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Impact of HR slack on firm performance: An empirical study on Chinese high-tech firms

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I hereby declare that this PhD dissertation is my original work

and it has been written by me in its entirety.

I have duly acknowledged all the sources of information

which have been used in this dissertation.

This PhD dissertation has also not been submitted for any degree

in any university previously.

[INSERT DIGITAL SIGNATURE]

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FENG Weixiong

20 March 2024

Table of Contents

Figure Index

Table Index

Formula Index

Impact of HR Slack on Firm Performance: An Empirical Study of Chinese High-Tech Firms

Abstract

As part of organizational slack, HR slack plays a role in managing external risks and opportunities when the global business environment is in turmoil. In recent years, Chinese high-tech companies have faced external shocks such as reverse globalization, the decoupling of economic and trade relations, supply chain disruptions, and epidemics. These have posed new challenges to their strategy formulation, business operations, and talent acquisition. High-tech Chinese companies must know whether they must prepare adequate human resources as buffers to address these challenges and opportunities. For high-tech companies, this study proposes, for the first time, that HR slack must be analyzed in both quantitative and qualitative dimensions based on the Resource-based View (RBV) and Knowledge-based View (KBV). To facilitate observation and measurement, this study proposes defining absolute HR slack and relative HR slack in terms of "relative change," which reflects the change in HR slack in the firm itself and in the industry. Furthermore, this study posits that HR slack in different groups may affect firm performance to different extents, leading to an optimal HR configuration. This study presents, for the first time, the definition and metrics of HR slack in different groups and validates the extent of its impact on firm performance. This is the first study to use mediation effects to test HR slack effects on firm performance under financial constraints. This study confirms the positive relationship between HR slack and firm performance using ten-year

(2011–2021) panel data for Chinese listed companies, including more than 2,000 listed companies and more than 17,000 observations. This finding enriches empirical studies on HR slack.

Key Words: absolute HR slack, relative HR slack, tacit knowledge, firm-specific knowledge, prior expertise

Introduction

Motivation

In 2015, I worked at Huawei in Africa. As the market grew beyond expectations, I was often confronted by a lack of personnel: relatively few people were willing to come to Africa, or those who were recommended were not as competent as the requirements of the position (e.g., English as a working language, minimum work experience, etc.). I constantly appealed to the headquarters to prioritize African businesses and send more experts to Africa. Simultaneously, I asked the local HR team to attract more people and provide intensive training for newcomers in line with the rapid development of the business. As I was planning a larger business team for future development, I was surprised by the news from the headquarters. Instead of receiving more staff, each region had to select its best employees, approximately 10% of its current size, and send them to a new organization, the Strategic Reserve Team.

Huawei set up a new organization, "Strategic Reserve Team," at the top of all business groups. Without any Key Performance Index (KPI), the strategic reserve team assembled personnel from other business groups or regions into a resource pool as the main task in its early stages. The strategic reserve team then organized personnel in the pool to be trained for new businesses or skills. In the Strategic Reserve Team, the majority of personnel participated in centralized training and were sent out to practice in real business scenarios, with a total journey time of approximately 6–9 months. By the end of 2019, more than 20,000 personnel had participated in training and real-scenario exercises organized by the Strategic Reserve

Team at an estimated $1 billion in participant's salaries, travel, and daily operating costs.

While we questioned why we did not invest more in our fast-growing business, why we invested in "training" people who did not produce value-adding outcome, and why we did not set the money as an incentive for our employees, two changes occurred. The first thing evolved quietly, and we were only able to recognize it in retrospect. Owing to a continued lack of staffing, these fast-growing businesses resorted to new tools, processes, and operating models, such as high-resolution video conferences, simulation, and emulation of networks and businesses, global resource centers, global competence centers, and localization. The operational model was modified. The elite combat model, supported by a large platform and digital transformation, has significantly improved operational business efficiency. The second thing happened out of the blue. Huawei was sanctioned by the US[1]. After being hit by US sanctions, the company's executives admitted that it would be years before they could develop their own alternatives for high-end chips, Google's APP, databases, and industrial software. While parts of its business or some regional operations had to be abandoned, Huawei struggled to establish new businesses. Those who had been trained in a new business or had new skills were prioritized and quickly established in the business. During the past four years, Huawei's performance has fluctuated, but this has not affected its survival and development. Its revenue was

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[1] Effective May 16, 2019, the U.S. Commerce Department's Bureau of Industry and Security ("BIS") added Huawei and 68 Huawei non-U.S. affiliates in 26 countries (collectively, the "Huawei Group") to BIS's Entity List. This action generally forbids anyone to supply Huawei Group items from the United States or that are otherwise subject to the U.S. Export Administration Regulations ("EAR").

$92.379 billion in 2022[2].

The new mission of the Strategic Reserve Team is as follows: first, to transform the team through a cycle of mobility to refresh their thinking and skills, maintain organizational vitality, and ensure Huawei's sustainable development;   second, to cultivate strategic capabilities through a cycle of empowerment to understand and satisfy customers' needs and to support Huawei's business success by "pouncing on and knocking down" strategic opportunities when they are identified.

I sincerely marvel at how quickly the world is changing. If the business were growing fast, I would like to use all available resources. Nevertheless, when the business was experiencing setbacks, I would have liked to get rid of all baggage. As the business world is full of uncertainties, such as risks or opportunities, we are unlikely to make perfect decisions. By providing a small cushion or slack, we may have more room to move in and out.

Background

Chinese high-tech enterprises are currently in a bottleneck period of development, facing the dilemma of core technology "bottleneck" in key areas, and are under the pressure of the "broken global chain." In view of this, Chinese high-tech enterprises must change their scientific and technological research model; that is, it is necessary to expand the research of core technologies in key areas from the traditional "Edison quadrant" model of "application-oriented research" to the "Pasteur quadrant"

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[2] Source: https://www.huawei.com/cn/annual-report/2022

model of "application-oriented basic research" (Bush, 1960; Kleinman, 1999). To

accelerate the transformation of this model in terms of increasing uncertainty in

domestic and international environments, high-tech enterprises must attach more

importance to the investment and configuration of human resources.

