment	822	0.031	0.005	0.022	0.042	-0.001	-0.570
AQI	822	4.323	0.247	3.801	4.824	-0.073	-0.604
Education	822	8.540	0.580	6.480	9.388	-1.533	4.603
Beds	822	3.795	0.359	3.001	4.596	0.203	-0.036
Elder	822	0.167	0.034	0.103	0.238	-0.004	-0.633
Unmarried	822	0.184	0.332	0.133	0.268	0.730	0.125
Institution	822	1.649	0.302	1.154	2.345	0.700	-0.300
Loan	822	8.748	0.638	7.798	12.271	2.534	11.412
Gender	822	1.046	0.045	0.967	1.181	1.186	1.737
Internet	822	12.271	0.893	9.944	14.137	-0.383	0.210

This table shows summary statistics of main variables. Detailed definitions of variables are reported in the Appendix.

The heat maps in Figures 5.2 and 5.3 represent the average birth rate and DF index in each province of China[20]. The darker the colour, the higher the variable value. Provinces with higher birth rates (shown in red) are more concentrated in the southwestern regions, where minority ethnic groups reside. DF technology is more developed in the eastern coastal provinces (shown in blue). Overall, both figures indicate very large variations in the key variables across different regions.

Figure 5.2. Birth rate heat map of China

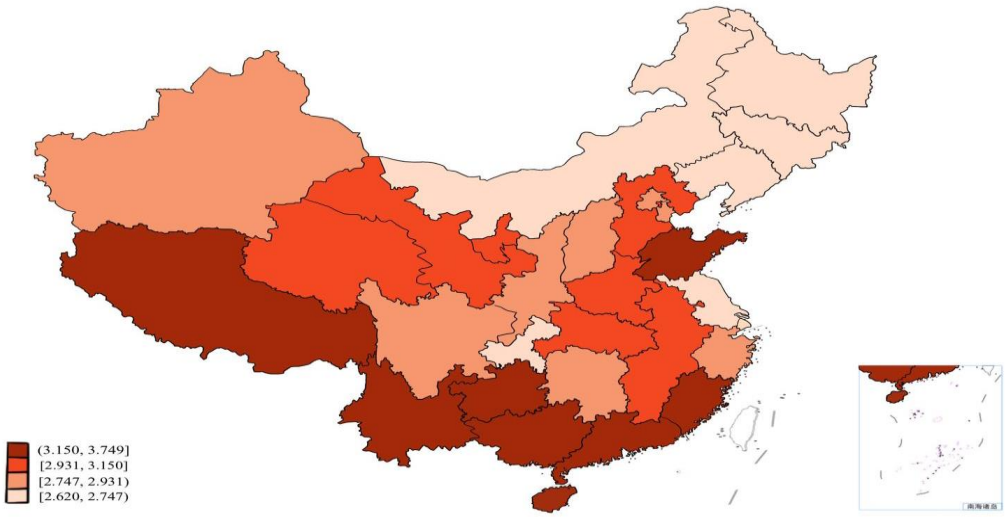
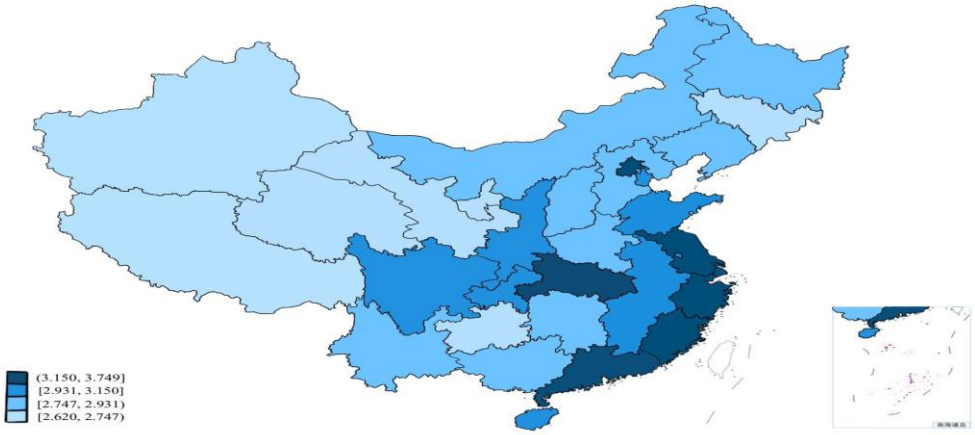


Figure 5.3. Digital finance index heat map of China



[20] Due to the data availability, we only include 27 provinces and 4 municipalities directly under the Central Government which are Beijing, Shanghai, Tianjin, and Chongqing.

Table 5.2. Correlation matrix and VIF test

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	VIF
1. DF	1.0000														4.45
2. Marketization	0.3940	1.0000													3.16
3. Road	0.1312	0.0367	1.0000												1.30
4. GDP	0.7702	0.1577	0.1326	1.0000											3.24
5. Unemployment	-0.3037	-0.2075	-0.1409	-0.1494	1.0000										2.24
6. AQI	0.0463	0.0530	0.1401	0.0208	0.0797	1.0000									1.47
7. Education	0.2716	0.6536	0.0343	0.1507	-0.1027	0.2458	1.0000								4.59
8. Beds	0.4894	-0.0795	-0.1987	0.5359	0.2066	0.0701	-0.0309	1.0000							2.63
9. Elder	0.0806	0.0884	0.1240	0.1174	0.2706	0.3212	0.3980	0.1215	1.0000						3.61
10. Inmarriage	-0.0425	-0.0231	-0.1510	-0.1046	-0.5386	-0.3352	-0.1747	-0.2023	-0.6935	1.0000					3.14
11. Institution	0.0155	-0.0663	-0.1064	0.0715	0.3871	0.0464	-0.1359	0.3277	0.0459	-0.3131	1.0000				1.90
12. Loan	0.3485	0.0445	-0.0728	0.3333	0.0039	-0.1252	-0.3375	0.2878	-0.1742	-0.0220	0.4985	1.0000			2.39
13. Gender	0.2318	0.3607	-0.0090	0.0571	-0.5291	-0.3532	0.1110	-0.2011	-0.6052	0.5913	-0.1975	0.0976	1.0000		3.31
14. Internet	0.4703	0.2733	0.1139	0.4510	-0.3176	-0.0644	0.5683	-0.0181	0.2673	0.0040	-0.2077	-0.1133	0.2250	1.0000	1.30

Furthermore, we check whether independent variables included in the same model are highly correlated. This step is fundamental because multicollinearity could bias estimated results. As shown in the **Table 5.2**, the highest correlation coefficient registered between two independent variables included in the same econometric model is reported between GDP and DF as 0.770. According to Batrancea et al. (2023), correlations below 0.8 indicate no multicollinearity issues. Following literature, multicollinearity is further investigated for each econometric model with the help of the variance inflation factor (VIF). In all cases, the VIF values are lower than 4, which is below the standard cutoff value of 10 suggested in the literature (Batrancea et al., 2022). Since there is no multicollinearity risk for our econometric models due to the low VIF values, we conclude that multicollinearity would not bias the econometric estimations.

5.3.2. Regression model settings

We develop the following regression model to estimate the impact of DF on birth rates:

$$BR_{i,t} = \beta_0 + \beta_1 DF_{i,t} + \beta_2 Control_{i,t} + city_i + year_t + \varepsilon_{i,t} \quad (6)$$

where the subscripts i and t represent city and year, respectively. BR represents the birth rate of city i in year t. DF represents the digital finance index in year t in the city i, which is measured by the level of digital finance development. $Control$ denotes control variables and ε is the random error term. We conduct the Lagrange Multiplier (LM) test, F test and Hausman test where we find that the panel data provides the best fit with a fixed effects model. We then control the year fixed effect and city fixed effect in the model. We also conduct the panel cointegration test and Im-Pesaran-Shin unit root test. Based on the current short sample period, time trend between variables cannot be effectively identified and our regression results are not driven by the cointegration, or an estimated panel data regression contains a unit root.[21]

[21] Results can be provided upon request. We thank an anonymous reviewer for advice of performing these tests.

5.4. Empirical results

5.4.1. Baseline regression analysis

Table 5.3 reports the results of the baseline regression. We estimate the regression between our explanatory variable and dependent variable in column (1) and then we add control variables in column (2). It can be clearly seen that the coefficients of DF are both significantly negative at the 1% level in columns (1) and (2), which indicates that DF has a negative impact on birth rates. In terms of economic significance, the results indicate that one standard deviation increase in DF development implies a 20.1% decrease in birth rates[22]. For robustness, we first introduce the forward value of the birth rate and columns (3) and (4) report the results. We also include the lag term of DF and present the result in columns (5) and (6). The coefficients of DF are again significantly negative. In terms of the control variables, and consistent with previous findings (e.g. Yang et al., 2022), we find the high unemployment rate, greater loan burdens and well-developed internet technology have a negative impact on the fertility rates. In addition, the ratio of males (more males in comparison to females) is also negatively related to birth rates. Overall, the baseline results indicates that there is a negative relationship between DF and birth rates, which is consistent with Hypothesis 1b.

Table 5.3. Baseline results

VARIABLES	(1) Birth Rate	(2) Birth Rate	(3) Birth $Rate_{t+1}$	(4) Birth $Rate_{t+1}$	(5) Birth Rate	(6) Birth Rate
DF	-10.856***	-10.938***	-9.792***	-5.669**		
	(-4.302)	(-3.535)	(-3.286)	(-1.988)		
L.DF					-9.792***	-9.070**
					(-3.286)	(-2.588)
Marketization		10.127		-27.320*		-11.232
		(0.811)		(-1.929)		(-0.896)
Road		0.386		-0.839		0.086
		(0.565)		(-1.615)		(0.118)
GDP		-0.163		-0.150		1.532

[22] To test the economic significance, we use the coefficient of DF obtained from regression analysis, the standard deviation of the DF index and mean of birth rates from summary statistics. The calculation is 10.856*0.23/12.406 = 0.201.

		(-0.574)		(-0.998)		(1.275)
Unemployment		-91.373**		-271.141***		-94.255*
		(-2.095)		(-5.728)		(-1.953)
AQI		-0.475		-1.889		0.331
		(-0.290)		(-1.423)		(0.121)
Education		-0.652		0.742		-0.635
		(-0.612)		(0.819)		(-0.379)
Bed		-0.045		0.284		-0.943
		(-0.032)		(0.248)		(-0.631)
Elder		-22.829		-22.837**		116.414***
		(-1.235)		(-2.555)		(3.577)
Unmarried		5.424		-13.561		9.555
		(0.472)		(-1.262)		(0.736)
Institution		-0.083		-1.742		1.607
		(-0.060)		(-1.325)		(0.679)
Loan		-3.530*		0.692		2.652
		(-1.924)		(0.485)		(0.725)
Gender		-7.256		-10.559**		4.061
		(-1.305)		(-2.170)		(0.522)
Internet		-1.779*		-2.945***		-2.740*
		(-1.967)		(-4.182)		(-1.916)
Constant	38.497***	38.759**	34.107***	81.798***	34.107***	18.879
	(6.851)	(2.087)	(5.146)	(4.958)	(5.146)	(0.368)
Observations	822	822	529	529	529	529
Adjusted R^2	0.878	0.882	0.909	0.926	0.909	0.923
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 5.3 shows the baseline results, controlling for regional fixed effects and time fixed effects. The dependent variables are city-level birth rates in columns (1), (2), (5) and (6) while the dependent variables are the forward value of city-level birth rates in columns (3) and (4). The independent variable is city-level total DF index in columns (1), (2) and one year lagged term in column (5) and (6). Detailed definitions of variables are reported in the Appendix. Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

5.4.2. Endogeneity

To avoid the possible reverse causality between DF level and birth rates, we adopt an instrumental variable (IV) approach. Previous literature has shown that communication technology, internet coverage and distance to Hangzhou are good IVs for digital finance (e.g. Mu et al., 2023; Yu et al., 2023). However, evidence also shows that internet and mobile phone use could reduce the demand for children (Dettling, 2017; Billari, 2020), and therefore we choose the distance from the city in our sample to Hangzhou as a potential instrumental

variable[23]. However, distance does not change over time, which invalidates the second-stage estimation as an instrumental variable. Therefore, following Zhang et al. (2020b), we interact the instrumental variable with the mean of the DF index at the national level (except for the specific city) as our first instrumental variable (*IV-Distance*) with time-varying effects. In addition, considering the strong relation between communication infrastructure and the development of DF, similarly to previous literature such as Chen and Zhang (2021), we introduce our second IV (*IV-Intel)* which is created as the number of Internet users in year *t-1* times the number of fixed-line telephones per 100 people per city in 1984.