High-tech enterprises are knowledge-intensive organizations, and human

resources occupy an important strategic position among all resources. In the face of

external risks and internal transformation challenges, human resource configuration in

high-tech enterprises aims to achieve innovative breakthroughs in key areas and

business goals to ensure enterprises' survival. Regarding demand, both technological

innovation and market growth require the continuous investment of all types of talent

with different competencies. Regarding supply, it is necessary to have a "strategic

reserve team" that can respond quickly to unexpected changes, regardless of risks or

opportunities. Therefore, managers are not expected to experience chronic resource

scarcity. Simultaneously, managers consider the costs of staff redundancy. If there are

too many "redundant" human resources or if there is an inability to allocate them

owing to a lack of mobility, it will not be conducive to improving enterprise

efficiency. Therefore, to achieve their business goals, Chinese high-tech enterprises in

a turbulent environment must know whether human resources are "too scarce" or "too

abundant." They should also know how to efficiently configure human resources in

different areas.

Human resources are different from financial resources, such as cash, assets, and

inventory. First, financial resources are easy to measure and compare, whereas

people's values are more challenging to compare. For example, a system architect and

a junior code development engineer play completely different roles in a firm. The

costs paid and the value created by these two employees are different in the firm.

Consequently, it is challenging for managers to monitor the use of human resources

and evaluate their benefits. Second, from the perspective of liquidity and mobility,

human and financial resources are reflected in two different approaches. Cash has the

highest liquidity among firms' resources. General materials (or inventory) have lower

liquidity, followed by inventory, equipment, and specific materials, which are

challenging to move and have low liquidity. Meanwhile, the mobility of people within

an organization is subject to various constraints or barriers. "People" in organizations

often have organizational attributes and are constrained within or influenced by

organizational boundaries such as organizational systems, processes, and culture.

Additionally, people in a firm are bound to organizations for various reasons. For

example, agency theory suggests that managers are less likely to give subordinates

permission to move outside an organization (Suzuki, 2018, p. 557). Owing to the

knowledge threshold, it is rarely possible to transfer salespeople into R&D

departments. It takes several months or more for a new member to be entirely

integrated into a new position. Therefore, the stickiness of human resources in an

organization may result in excessive current business requirements. As mentioned

previously, the actual level of human resources in firms often exceeds the ideal level.

Human Resource Slack (i.e., HR slack) is an important part of organizational

behavior theory. It is a measure of the difference between the actual level of human

resources in an organization and the minimum level (Cyert & March, 1956). It is the

pool of human resources in an organization that exceeds the minimum necessary to

produce a given level of organizational output (Nohria & Gulati, 1996, p. 1246). The

existing literature is generally consistent in its view of the role of HR slack: when

dealing with uncertainty, HR slack can act as a "buffer" to avoid risks or capture

opportunities (Bourgeois, 1981). Concerning the roles of avoiding risks and capturing

opportunities, HR slack's strength comes from two aspects, "quantity" and "quality,"

based on the resource-based view (RBV) and knowledge-based view (KBV) theories.

Current Literature Gaps

From an empirical perspective, Bourgeois (1981) and Bourgeois and Singh (1983)

provide a starting point for analyzing the effect of HR slack on firm performance.

Despite the extensive literature analyzing the relationship between organizational

slack and firm performance, the findings do not provide conclusive results regarding

the relationship between HR slack and firm performance. Some studies have shown a

positive effect on profitability (Carnes et al., 2019; Vanacker et al., 2013) , while

others have found the relationship between HR slack and firm performance to be

either negative or curvilinear. However, these studies were also used as being cross-

sectional or covering only a short period of time (Agusti-Perez et al., 2020; Carnes et

al., 2019; Gral, 2014; Titus et al., 2022).

This study addresses the research gap in the field of HR slack from three

perspectives. First, the duality of human resources is analyzed, and the types of HR

slack are expanded based on RBV and KBV theories. In this study, educational

background is used as a proxy to measure the level of prior expertise that employees have acquired prior to joining the organization (such as a high academic degree, professional certification or qualification, work experience in benchmark companies, and routine professional skills training). The richer and higher the level of prior expertise that the employee acquired before taking the position, the higher the degree of job matching for the employee, which leads to a shorter learning time for the position. Consequently, it can provide business managers with greater flexibility when making decisions regarding workforce configurations. Companies generally divide their employees into several functional segments, such as production, technology, sales, and finance. Each of these segmentations requires a distinct set of knowledge, skills, experience, and abilities, including business secrets and knowledge. Trade secrets and technical know-how are core assets and sources of competitive advantage for high-tech companies. It is challenging for the average person to learn and absorb such capabilities within a short period of time. Moreover, it is difficult to obtain similar talent from the market. In a competitive environment, an organization's tacit or firm-specific knowledge is a competitive advantage through which it continuously innovates, transforms, and improves efficiency to achieve better business performance. Thus, functional segmentations such as production, technology, sales, and finance act as containers for the company's tacit and firm-specific knowledge. If there are slacks in these segmentations, companies can cope with competition more comfortably. This means that even if they encounter an unexpected situation, they still have the resources to deal with it. Consequently, business leaders preserve a certain

amount of HR slack in key or core departments/positions to maintain or improve performance in the event of uncertainty.

Second, a company's performance can be measured on multiple dimensions, such as revenue, profitability, and market value. Generally, profitability and revenue growth reflect a firm's short-term market performance, whereas market value reflects the values recognized by the public. Although these indicators indicate similar fluctuations most often, in some special cases, they can move differently. This study finds that the impact of HR slack on firm performance, as measured by different indicators, is not the same.

Third, this study adopts a relatively long longitudinal approach from 2010 to 2021 and uses a sample of Chinese high-tech enterprises. After the financial crisis in 2008–2009, Chinese high-tech enterprises have experienced external risks such as "anti-globalization," "broken supply chains" and "key technology bottlenecks" as well as new market opportunities such as "Belt and Road," "home-made substitution," and "digital transformation." We observed how Chinese high-tech companies configure HR slack to maintain their performance during this period.

Additionally, when selecting a proxy for HR slack and firm performance, the possible correlation between the two types of measures should be discrete.

Literature Review

Concept and Definition of HR Slack

HR Slack Definition

HR slack is a part of organizational slack in the theory of organizational behavior (Tan & Peng, 2003). Conceptually, there are four types of organizational slack: financial, customer relationship, operational, and human resources (Voss et al., 2008, p. 149). In early literature, organizational slack is defined as follows (Cyert & March, 1992, p. 36): "[The] disparity between the resources available to the organization and the payments required to maintain the coalition." Some scholars have pointed out that its function lies in (Bourgeois, 1981, p. 30):

> *"Organizational slack is that cushion of actual or potential resources which allows an organization to adapt successfully to internal pressures for adjustment or to external pressures for change in policy, as well as to initiate changes in strategy with respect to the external environment."*

Although the definition of slack is well established, a consensus on how it affects performance remains elusive (Daniel et al., 2004, p. 566). Nevertheless, the prevailing understanding of organizational slack is that it could reduce uncertainty in the business environment.

Uncertainty is a fundamental problem for complex organizations that deal with it as the essence of the administrative process (Thompson, 2003). Especially in a turbulent environment, business leaders must think strategically about "slack" to

manage uncertainty. HR slack can play three roles based on the probability of uncertain events and their duration (in relation to the cost of holding resources). First, because some types of changes are part of business as usual (BAU), redundancy exists everywhere in the organization. For example, N+1 redundancy is widely considered in shift scheduling for seasonal order peaks in manufacturing companies. Typically, companies reserve a portion of their human resources as "routine slack" to address the short-term fluctuations in business, which occur with high frequency, even on a daily basis. Second, in the case of unexpected emergencies (which can be threats or opportunities), companies must temporarily allocate manpower to handle the event, such as solving a technical problem or participating in product customization for new markets/customers. These emergencies occur rarely, probably once or twice per year. Third, future risks or opportunities occur only in the long run. For example, firms invest in new markets or technologies because of their evolution and competition. These investments do not pay off in short-term performance, such as the digital transformation of enterprises, Google's 20% time rule (Girard, 2009), and the basic scientific research of the Alibaba DAMO Academy[3]. In conclusion, slack is embedded in an organization's operations in different ways or forms, such as processes, resources, and assets.

Therefore, with reference to the definition of organizational slack, HR slack can be defined as the difference between the actual level of human resources possessed by organizations and the minimum necessary level to enable the organizations to flexibly

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[3] See: https://damo.alibaba.com/?lang=en

allocate human resources and achieve organizational goals in the face of internal and external uncertainties. To "flexibly configure" human resources and achieve business goals, HR slack must meet three conditions: first, there is sufficient slack available in advance; second, it can quickly convert other resources into the types of human resources needed by the business; and third, immediate or future benefits outweigh the costs of acquisition, reservation, and conversion.

Table 1

Findings on Organization Slack

Study	Year	Authors	Finding
Resource-based View	1959	Penrose	• Employing an early resource-based view of the firm, proposed that because firms require surplus resources to grow, they have an incentive to use these resources productively.
A behavioral theory on slack	1963	Cyert and March,	• Employing a behavioral theory of the firm, proposed that slack fulfills both a stabilizing and adaptive role by absorbing environmental variability.
A curvilinear relationship	1981	Bourgeois	• Proposed a curvilinear slack – performance relationship because slack can provide resources for managers to engage in either creative or non-optimizing behavior.
Types of slack	1983	Bourgeois and Singh	• Found that different slack types differentially affected political behavior, goal disagreement, and goal consensus.
Relative HR slack	1983	Marino & Lang	• Difference between amount of firm HR slack and industry average (rival firms) is call relative HR slack (RHRS).
Slack related to risk-taking and performance	1986	Singh	• Found that (1) absorbed slack was positively related to risk-taking, and (2) both absorbed and unabsorbed slack were positively related to performance.
An agency theory on slack	1986	Jensen	• Employing an agency theory perspective, argued for a negative slack – performance relationship by suggesting that managers will squander these resources by using them unproductively.
A curvilinear relationship	1988	Sharfman et al.,	• There is an optimal level of slack.
Linear relationship with performance	1991	Bromiley	• Found that both available and potential slack have a positive, linear relationship with performance, but found little support for any hypothesized curvilinear slack – performance relationship.
A curvilinear relationship	1996	Nohria and Gulati	• Found strong support for a curvilinear slack – innovation relationship, suggesting that too little slack inhibits innovation whereas too much reduces investment discipline.
Slack strategy	1997	Cheng and Kesner	• Found that a firm's strategy differentially affected how it employed slack when responding to environmental shifts.

Mixed relationships relying on different contexts	1998	Greenley and Okemgil	• Found that slack has (1) positive and negative and (2) linear and nonlinear relationships with performance.
Absolute HR slack	2005	Love & Nohira	• Absolute human resource slack may have immediate performance effects leading to over-working of existing HR.
Organizational renewal as a moderator	2018	Bartłomiej	• Organizational renewal as dynamic capability with organizational(Bartłomiej J. Gabryś, 2018) • slack as a moderator
Competitive action as a mediator	2019	Carnes et al.,	• A firm's competitive behaviors direct the utilization of slack toward the realization of firm performance

Note. Listed by year of publication from far to near.

Note. Data sorted out by the author.

Resource-Based View and Knowledge-Based View

In previous studies, two theories explained the need for HR slack: the resource-based view (RBV) and knowledge-based view (KBV).

RBV believes that sustainable competitive advantage is derived from the resources and capabilities that a firm controls, which are valuable, rare, imperfectly imitable, and non-substitutable (J. Barney, 1991; J. Barney et al., 2001; J. B. Barney & Clark, 2007). When an organization formulates strategies to improve its effectiveness based on heterogeneous resources, the value of these resources is revealed. Resources have two characteristics. First, resources are scarce. Most organizations want them, but they find them difficult to come by. Second, the resources are irreplaceable and difficult to imitate. Replacing or imitating resources costs significantly (J. B. Barney & Clark, 2007). Establishing a competitive advantage in human resources can generally be achieved in a relatively short period through

external recruitment or internal training (Helfat & Peteraf, 2003).

However, some scholars believe that the knowledge and skills of human resources cannot be fully acquired through recruitment or training or cannot be acquired in a short period of time. First, competitive efforts among companies increase the rarity of human resource slack because skilled personnel cannot be easily acquired. Second, human resource slack is absorbed because resources are tied up in an organization's current operations (Voss et al., 2008, p. 151). Thus, human resource slack is rare and absorbed by nature. Based on KBV (Grant, 1996a, 1996b; Kogut & Zander, 1992), the heterogeneity of HR slack is reflected in the fact that specific employees possess unknown "tacit knowledge" (Ancori et al., 2000) or "firm-specific knowledge" (H. C. Wang et al., 2009). This is in contrast to employees with only "general knowledge" of the industry or who have acquired well-known "codified knowledge" through simple learning.