Two-stage-least squares regression (2SLS) is employed in the model, and **Table 5.4** shows the results. In panel A, the F-value of *IV-Distance* is 113.125, which is much greater than 10, indicating the instrumental variable is not weak. In column (1), we report the results of the first stage regression. It is clear that the distance instrumental variable is significantly negatively related with DF, implying that the further away from the centre of DF, the lower the level of DF development. This is in line with expectations. The estimation results of the second stage shown in column (2), indicate the coefficient of fitted DF is still significantly negative at the 1% level, which is consistent with the baseline results.

Panel B of **Table 5.4** reports an F-value of 15.383 for *IV-Intel*, which exceeds the standard threshold of 10, indicating that the instrumental variable is sufficiently strong. Column (1) presents the results of the first-stage regression, showing a significantly positive relationship between the instrumental variable and DF. This suggests that the development of DF is closely associated with the widespread adoption of fixed-line telephone and internet technology, as

[23] Hangzhou is located in the eastern region of China and is the capital of the economically developed province of Zhejiang. Hangzhou is also the birthplace and headquarters of Alipay, which is a typical DF company and a leader in DF development in mainland China. Thus, Hangzhou is recognized as the centre of DF technology and has many IT and DF talents.

expected. The second-stage results, displayed in Column (2), indicate that the coefficient of fitted DF remains significantly negative at the 10% level, consistent with the baseline findings. IV-2SLS tests confirm the robustness of the baseline results.

Table 5.4. Endogeneity check – 2SLS

Panel A. Distance to Hangzhou as instrumental variable

	First Stage	Second Stage
	(1)	(2)
VARIABLES	DF	Birth Rate
DF		-12.465**
		(-2.017)
IV-Distance	-0.010***	
	(-3.911)	
Marketization	0.907***	14.307
	(3.129)	(1.058)
Road	0.006	0.380
	(0.618)	(0.919)
GDP	-0.009**	-0.188
	(-2.143)	(-1.054)
Unemployment	2.314***	-84.180**
	(3.565)	(-2.557)
AQI	0.031	-0.235
	(1.242)	(-0.223)
Education	-0.011	-0.769
	(-0.480)	(-1.041)
Bed	-0.003	-0.083
	(-0.124)	(-0.102)
Elder	0.049	-22.817**
	(0.217)	(-2.124)
Inmarriage	0.026	6.598
	(0.116)	(0.873)
Institution	-0.015	0.006
	(-0.344)	(0.007)
Loan	0.058*	-3.348***
	(1.859)	(-2.696)
Gender	-0.121	-7.956**
	(-1.269)	(-2.112)
Internet	-0.008	-1.735***
	(-0.505)	(-3.099)
Constant	1.816***	46.758***
	(5.891)	(3.674)
Observations	822	822
Adjusted R^2	0.989	0.882
City FE	Yes	Yes
Year FE	Yes	Yes
F-value	113.125	

Panel B. Internet users and fixed-line telephones in 1984 as instrumental variable

	First Stage	Second Stage
	(1)	(2)

VARIABLES	DF	Birth Rate
DF		-26.766*
		(-1.858)
IV-Intel	0.167**	
	(2.441)	
Marketization	1.671***	38.572
	(6.574)	(1.479)
Road	-0.001	0.343
	(-0.121)	(0.850)
GDP	-0.008*	-0.334
	(-1.717)	(-1.551)
Unemployment	3.021***	-42.418
	(4.237)	(-0.855)
AQI	0.089***	1.158
	(3.549)	(0.636)
Education	-0.049**	-1.453
	(-2.403)	(-1.452)
Bed	-0.009	-0.304
	(-0.356)	(-0.357)
Elder	-0.032	-22.744**
	(-0.129)	(-2.105)
Inmarriage	0.458**	13.412
	(2.187)	(1.278)
Institution	0.027	0.521
	(0.713)	(0.497)
Loan	0.075***	-2.291
	(3.017)	(-1.456)
Gender	-0.265***	-12.022**
	(-2.846)	(-2.495)
Internet	0.018	-1.480**
	(1.227)	(-2.484)
Constant	-1.292	119.309***
	(-1.632)	(6.155)
Observations	822	822
Adjusted R^2	0.987	0.871
City FE	Yes	Yes
Year FE	Yes	Yes
F-value	15.383	

This table reports the 2SLS-IV estimation results. Panel A uses the interaction term between the mean of the DF index at the national level (except for the specific city) and the distance to Hangzhou as an instrument variable *Distance* for digital finance level in each city. Panel B uses the interaction term between the number of Internet users in *t-1* and the number of fixed-line telephones per 100 people per city in 1984 as instrumental variable. Detailed definitions of variables are reported in the Appendix. Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

5.4.3. Robustness tests

To verify the reliability of the baseline results, we also conduct a series of robustness tests, which include adding provincial fixed effects, removing key cities in the sample and using a province-level DF index.

Fertility levels in a city can be influenced by various factors, including socio-economic characteristics, cultural background, and policy orientation at the provincial level. Since the province to which a city belongs is a crucial determinant of fertility, we include province-level fixed effects to control for time-invariant, province-specific factors, enhancing the logical rigor of the analysis. Panel A of **Table 5.5** presents the results, which are consistent with the baseline findings—DF continues to exhibit a negative effect on birth rates.

People who live in key cities with well-developed economies often have access to more advanced finance technology and have more negative fertility intentions. Therefore, it is necessary to test the impact of the development of DF on the birth rates after excluding key cities. Following Shen and Ren (2023), four municipalities directly under the central government, 22 provincial capitals and five cities specifically designated in the state plan[24] are excluded, and the regression results are shown in **Table 5.5** panel B. The results show that the impact of the development of DF on birth rates is still significantly negative after excluding the corresponding key cities, which indicates the baseline findings are robust.

We also introduce a provincial level DF index as an alternative independent variable and rerun the baseline regression. Panel C of **Table 5.5** presents the results. Consistent with baseline findings, the provincial level DF has a negative influence on birth rates.

Table 5.5. Robustness tests

Panel A. Other fixed effects

	(1)	(2)	(3)
VARIABLES	**Birth Rate**	**Birth Rate$_{t+1}$**	**Birth Rate**
DF	-10.020***	-5.073*	
	(-3.282)	(-1.897)	
L.DF			-9.273***
			(-2.661)
Constant	90.932***	110.073***	9.787
	(3.799)	(4.530)	(0.192)
Observations	822	529	529

[24] The city specifically designated in the State Plan include Shenzhen, Dalian, Qingdao, Ningbo and Xiamen.

Adjusted R^2	0.883	0.926	0.922
Control	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Province-Year FE	Yes	Yes	Yes
Panel B. Eliminating key cities			
	(1)	**(2)**	**(3)**
VARIABLES	**Birth Rate**	**Birth Rate$_{t+1}$**	**Birth Rate**
DF	-11.375***	-4.689*	
	(-3.302)	(-1.641)	
L.DF			-8.515**
			(-2.385)
Constant	106.896***	93.520***	-16.478
	(3.289)	(3.402)	(-0.306)
Observations	725	465	465
Adjusted R^2	0.882	0.921	0.921
Control	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Panel C. Using provincial level total DF index			
	(1)	**(2)**	**(3)**
VARIABLES	**Birth Rate**	**Birth Rate$_{t+1}$**	**Birth Rate**
$DF_{province}$	-0.068***	-0.030*	
	(-3.149)	(-1.666)	
$L.DF_{province}$			-0.084***
			(-2.667)
Constant	94.422***	109.294***	42.171
	(3.473)	(4.637)	(0.746)
Observations	822	529	529
Adjusted R^2	0.882	0.926	0.925
Control	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

This table reports the robustness test results. We add additional province-level fixed effect in Panel A. In Panel B, we remove the key cities in the sample and rerun the baseline regression, while Panel C takes province-level DF index as independent variables. Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

5.4.4. Channel tests

In this section, we present the results of our channel tests.

There is an old saying among Chinese, “Yang Er Fang Lao” that means the major goal of parenting is to have someone to look after you in your old age. Traditional fertility decisions are often driven by the need for children to provide support at the old age, especially in economies where formal pension and welfare systems are underdeveloped. However, access to financial services such as insurance, pensions, and investment opportunities could reduce

reliance on children for financial security in later life. The advancement of society and the enhancement of social security systems have gradually replaced the traditional role of children in providing old-age support. What was once solely achievable through having children can now be addressed through well-established social security mechanisms (Stevenson et al., 2021). Prior literature suggests that the use of DF boosts financial literacy (Yang et al., 2023b) and increases availability of financial services; this in turn influences family planning decisions by mitigating old-age concerns about purchasing life insurance and planning for retirement (Wang et al., 2021a; Lusardi & Mitchell, 2017).

Table 5.6 presents the results in relation to this prediction. First, we divide our sample into high financial institution coverage regions and low financial institution coverage regions, and we find that the negative impact of DF on birth rates only exists in high coverage regions as shown in **Table 5.6** panel A. Then we classify the sample into two categories: regions with higher insurance purchase and those with lower insurance purchase, based on the sample median in a year. Comparing columns (1) and (2) of panel B of **Table 5.6**, it is clear that the negative influence of DF on birth rates is more substantial in regions with higher insurance purchase. This indicates that DF can decrease birth rates because the need to raise children to look after aging parents is reduced with better financial services and higher insurance coverage.

Table 5.6. Channel tests - Investment opportunities

Panel A. Financial institution coverage (FIC)

	High	**Low**
	(1)	**(2)**
VARIABLES	**Birth Rate**	**Birth Rate**
DF	-7.900***	3.665
	(-2.900)	(0.513)
Constant	-21.764	24.680
	(-0.447)	(0.650)
Observations	428	394
Adjusted R^2	0.916	0.883
Control	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes

Panel B. Commercial insurance purchase (CIP)		
	High	Low
	(1)	(2)
VARIABLES	Birth Rate	Birth Rate
DF	-6.708*	-1.126
	(-1.890)	(-0.306)
Constant	80.418***	11.855
	(2.663)	(0.417)
Observations	434	388
Adjusted R^2	0.881	0.925
Control	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes

This table reports the test results regarding the channel of investment and insurance. The channel variables are *FIC* and *CIP* separately. *FIC* refers to the average number of financial institution outlets serviced per 10,000 population of a province, while *CIP* refers to the average commercial insurance purchase per person of a province. Detailed definitions of variables are reported in the Appendix. Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Second, unlike the previous finance literature (e.g. Qu et al., 2023; Yang et al., 2023b), which focuses on the possibility of higher incomes and lower financial constraints benefiting from DF as a way of mitigating the cost of childbearing, we focus on the changes in the consumption mindset of newly married or young couples. Psychology literature and business studies both point out the close relationship between consumerism and individualism (Ahuvia, 2002; Lee et al., 2010), while DF makes consumption more convenient, potentially leading to over-consumption and individualism, and thereby reducing birth rates. To test our conjecture, we spilt our sample into two subsamples, which are regions with higher consumer expenditures scaled by GDP per capita and regions with lower consumer expenditures scaled by GDP per capita. We find DF only weakens the regional birth rates in the sample of high consumption regions, as shown in panel A of **Table 5.7**.

Opposite to individualism is the family or group oriented social norm. In China, the Han ethnic group constitutes the majority of the population[25]. The other 55 ethnic groups are called minority ethnic groups, as their populations are comparatively smaller. Therefore, the one-child

[25] According to the latest seventh population census of China, the Han group accounts for 91.11% of the total population. Data is publicly released in *www.gov.cn*.

policy was less restrictive among minority ethnic groups in order to support their population levels (Ebenstein, 2010), and minority ethnic groups have the strong social norm of procreation. In response to this social norm, ethnic minority populations pay more attention to the concept of fertility and family legacy (Wan et al., 2021). We divide our sample into ethnic minority provinces and non-ethnic minority provinces[26]. The results in Panel B of **Table 5.7** show that the coefficient of DF is only significantly negative in the sample of non-ethnic minority regions, where people have a stronger sense of individualism and a weaker social norm of fertility.