Codified knowledge is formal and structured; easy to identify, store, and retrieve; and relatively easy for people to obtain. Tacit knowledge is intuitive, difficult to define, and primarily based on experience. It is often situational and has individual characteristics that make it challenging to transfer and depend on individual actions, commitments, and participation (Polanyi, 1958). Although there are usually written job descriptions, officially released processes, rules and regulations, and operational guidelines for positions in organizations, new employees generally must go through complicated learning processes such as on-the-job training, on-the-job practice, tutoring, mentoring of key members, and personal experience accumulation. Before

they possess "tacit knowledge" and firm-specific knowledge, it takes a long time for them to become truly competent. Both tacit and firm-specific knowledge help firms gain a competitive advantage (J. Barney, 1991). Some tacit and firm-specific knowledge are firms' trade secrets. They are not shared outside the organization and may also be protected by relevant policies and laws, such as patent law. Codified knowledge can easily be acquired through short-term training and instruction manuals. General knowledge has a degree of universality and can be obtained in a timely manner from internal and external labor markets. However, it is challenging to attract talent with enterprise-specific knowledge from the external labor market and quickly place them in positions needed by the enterprise. Therefore, if enterprise managers can help other employees acquire tacit or firm-specific knowledge in a short period of time, the productivity of the organization will improve (Wambui et al., 2013).

Based on the KBV, firms' tacit or firm-specific knowledge explains why they reserve an appropriate amount of HR slack (Lecuona & Reitzig, 2014, p. 955). If a position requires only codified or general knowledge, an organization's HR Slack level may be low or close to zero under normal circumstances. Even if an emergency requires an increase in manpower, the organization can allocate existing employees or recruit them from the labor market. If a position requires tacit or firm-specific knowledge, employees need to spend time learning to meet their job requirements in the event of an emergency. Managers must also consider the opportunity cost of missing market opportunities and the best time to solve problems. From a cost-benefit

perspective, as long as the labor cost of reserving HR slack is less than the sum of the

learning time and opportunity costs, HR slack is beneficial to firm performance. Firm-

specific knowledge is often concentrated in core or critical links such as production or

technology. Therefore, if the number of employees in these core or key positions is

sufficient, companies can reduce the need for external labor or the time and

opportunity costs for new employees to acquire firm-specific knowledge.

In addition to tacit or firm-specific knowledge, does prior general knowledge

acquired by employees have a positive effect on labor productivity? Employees' prior

knowledge and experience included their educational background, work experience

and skills, and general training received from the company. Studies have shown that if

employees have richer prior knowledge and experience before joining, they can have

higher productivity, improve the long-term performance of the enterprise, help the

enterprise adapt to the environment, and update their knowledge resources from the

perspective of evolution (Dencker et al., 2009; Dokko et al., 2009; Franco & Filson,

2006). Regarding workforce recruitment, business leaders believe that talent with

work experience is more relevant to their work; therefore, candidates with work

experience and relevant knowledge are preferred (Rynes et al., 1997). Therefore,

under the same conditions, managers are more willing to recruit and retain employees

with richer prior knowledge related to their positions to improve the organization's

performance in dealing with uncertainty.

Based on the above analysis of RBV and KBV, companies need to maintain a

certain amount of HR slack to maintain competitive advantage in an uncertain

environment. The organization should have a certain amount of slack and consider the configuration of human resources with prior, tacit, and firm-specific knowledge within the organization.

HR Slack Classification

It can be classified as follows based on the attributes of HR slack:

(1) Absorbed/Unabsorbed Slack. Whether the HR slack is absorbed by the organization or by the team: Unabsorbed slack refers to the slack of liquid resources in an organization that has not been constrained within the organization, and absorbed slack refers to the slack of resources that have been constrained within the organization (Singh, 1986, p. 567). For example, employees who have completed training and are ready for assignments have unassigned slack. These employees are not currently assigned to any organization and can be flexibly assigned by managers. The mobility of human resources in enterprises or the severity of "departmental barriers" affects the levels of absorbed and unabsorbed slack. From the perspective of agency theory, departmental managers tend to retain more "HR Slack," i.e., a higher level of absorbed HR slack, in order to cope with risks or seize opportunities (Suzuki, 2018). Then the entire organization can form a "resource hardening" that is not conducive to the organization's overall agile response to risks or seizing opportunities.

(2) Internal/External Slack. Exists inside or outside the organization: Internal

slack refers to the resource that can be accessed within an organization or belongs to an organization; external slack refers to the resource that is outside the organization but can be accessed (Geiger & Cashen, 2002, p. 69). For example, after the diversification of employment in enterprises, "personnel outsourcing" or "business outsourcing" is adopted to enhance personnel flexibility, so that external personnel companies become a type of external slack for enterprises.

(3) Available/Recovered/Potential Slack. Available status: The available slack refers to the amount of unused resource slack that can be drawn at any time. Recoverable slack refers to the resource slack that is embedded in the organization but can be recovered for use when needed and can be considered the resource slack that the organization has absorbed. Potential slack refers to the potential resource slack that an organization can acquire through purchases, exchanges, conversions, and other means (Bourgeois, 1981; Bourgeois & Singh, 1983; Marlin & Geiger, 2015, p. 2341). One such example is Huawei's strategic reserve team. Owing to regional business turbulence or product line adjustment, employees join the strategic reserve team for skill conversion, which is considered recoverable slack. Employees who complete the reserve team training and leave the team may become slack in the target department. Employees who enter the succession plan for the target position in the cadre reserve team have a potential slack for the cadre position.

(4) High/L Discretion Slack. Flexibility: High discretion slack refers to highly flexible and versatile resource slack that can be used as needed. Low discretion slack refers to resource slack with a limited scope and purpose of use (Sharfman et al., 1988, p. 602). Just as cash can be used for any investment purpose, versatile talent has a high discretion slack. It is common for product or technical personnel to transfer to positions such as sales, production, and services in high-tech enterprises because it is easier for them to extend to other fields after mastering key skills. Moving from sales to a product or technical position is relatively rare. High-tech companies often offer numerous R&D and technical positions during campus recruitment to improve the level of high discretion slack. In some companies, sales, production, and other positions can be transferred from the existing R&D positions. For example, in a company with multiple business divisions or diversified businesses, if the correlation of knowledge and experience between business divisions is weak and personnel skills are difficult to reuse or cooperate with among business divisions, the company is at a low discretionary slack level. However, if the correlation of knowledge and experience between companies is strong, or there are "middle offices" and other platforms, processes, or mechanisms for coordination, the reuse or collaboration of personnel will be enhanced, and the company as a whole will have a high level of discretionary slack.