Table 5.7. Channel tests - Individualism and social norm

Panel A. Consumption

	High	**Low**
	(1)	**(2)**
VARIABLES	**Birth Rate**	**Birth Rate**
DF	-11.696**	-6.433
	(-2.577)	(-1.077)
Constant	155.240***	64.793*
	(3.491)	(1.682)
Observations	412	410
Adjusted R^2	0.901	0.875
Control	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes

Panel B. Ethnic groups

	Ethnic minority areas	**Non- ethnic minority areas**
	(1)	**(2)**
VARIABLES	**Birth Rate**	**Birth Rate**
DF	-2.807	-11.914***
	(-0.307)	(-3.141)
Constant	-2.509	73.293**
	(-0.019)	(2.512)
Observations	136	686
Adjusted R^2	0.877	0.889
Control	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes

Table 5.7 reports the channel test of individualism and social norms. We use the average total expenditures made by consumers per person scaled by GDP per capita in the region (*Consumption*), and ethnic minority areas vs. non-ethnic minority areas (*Ethnic*) respectively. Detailed definitions of variables are reported in the Appendix. Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively

[26] The ethic minority areas include 5 ethnic minority autonomous regions (Inner Mongolia, Xinjiang, Xizang, Ningxia and Guangxi) and 3 provinces with a high concentration of ethnic minorities (Guizhou, Yunnan and Qinghai). The non-ethnic minority provinces are predominantly inhabited by Han Chinese.

We further propose DF provides more opportunities for women to enter the labour market and access financial services at a lower cost (Ji et al., 2022). DF leads to higher levels of income and more economic independence for women as found by Han et al. (2023). Childbearing often leads to reduced labour participation or career interruptions, especially for women (Han et al., 2023). This lost potential income can also be compared to disposable income, quantifying how much economic opportunity is traded off for childbearing. In addition, time spent on unpaid domestic labour and childcare can be monetized using the market cost of equivalent services (Folbre, 2006). This conversion reflects the implicit cost of time diverted from income-generating activities. Thus, to further clarify the mechanism of opportunity cost, we divide our sample into high disposable income regions and low disposable income regions based on the sample median of the year. Results have been reported in **Table 5.8** panel A. We can see the negative impact of DF on fertility is larger in high disposable income regions, where the opportunity cost of childbirth is higher for women.

In addition, in regions where there is a higher proportion of females, women are likely to have a stronger voice (e.g. Goodkind, 2011). Bulte et al. (2015) find that a higher female ratio increases females' bargaining power with respect to household purchases, education, labour market engagement and fertility. Women bear most of the cost of having children in the family, but in regions with a high female ratio, women may have stronger voices regarding child-raising. We compare the impact of DF on birth rates in regions with different gender ratios. The results in panel B of **Table 5.8** indicate that DF has a negative impact on birth rates in cities with a higher female ratio, suggesting that in those cities women have more independence with respect to fertility decisions.

Table 5.8. Channel tests - Opportunity cost for women and women's voice

Panel A. Disposable Income

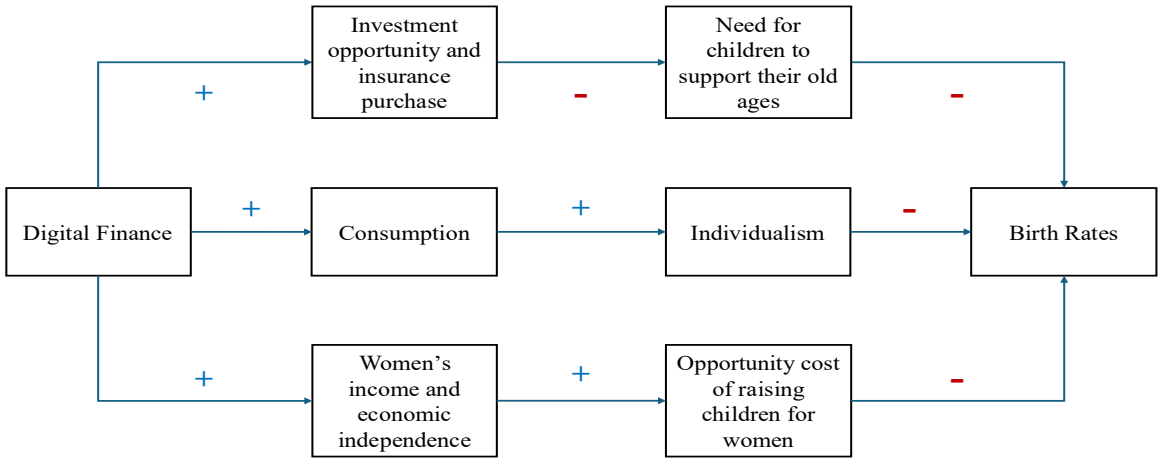
	High	**Low**

VARIABLES	(1) Birth Rate	(2) Birth Rate
DF	-6.757**	-9.881
	(-2.052)	(-1.252)
Constant	122.052***	106.365*
	(3.138)	(2.004)
Observations	425	397
Adjusted R^2	0.906	0.871
Control	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes
Panel B. Gender (Male/Female) ratio		
	High	**Low**
VARIABLES	**(1) Birth Rate**	**(2) Birth Rate**
DF	1.796	-10.437**
	(0.446)	(-2.230)
Constant	12.765	109.508**
	(0.433)	(2.361)
Observations	425	397
Adjusted R^2	0.894	0.875
Control	Yes	Yes
City FE	Yes	Yes
Year FE	Yes	Yes

Table 5.8 reports the channel test of opportunity cost of fertility for women. We use the regional disposable income and the male/female gender ratio (*Gender*) in the region divide all cities into high and low groups according to the median value in a year, respectively. Detailed definitions of variables are reported in the Appendix. Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

In all, the channel test results explain the potential reasons why DF affects birth rates. We create a conduction diagram to visually represent the relationship between these channel factors. The graph is shown in Figure 5.4.