(5) Absolute/Relative HR Slack. Industry or historical comparison: Slack is

essentially a margin above the necessary level, and it is difficult to observe in practice: "What is a necessary level?" Some scholars have proposed new ideas in which relative changes (increases or decreases) are easy to observe. Therefore, comparing a company's level with its historical level in a time series can reflect an increase or decrease in the level of HR slack (Bourgeois, 1981, p. 37), which is considered absolute HR slack. Other scholars propose that it can be compared to the industry-average level (Marino & Lange, 1983, p. 82), which is known as relative HR slack. It indicates that an organization's level of HR slack is higher or lower than the industry average and is an alternative measure that considers the industry average as the "necessary level" (Mishina et al., 2004, p. 1188).

The classification of HR slack helps us better understand the meaning of HR slack and the mechanisms that affect organizational performance, and it facilitates the measurement and configuration of HR slack in practice. Although slack can be classified from multiple perspectives, there is considerable overlap in the classifications of existing studies (Gral, 2014, p. 53). When analyzing the composition and size of HR slack, it is impossible to achieve "mutual independence and collective exhaustion" (MECE). "Therefore, most of the existing literature focuses on the "overall" level without conducting in-depth analysis of the composition of HR slack.

Firm Performance

Firm Performance Definition

Firm performance refers to how well a company performs in terms of its financial and operational results. It can be measured using various financial and non-financial indicators, such as revenue growth, profitability, return on assets, market share, customer satisfaction, and employee productivity. Firm performance is often defined as a company's ability to achieve goals and objectives. Researchers may use slightly different definitions and measures of firm performance, but the overall concept remains unchanged.

This study examines the relationship between HR slack and firm performance. Previous studies failed to reach a consensus on the relationship between the two. There are two reasons for this finding. On the one hand, as a unique production factor for firms, HR has both resource and knowledge attributes. HR slack has different effects on firm performance in terms of management decisions and business operations. On the other hand, firm performance has a wide range of perspectives, and there is no single optimal performance proxy. The selection of a performance proxy also depends on the purpose and context of the study.

Firm Performance Proxy Classification

This section discusses the proxies for "firm performance." A business organization is a combination of human resources, materials, and capital aimed at

achieving certain common goals. An organization's financial performance is the result of a series of management decisions and their implementation. There is no single optimal method for measuring performance, either in the literature or in practice. Generally, the measurement methods and proxies of performance are determined by the theories adopted and the research objectives (Carton, Robert B. & Hofer, Charles W., 2007, p. 2).

Firm performance can be measured from multiple perspectives, such as financial, operational, and shareholder perspectives. From a financial perspective, firm performance proxies can be further subdivided into profitability, growth, efficiency, and liquidity. Because of the different meanings of the proxies, a company that performs well according to one proxy may not necessarily perform well according to others. Even if a company performs well when measured using one performance proxy, it may perform poorly when measured using another. For example, Huawei invested 10% more of its annual revenue in R&D. It may sacrifice profitability or efficiency in the short term to promote long-term growth or ensure survival (Carton, Robert B. & Hofer, Charles W., 2007, p. 56).

Different measurement methods have been used for different performance proxies. The research purpose and the need to support decision-making determine the structure of performance proxies, categories of proxies, and specific proxy items. Generally, proxies for firm performance can be divided into the following categories:

Figure 1

Firm Performance Proxy Classification
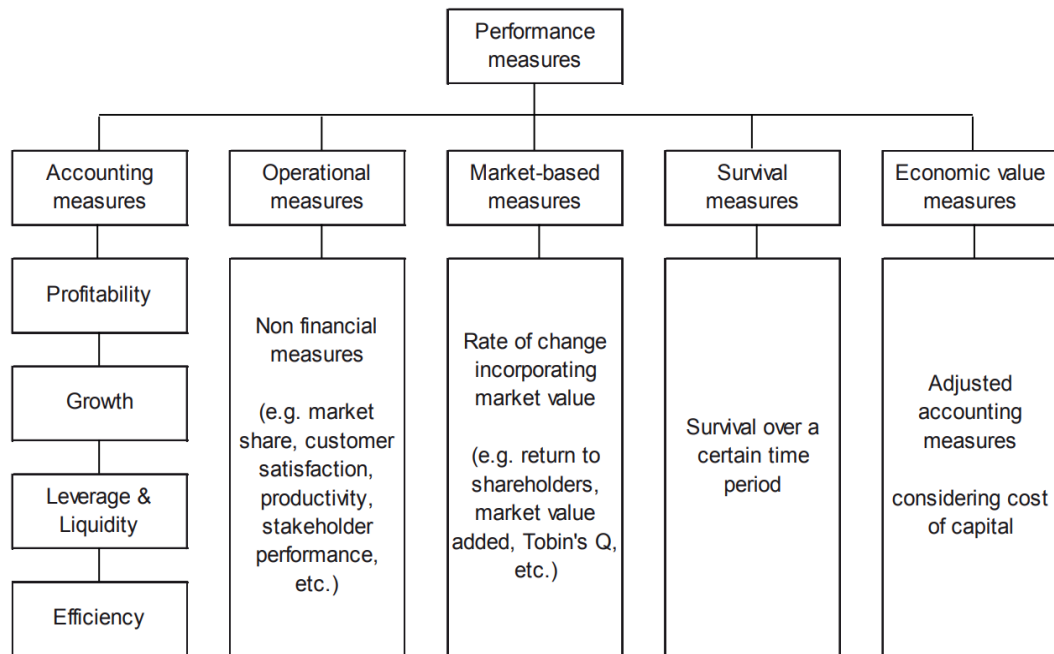
Note. Data source (Carton, Robert B. & Hofer, Charles W., 2007, pp. 61–63) .

Although there are few choices for a proxy of firm performance, they must be consistent with the purpose of this study. According to the definitions of HR slack (Equations 1, 2, and 3), it contains at least one financial factor, sales, or operational revenue. The proxy selection of firm performance should be discrete to avoid possible correlation problems. For example, as described in the following formula, the revenue factor (or sales) is embedded as a proxy for growth:

Growth = (Revenue in this year – Revenue in last year)-1

Therefore, the proxy for growth in Figure 1 was not selected for this reason.

In addition, we consider the extent to which these indicators have been used in previous studies. Carnes summarized the types of firm performance proxies involved

in the slack topic, as presented in Table 2 (Carnes et al., 2019, p. 66), such as

accounting measures (e.g., ROA or ROE), market-based measures (e.g., Tobin's Q),

operation proxies (e.g., market share), and surveys. In slack research, ROA and

Tobin's Q are often used as proxies for firm performance (Carnes et al., 2019; Daniel

et al., 2004). ROA is an accounting measure or financial proxy, whereas Tobin's Q is a

market-based measure, accounting for 31.7% and 9.6%, respectively. ROA measures

how efficiently a company uses its assets to generate profits. Tobin's Q is used to

assess whether a company is overvalued or undervalued.   In this study, accounting-

and market-based measures were used to determine companies' financial

performance.