Figure 5.4. The channels between DF and birth rates



5.4.5. Sub-categories of the DF index

Given DF development is a non-stoppable trend, will further development of DF continue to impact the birth rate in the future? We try to answer this question by investigating sub-categories of the DF index. According to previous literature (e.g. Mu et al., 2023), DF is a multi-dimensional concept, and therefore our paper not only examines the impact of the total index of DF on fertility rates but also uses the sub-category indices in the regression analysis. **Table 5.9** presents the results for the impact of DF on birth rates using the different dimensions of the index. We find all the sub-indices including coverage breadth, depth of use and level of digitization have negative impacts on fertility. However, in contrast with the other two categories, the negative relationship is only significant at the 1% level for breadth of coverage. The results from **Table 5.9** indicate that as DF technology continues to move from coverage to depth and digitization, its negative effect on the birth rate will reduce.

The possible explanation is that DF, taking advantage of its inclusiveness, makes financial services more accessible to more households and reduces the cost of financial services (Ji et al., 2021). Financial inclusion refers to the accessibility and availability of formal financial services to all members of society, ensuring that individuals and businesses can utilize affordable financial products that meet their needs responsibly and sustainably (Mader, 2018). According to Mhlanga (2020), in the context of the Fourth Industrial Revolution, the current digital financial inclusion emphasizes financial inclusion initiatives for vulnerable populations — such as the poor, women, the elderly, and disabled individuals—who are more susceptible to financial exclusion and economic shocks. This convenience and cost reduction make it easier for households to participate in financial markets and invest and purchase financial products such as insurance, which in turn reduces the need to rely on future generations for old age financial security. However, depth and digitalization focus more on the sophistication and

efficiency of financial services and technological advancement (Li et al., 2020a). Therefore, the negative impact of depth and digitalization on birth rate is limited.

Table 5.9. Alternative proxies for digital finance

VARIABLES	(1) Birth Rate	(2) Birth Rate$_{t+1}$	(3) Birth Rate	(4) Birth Rate$_{t+1}$	(5) Birth Rate	(6) Birth Rate$_{t+1}$
Coverage	-0.139***	-0.149***				
	(-3.321)	(-2.721)				
Depth			-0.031*	-0.002		
			(-1.774)	(-0.127)		
Digit					-0.017**	-0.008
					(-2.166)	(-0.883)
Marketization	1.483	-33.222***	1.171	-40.116***	-0.768	-34.093
	(0.134)	(-2.639)	(0.116)	(-2.895)	(-0.068)	(-1.595)
Road	0.527	-0.668	0.345	-0.834	0.445	-0.805
	(0.758)	(-1.288)	(0.684)	(-1.577)	(0.627)	(-1.018)
GDP	0.035	-0.016	-0.134	-0.103	-0.134	-0.125
	(0.120)	(-0.105)	(-0.720)	(-0.661)	(-0.466)	(-0.647)
Unemployment	-88.500**	-260.616***	-105.418***	-305.417***	-119.697***	-296.772***
	(-2.047)	(-5.600)	(-3.290)	(-6.445)	(-2.862)	(-4.888)
AQI	-0.741	-1.674	-1.014	-1.881	-1.212	-2.008
	(-0.467)	(-1.267)	(-0.849)	(-1.392)	(-0.751)	(-0.847)
Education	-0.266	0.982	-0.424	1.094	-0.499	0.787
	(-0.247)	(1.113)	(-0.482)	(1.214)	(-0.463)	(0.621)
Bed	0.078	0.461	-0.051	0.037	-0.001	0.072
	(0.056)	(0.404)	(-0.052)	(0.033)	(-0.000)	(0.057)
Elder	-26.500	-23.739***	-23.102**	-22.239**	-21.553	-22.749
	(-1.421)	(-2.671)	(-2.464)	(-2.469)	(-1.137)	(-1.500)
Inmarriage	1.939	-11.999	2.883	-14.731	3.354	-14.122
	(0.167)	(-1.121)	(0.305)	(-1.360)	(0.290)	(-1.007)
Institution	-0.970	-2.040	-0.198	-2.134	-0.169	-1.904
	(-0.721)	(-1.584)	(-0.139)	(-1.593)	(-0.122)	(-0.834)
Loan	-3.433**	1.100	-4.325***	-0.156	-4.055**	0.122
	(-2.003)	(0.772)	(-3.272)	(-0.112)	(-2.154)	(0.071)
Gender	-7.013	-10.041**	-5.452	-8.868*	-5.279	-9.726
	(-1.287)	(-2.106)	(-1.352)	(-1.820)	(-0.954)	(-1.249)
Internet	-1.362	-2.594***	-1.851***	-3.163***	-2.088**	-3.145***
	(-1.544)	(-3.593)	(-2.762)	(-4.425)	(-2.307)	(-2.984)
Constant	104.810***	118.991***	100.257***	116.796***	100.346***	113.877***
	(4.039)	(5.207)	(4.804)	(4.937)	(3.738)	(3.730)
Observations	822	529	822	529	822	529
Adjusted R^2	0.882	0.927	0.879	0.925	0.880	0.925
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 5.9 reports the regression results after we introduce sub-categories of the DF index. The three dimensions of DF index in the ranking system are coverage breadth (*Coverage*), index of use depth (*Depth*) and degree of digitization (*Digit*). Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

5.4.6. Moderating effects of government policies

Because child-raising is treated as a type of investment, the expense to become responsible parents, such as the increasing costs of children education and rising living expense, increases with the development of the economy (Preston, 1986; Lin & Kamo, 2015). Given that the development of DF is an inevitable trend going forward, we investigate whether government policies on providing more support for raising children and protecting the social norm of fertility may weaken or moderate the negative effect of DF on birth rates.

A large number of sociological surveys and studies have shown that contemporary Chinese couples bear enormous pressures when faced with child-raising (e.g. Qian & Jin, 2018). These pressures include covering children's future education and health expenses. The current distribution imbalance of education and medical resources in China has exacerbated their worries about becoming parents (Zhang et al., 2015). Meanwhile, high property prices have put pressure on many young couples to take out mortgages (Gao et al., 2022). These issues, on the one hand, require them to spend more time on work to ensure a stable income, thus reducing the time for family life. On the other hand, mortgages constrain their financial freedom and reduces the possibility of investing in their children. In addition, technological development stimulates the formation of individualism and challenges the belief in fertility and family (He et al., 2019; Wan et al., 2021). However, religious beliefs emphasize family ties and family lines (Wan et al., 2021).