Table 2

Number of Firm Performance Proxy in the Slack's Research

Performance Proxy	Number	Percentage
ROA	93	31.7%
Profit	36	12.3%
Tobin's Q	28	9.6%
ROS	18	6.1%
Revenue (including growth and per share)	17	5.8%
Survey	14	4.8%
ROE	14	4.8%
Sales growth	13	4.4%
Net income (including scaled by revenue)	9	3.1%
Market share	8	2.7%
EBITDA	8	2.7%
Market-to-book ratio	6	2.0%
ROI	5	1.7%
EBIT (including scaled by sales)	4	1.4%
ROIC 400	4	1.4%
Other	3	1.0%
Operating revenue	3	1.0%
Sales	2	0.7%
Stock price	2	0.7%
Composite financial indicators	1	0.3%
Operating profit	1	0.3%
Stock return	1	0.3%
Productivity	1	0.3%
Market value	1	0.3%
Asset turnover	1	0.3%
Total	293	100.0%

Note. Data source, (Carnes et al., 2019, p. 66).

Relationship Between HR Slack and Firm Performance

HR slack is a subset of organizational slack. Academic research has been

conducted on the relationship between organizational slack and firm performance.

Scholars generally believe that organizational slack, while imposing certain costs,

mitigates the impact of internal and external pressures on the core part of an

enterprise, thereby facilitating improvements in firm performance (Daniel et al.,

2004). Some scholars also believe that slack is a source of agent problems, which can

lead to inefficient resource configuration, risk-taking, and reduced performance

(Jensen, 1986; Jensen & Meckling, 1976). Some studies suggest that the relationship

between organizational slack and firm performance may be nonlinear (e.g., inverted

U-shaped) in certain contexts (Bromiley, 1991; Love & Nohria, 2005; Tan, 2003).

There is no consensus in the existing research literature on the relationship

between HR slack and business performance.

Table 3

Literature on the Relationship between HR Slack and Firm Performance

No.	Author (s)	Year	Journal	Variables	Slack Proxy	Performance Proxy	Context	Relation
1	Greer, Charles R Bruton, Garry D Zachary, Miles A	2022	International journal of human resource management	Human resource slack	HR slack=firm employees/firm sales - X industry employees/ X industry sales.	patent counts	Standard and Poor's 500 (S&P 500) list from 2007-2013	negative
2	Scott Bentley, F Kehoe, Rebecca R	2020	Academy of Management journal	HR slack	the difference between a firm's employees-to-sales ratio and the average employees-to-sales ratio across other firms in the industry	Tobin's Q	U.S. commercial banks from 2002 to 2014,	positive
3	Zhang, Ying Li, Ji Hu, Yanghong Song, Wenwen Jiang, Wanxing Ding, Wanling	2020	International journal of human resource management	Research-and Development HR Slack	the difference between the organizational-level and the industry-level average of the R&D employees over firm sales	ROA Tobin's Q numbers of R&D patent applications and grant	325 publicly listed firms, i.e. the Chinese automobile industry from 2001 to 2014	a linear positive relationship between RHR slack and stock market performance

4	Meyer, Michael Leitner, Johannes	2018	Nonprofit management & leadership	Human resource slack	Questionnaire scale，3 items: 1. The level of qualification of our employees exceeds by far the minimum necessary to correctly carry out the task 2. Our employees are highly motivated and would deliver additional performance in times of stress. 3. If necessary, we can easily recruit additional volunteers	innovation performance (metric score)	250 Austrian nonprofits (NPOs)	highly significant and positive
5	Lecuona, Jose R Reitzig, Markus	2014	Strategic management journal	HR slack Codified HR slack Tacit and general HR slack Tacit and specific HR slack	relative HR Slack compares to industry average value	gross profits	labor intensive firms, Mexicao Manufacture firms （operating under Mexico's In-bond Industry Program), Year 1991-2006	only tacit and firm-specific HR slack can increase firm profitability
6	Fonseka, M M Wang, Peng Manzoor, Muhammad Suhaib	2013	Zbornik radova Ekonomskog fakulteta u Rijeci	absolute HR slack relative HR slack	revenue/employee numbers	ROI	Chinese SOE and non-SOE （Excluding financial companies），Year 2000-2009	AHRS and RHRS show positive and negative effects on performance respectively
7	Vanacker, T., Collewaert, V. and Paeleman, I.	2013	Journal of management studies	HR slack	employment cost / assets	gross profits	Private Equity like Venture Capital, Angel Capital，1215 Belgium firms from Year 1994-2004	positive

#	Author	Year	Journal					
8	Huang, Jing-Wen Li, Yong-Hui	2012	Journal of business research	team learning (Exploitative learning, Exploratory learning)	absorbed and available HR slack as moderating variables	project performance	survey by questionnaire，top 5000 Taiwanese firms listed in the yearbook	absorbed slack resources have a positive interaction effect on the relationship between, team learning and project performance
9	Mellahi, Kamel Wilkinson, Adrian	2010	Journal of management studies	slack reduction	the percentage of employee reduction	patent count as innovation output	Panel date and 6 interviews with top management among 258 medium and large British companies，Year 1997-2003；Patent data from Year 1999-2004	the level of sudden decline in slack as a result of downsizing does not have a significant impact on innovation
10	Geoffrey Love, E Nohria, Nitin	2005	Strategic management journal	personnel-related absorbed slack	sales, general, and administrative (S&GA) expense	ROA-Market ROA-Book	Year 1977-1993，Fortune Top 100 manufacture companies，downsize events	high-absorbed-slack more positive on firm's performance
11	Mishina, Yuri Pollock, Timothy G Porac, Joseph F	2004	Strategic Management Journal	Human resource slack	Human resource slack=firm (employees/firm sales) - (industry employees/ industry sales)	Sales growth (Market expansion & Product expansion)	112 listed companies in manufacturing industry from Ewing Marion Kauffman Foundation's database, Year 1991-1997	human resource slack would positively moderate the relationship between market expansion and sales growth；and negatively moderate the relationship between product expansion and sales growth.

Note. Sorted by year of publication.

Note. Data sorted out by the author.

Table 3 shows the recent research results on HR slack and firm performance. The types of HR slack, measurement proxies, research scenarios, and key findings of each study are presented. These significant differences are mainly due to (1) types of HR slack, (2) measurement proxies, and (3) research contexts.

(1)   Differences in HR slack types: Most studies rely on a resource-based view to analyze the types of HR slack, taking employees, with no differences between individuals. When analyzing absorbed and unabsorbed HR slack, the criteria for distinguishing between them are not based on individuals but rather on the organizations on which the resources rely (George, 2005; Huang & Li, 2012). If there are significant differences in the nature of the workforce within or between organizations, the definition of HR slack may differ.

(2)   Differences in measurement proxies: While HR slack is typically measured as the ratio of a company's headcount or cost to its revenue or assets, some scholars choose a "reference" when selecting a particular proxy, that is, the company's historical level or industry average level; therefore, the proxy is relative (Fonseka et al., 2013; Greer et al., 2022; Lecuona & Reitzig, 2014; Mishina et al., 2004). Compared with its historical level, the fluctuation in the HR slack level is greater. Compared with the industry-average level, the fluctuation in the HR slack level is smaller. Therefore, the significance and correlation of the impact of HR slack on firm performance may vary depending on the choice of proxies. Although most studies selected proxies

related to profitability, such as ROI, ROA, and gross profits, some selected

proxies related to market and growth, such as sales growth, market, and

product expansion (Mishina et al., 2004). The business strategies chosen by

a company can vary widely because of the different goals set by its

management (growth or profitability, short- or long-term). For example,

layoffs may reduce HR slack and improve profits in the short term, but they

may destroy the innovative atmosphere that has a significant impact on long-

term performance (Mellahi & Wilkinson, 2010).

(3) Differences in research contexts: The role of HR slack can be more

significant when human resources are key elements of a business, such as in

labor-intensive manufacturing companies (Lecuona & Reitzig, 2014),

knowledge-intensive technology companies (Greer et al., 2022), and non-

profit service organizations (NPOs) (Meyer & Leitner, 2018). However,

using manufacturing as a sample, the impact of different types of HR slack

on firm performance may also differ, especially regarding firm-specific

knowledge or competitive advantage (Lecuona & Reitzig, 2014; Mishina et

al., 2004).

Therefore, HR slack research requires a careful explanation and analysis based on

the research purpose, scenario, nature of the research object, and available

measurement proxies and data.

Summary for Literature Review

HR slack is defined as the gap between the actual and the minimum necessary

levels of human resources possessed by organizations, which allows the organization to be more flexible in dealing with internal and external risks or uncertainties for the goals of the business.

However, the role of HR knowledge attributes in HR slack research is poorly understood. HR slack is commonly considered a "redundant" resource or an "additional" cost. Moreover, such "redundant" and "additional" resources are meaningful only for risk prevention. There is no consistent perception of the relationship between HR slack and firm performance.

Human resources are a type of resource for the company, and they are also a type of resource that condenses the knowledge and skills of the company. It possesses the characteristics of both resources and knowledge. Most studies adopt a resource-based view to analyze types of HR slack, recognizing employees as a whole with no differences between individuals. However, organizations rely on different resources to perform various functions, which means that the nature of the workforce within and outside organizations differs significantly. Therefore, further studies on HR slack types based on KBV are mandatorily required. The KBV and RBV theories explain the dual value of human resources in achieving a firm's objectives.

Scholars claim that HR slack positively affects firm performance in a risky, fiercely competitive, or uncertain environment. However, few studies reveal the mechanism through which HR slack (i.e., unused human resources) promotes firm performance. Therefore, both theoretical and empirical analyses were required.

Previous studies have not clarified the mechanism underlying the impact of HR

slack on firm performance in terms of the dual attributes of resources and knowledge.

We must recognize the attributes of HR slack better, select variables and

measurements, and identify specific research contexts. Practically, HR slack is

difficult to measure when there are many firms in various industries. Some scholars

use a relative proxy to compare with a firm's own historical level, whereas others use

another relative proxy to compare with the industry-average level. It is necessary to

reconcile these proxies based on understanding the generation and development of

HR slack in firms. Additionally, the correlation problem should be avoided when

selecting a proxy for the dependent and independent variables.

Theory and Hypothesis Development

Based on the literature review, this section develops key hypotheses on the

relationship between HR slack and firm performance. Previous studies failed to reach

a consensus on the relationship between HR slack and firm performance. There are

two reasons for this finding. Different scholars use completely different research

methods (such as theory, concepts, definitions, measurement proxies, samples, and

data), and the research scenarios are different. More importantly, the attributes that

distinguish HR slacks from other resource slacks have not yet been fully uncovered

and validated. Some scholars suggest that the uniqueness of HR slack lies in its

duality, which includes both resource and knowledge attributes (Lecuona & Reitzig,

2014; Voss et al., 2008).

Absolute HR Slack and Relative HR Slack

When a company is considered as a whole, the level of HR slack is mainly identified and measured by "comparison," and the key is the "reference" for comparison. As mentioned earlier, the reference can be the historical level of the organization or the average level of the industry. The change in HR Slack relative to the company's historical (e.g., prior year) level is defined as "Absolute HR Slack (AHRS)," which measures the increase or decrease in the company's HR slack over time. The change in HR slack relative to the average level of the industry in which the company operates is defined as "relative HR slack (RHRS)," which measures the amount of HR slack that exceeds the minimum required level relative to the industry average level.

Scholars have pointed out that the phenomenon of learning by doing has been observed in several labor-intensive enterprises; that is, as experience increases, production costs can be reduced, and a certain amount of labor is generated after productivity increases (Hatch & Dyer, 2004, p. 1156). Under the condition of unchanged technology, processes, and management methods, the production efficiency of enterprises will gradually improve with an increase in working hours/time and output scale, and the manpower required for output of the same scale will decrease. As production efficiency improves, managers may find that the same output does not require as much labor as before. How should this "HR Slack" (AHRS) be handled compared to the previous period? In theory, managers have four options (Cheng & Kesner, 1997, p. 5): (1) investing a portion of the workforce in

new markets or products to increase output or optimize processes to improve efficiency; (2) reducing redundant staff and costs;   (3) performing knowledge and skill transformation for these employees and reserving talent to meet the needs of new positions; and (4) being absorbed by the original department. To cope with external uncertainty or explore market opportunities, enterprise managers combine and flexibly allocate the above options according to the principle of benefits outweighing costs. If HR slack persists for an extended period of time, or if layoffs continue, it will increase costs and affect employee morale. Therefore, companies should promptly identify HR slack and leverage this part of the workforce based on strategies and feasible resource deployment models to improve firm performance.