Based on the above discussion, in **Table 5.10** we report the effects of DF on birth rates with *Teacher*, *Doctor*, *House* and *Religious site* selected as the moderating variables. *Teacher* is the average number of teachers per 100 students at the compulsory education stage in a province. *Doctor* measures the number of certificated physicians in a province. *House* is measured as the natural logarithm of average sales price of residential property in the province. Last, as evidence of the local level of religious protection*, Religious site* is measured as the number of

religious sites per 10,000 square kilometers in a province[27]. The results show that the negative relationship between DF and the birth rate is moderated when regions have richer education resources, more certificated doctors, lower house price pressure and more religious sites.

Table 5.10. Moderating effects – Government policies

VARIABLES	(1) Birth Rate	(2) Birth Rate	(3) Birth Rate	(4) Birth Rate
DF*Teacher	**7.186***** **(5.625)**			
DF	-53.419*** (-6.293)			
Teacher	-15.222*** (-5.497)			
DF*Doctor		**9.455**** **(2.374)**		
DF		-42.086*** (-2.797)		
Doctor		-28.978*** (-3.175)		
DF* 1/House			**99.869** **(0.618)**	
DF			-20.185 (-1.176)	
1/House			-339.540 (-0.856)	
DF*Religious site				**0.797** **(1.124)**
DF				-14.664*** (-2.959)
Religious site				-1.530 (-1.017)
Constant	126.967*** (4.797)	179.186*** (5.246)	139.343** (2.435)	111.673*** (3.536)
Observations	822	822	822	822
Adjusted R^2	0.896	0.885	0.882	0.882
Control	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 5.10 reports the results of moderating effects. The moderating variables are *Teacher*, *Doctor*, *House* and *Religious site* accordingly. *Teacher* refers to average number of teachers per 100 students at the compulsory education stage (primary school and secondary school). *Doctor* is measured by the natural logarithm of the number of practicing physicians per 10,000 population. *House* is the natural logarithm of average sales price of residential property (Chinese RMB per square metre) and *Religious site* is calculated as the natural logarithm of the number of religious sites (Buddhist temples and Taoist monasteries) per 10,000 square kilometres. Detailed definitions of variables are reported in the Appendix. Robust *t*-statistics are reported in parentheses. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

[27] Due to the data availability in CSMAR, we use the number of religious sites in 2018 to proxy the number in 2017.

5.5. Conclusion, policy implications and future research

In recent years, there has been rapid development of DF based on digital technologies. Combining the city level data of birth rates and the DF index, this paper performs empirical analyses on the impacts of DF on fertility and explores the channels and moderators of this relationship. We find that DF has a negative effect on birth rates and this finding is verified by the robustness and endogeneity tests. Second, we find that DF affects birth rates via the channels of increasing investment opportunities, increasing consumption and individualism, and increases women's economic independence and opportunity costs of fertility. Furthermore, by using the sub-categories of the DF index, we find that as DF technology continues to improve from coverage to depth and digitization, its negative effect on the birth rate will reduce. Last, we find the negative effect of DF on birth rates can be moderated by government policies in enhancing people's fertility willingness.

Based on the above findings, our study has the following potential policy implications. First, previous evidence shows that DF improves financial services and products, increases consumption, and increases women's economic independence, while these positive direct economic impacts could potentially negatively impact social behaviours such as birth rates, and therefore harm economic development from a long run perspective. Policy makers need to be aware of the potential challenges related to fast development of DF, and understanding its impact on birth rates is both academically valuable and policy relevant. Second, our study highlights the importance of government medical and education support, freedom of religious belief and a shifting policy focus in DF development from coverage to depth and digitization in mitigating the negative impact of DF on birth rates. These findings have impactful policy implications with respect to fertility encouragement and further DF development.

Looking ahead, there are several promising avenues for future research. First, future studies could further examine how the evolution of DF from basic coverage to deeper integration and

advanced digitization can mitigate its negative impacts on declining birth rates and other potential social outcomes. A more nuanced understanding of how different levels of DF interact with household decision-making and life planning is crucial for designing inclusive financial systems that support long term social development goals. Second, we suggest further exploration of the cross-national implications of DF for women's economic empowerment and shifting family structures. Building on our findings, comparative studies across different cultural and institutional contexts can offer valuable insights into whether these patterns are globally consistent or shaped by local norms and policies. Such research can inform the development of more balanced financial and social policies that promote both economic inclusion and demographic sustainability.

5.6. Appendix

Variable Definition

Variables	Definitions
Birth rate	Births per year /Average population per year in the city *1000‰
DF	The index of Digital Finance of the city in the year divided by 100
Marketization	1- (the number of public-sector and collective employees as a proportion of the total number of employees), following Yang et al. (2022)
Road	The natural logarithm of road surface area per capita (m^2) in the city
GDP	The natural logarithm of GDP per capita of the city
Unemployment	The unemployment rate of the province
AQI	Air quality index, which is the natural logarithm of the average daily AQI (the concentration level of six atmospheric pollutants, namely, SO_2, NO_2, PM10, PM2.5, CO, and O_3) for a given year and city. The higher the AQI, the heavier the air pollution the city has.
Education	The natural logarithm of population with tertiary education and above (based on data from the 1‰ population sample survey conducted by the NBSC)
Bed	The natural logarithm of hospital beds per 10,000 population in the city
Elder	Ratio of the number of people 65+ to the number of people of working age (16-59) in the province
Unmarried	Ratio of unmarried persons to the number of persons aged 15 years and over in the province (based on 1‰ population sample survey conducted by the NBSC)
Institution	Financial institution coverage, measured as the average number of financial institution outlets serviced per 10,000 population of the province
Loan	The natural logarithm of the loan balance per capita of the province
Gender	Ratio of male to female population in the province (based on data from the 1‰ population sample survey conducted by the NBSC)
Internet	The natural logarithm of the total internet usage per capita of the province
IV-Distance	Instrumental variable, measured as the interaction term between the mean of the DF index at the national level (except for the specific city) and the distance to Hangzhou
IV-Intel	Instrumental variable, measured as the interaction term between the number of Internet users in year *t-1* at the national level and the number of fixed-line telephones per 100 people per city in 1984
CIP	Commercial insurance purchase, measured as the natural logarithm of commercial insurance purchased per capita of the province
Consumption	The average total expenditures made by consumers per person in the province scaled by GDP per capita
Ethnic	Dummy variable equals to one if the province is an autonomous region or concentration of ethnic minorities, and 0 otherwise
Disposable income	The natural logarithm of disposable income per person of the province
Teacher	The average number of teachers per 100 students at the compulsory education stage (primary school and secondary school) in a province
Doctor	The natural logarithm of the number of practicing physicians per 10,000 population in a province
House	The natural logarithm of average sales price of residential property (Chinese RMB per square metre) in a province
Religious site	The natural logarithm of the number of religious sites (Buddhist temples and Taoist monasteries) per 10,000 square kilometers in a province

CHAPTER SIX

CONCLUSION

This chapter presents the conclusions of the thesis, summarizing the key findings, discussing their theoretical and practical implications, and outlining directions for future research.

6.1 Main findings and implications

This thesis mainly sheds light on the influence and determinants of employee treatment in Chinese listed firms. The literature review summaries current literature on the impact of employee treatment on firm performance and decisions and potential determinants of better employee treatment policies within organizations. We find that modern firms make more effort to improve employee treatment as employees perform more significant roles. In return, employees contribute to better firm performance such as innovation (Mao & Weather, 2019), productivity (Korschun et al., 2014) and enhanced stock return (Edmans, 2011). The review demonstrates that employee treatment can be used as an effective mechanism to enhance human capital value and firm performance.

Essay one investigates the influence of employee medical welfare on firm productivity. We show that employee medical welfare significantly increases firm productivity. Moreover, we propose that employee psychological security provided by such caregiving is an underlying mechanism that fosters firm productivity by enhancing employees' feeling of security and stimulating their work efficiency. The evidence shows that this effect is more pronounced for firms with more low-skilled employees, firms with low R&D intensity, and non-state-owned firms, where employees' sense of security is weak. We also show that local medical facilities have a moderating effect through which employee medical welfare enhances productivity. In addition, we find that firms with better employee medical welfare had stronger firm resilience in the COVID-19 pandemic. Our results can be viewed as an example of ethics of care in action, in particular that organisational caregiving in the form of medical welfare enriches the work lives of employees and the organisational experience, and these results support the stakeholder theory (Titman, 1984) and organisational caregiving framework (Vijayasingham et al., 2018).

Essay two focuses on the determinants of employee treatment and provides new evidence showing that DF as a new finance technology significantly improves employee treatment. Our mechanism analysis indicates that the positive effect of DF on employee treatment is concentrated in financially constrained firms and in those with lower transparency, suggesting that DF promotes more employee-oriented practices by easing resource limitations and reducing information asymmetry. Further tests reveal that this positive relationship is more prominent in firms located in the regions with lower marketization levels and regions with severe air pollution, indicating that disadvantaged firms are taking advantage of digital inclusive finance to attract employees in a competitive market. In addition, government support, good corporate governance and financial flexibility strengthen DF's positive impact on employee treatment. Last, we find DF development drives corporate digital transformation and increases the demand for high-skilled labour, emphasizing the complementary dynamics between technological progress and workforce upskilling and reinforcing the critical role of human capital investment for both individual career growth and organizational competitiveness.

In the last essay of this thesis, we extend our study to the total population of China and explore how DF affects people's fertility behaviour. We find DF has a negative influence on birth rates and suggest several reasons. First, DF increases investment opportunities and therefore reduces the need for having children for support in old age. Second, DF increases consumption and possibly individualism. Third, DF also increases women's economic independence and their opportunity cost of having children, leading to lower birth rates. We further find that out of the three components of DF index measures, only the coverage of DF significantly decreases birth rates, while the higher level of DF development, depth and digitalization of the technology, have much less negative impact on birth rates. Most importantly, technology's negative impact

on DF can be moderated when governments make policy efforts to increase people's fertility willingness through increased educational and medical resources and protection of religion.

6.2 Limitations and future research

The essays in this thesis have limitations that may give rise to opportunities for further research. Essay one investigates the impact of employee medical welfare on firm productivity. Currently we have not included sick leave information in our study due to the data resource limitation. We expect the reduction in sick leave to be the most immediate channel through which employee medical welfare affects firm performance. In addition, this study uses donations as a proxy for firms' external caregiving. It should be noted, however, that prior research suggests such donations can also be driven by motives including ESG optimization, reputation enhancement, and the cultivation of government-business relationships. Given current data limitations, alternative or more refined measures are not feasible, but the analysis will be revisited and adjusted should more suitable data become available in the future. Last, air pollution and green space are selected as instrumental variables, given their documented links to employee health and welfare policies, however they may indirectly affect productivity. We acknowledge this potential limitation and note that future research could strengthen the analysis by incorporating policy shocks within a DID framework.

Essay two explores the impact of new finance technology on corporate employee treatment and finds modern firms are willing to provide improved treatment to attract talent and motivate employees. In the study, we measure a firm's employee treatment using firm ESG scores related to employees and the average employee compensation. As the integration of human capital and technology advancements becomes an inevitable trend, it is worth investigating how technological development affects firm level training costs and its impact on firms, where firm internal job training is an essential form of skill investment to better activate human initiative.

Insights from such research could provide valuable guidance for firms undergoing digital transformation and seeking to optimize employee treatment strategies.

Our final essay three studies the impact of DF on birth rates and only includes the sample data from 2017 to 2019, as the city level birth rate data in China is only publicly available in these three years. We expect more data will eventually be made available for academic research. Future research could further explore how the evolution of DF from basic coverage to deep integration and advanced digitalization interacts with household decision-making and life planning processes. This perspective is crucial for designing an inclusive financial system that supports long-term economic benefits. Additionally, we suggest investigating the cross-national impacts of DF on women's economic empowerment and changes in family structures. Based on our findings, comparative studies in different cultural and institutional contexts could provide valuable insights into whether these patterns are globally consistent or influenced by local norms and policies.

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