A high level of RHRS indicates that a company's current HR slack is higher than the average level of its competitors in the same industry. Talent is a core competitive advantage of knowledge-intensive industries. On the one hand, talent is scarce and hard to come by, and on the other hand, the learning threshold is high and requires a significant amount of capital and time. Simultaneously, when competition is fierce, business managers are particularly concerned about fleet market opportunities and always crave a "strategic reserve" that can be readily deployed in battle (e.g., new products and markets). Therefore, from a competitive perspective, company managers tend to have a slightly higher "HR slack" than their competitors, which means a higher RHRS, which helps the company grow its business. In addition, studies have shown (Majumdar, 1998) that having slightly more HR slack than competitors—that is, a higher level of RHRS in the company—does not significantly affect efficiency.

Thus, the following hypotheses are proposed in this paper:

Hypothesis 1a: Absolute HR Slack (AHRS) has a positive impact on firm performance.

Hypothesis 2a: Relative HR Slack (RHRS) has a positive impact on firm performance.

Figure 2

Hypotheses 1a and 2a: Overall AHRS/RHRS and Firm Performance
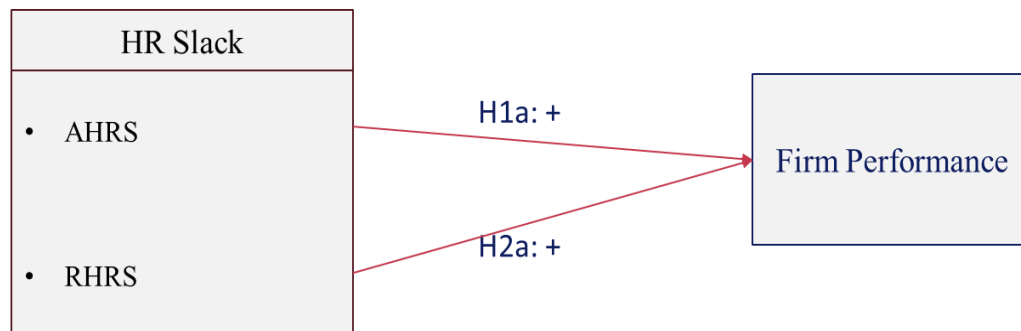
HR Slack with Tacit and Firm-specific Knowledge

Tacit and firm-specific knowledge are for a specific organization and are generally not related to individuals (Lecuona & Reitzig, 2014, p. 957). Firm-specific knowledge matters only in specific work environments (Helfat, 1994). When a company receives a large order with a tight delivery schedule and realizes that there are no "skilled" personnel available in key production and technical links, it will be extremely anxious and regret not having "reserved talent." Owing to the existence of tacit and firm-specific knowledge in various departments/positions of the organization, when unexpected situations arise, companies need a certain amount of

HR slack and qualified HR slack in departments/positions with requirements for tacit and firm-specific knowledge. "Firm-specific knowledge has the greatest potential to serve as a source of sustainable performance advantage" (H. C. Wang et al., 2009).

For certain departments and positions, managers prefer to reserve HR slack. Business leaders should consider two aspects: When unexpected situations occur, the organization's absorbed HR slack can be quickly replenished and put to immediate use without affecting current income or profits. However, temporary external hires or internal deployments require time to train newcomers, which may result in missed opportunities and impact current revenues or profits. Especially when a company's firm-specific knowledge is also a form of tacit knowledge, managers have no choice. It takes a longer time for newcomers to understand and master "the skills and knowledge of other colleagues in specific scenarios and key processes that are only slightly different" (Szulanski, 1996). Leaving aside the turbulence of "decoupling," "chain breaking," or "anti-globalization" that the high-tech industry is experiencing, "unexpected situations" are the norm; that is, "uncertainty appears as the fundamental problem for complex organizations, and coping with uncertainty is the essence of the administrative process" (Thompson et al., 2003, pp. 159–163). Managers should have an appropriate level of HR slack in core departments and key links.

Owing to the existence of tacit and firm-specific knowledge in almost every specific group of firms, it can be inferred that the HR slack of specific groups impacts firm performance, but to varying degrees. Therefore, instead of examining tacit and firm-specific knowledge, we identify which HR slack in specific groups, such as

production, finance, sales, and technology, may have different effects on firm performance.

Therefore, the following hypotheses are proposed in this paper:

Hypothesis 1b: AHRS with tacit and firm-specific knowledge positively affects firm performance.

Hypothesis 2b: RHRS with tacit and firm-specific knowledge positively affect firm performance.

Figure 3

Hypotheses 1b and 2b: AHRS/RHRS in Job Groups and Firm Performance
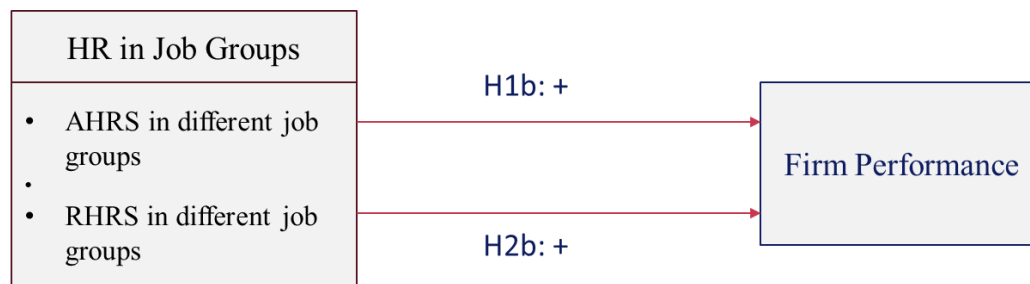
HR Slack with Prior Expertise

"Agility" is essential for companies to allocate human resources to cope with unexpected situations. Even within an organization, employees still need to spend time learning codified knowledge, in addition to the time cost of learning and mastering the organization's tacit and firm-specific knowledge for external hires. Considering the costs and benefits, can the "time cost" to the company be reduced if some knowledge can be learned "in advance" or mastered before starting the job?

General knowledge of the profession is not closely related to a company's work

environment (H. C. Wang et al., 2009, p. 1267). The general knowledge that employees acquire in advance of a new position comes primarily from three channels: prior employment education, post-employment general skills training, or self-directed learning based on personal interests. When companies hire employees, they typically examine a candidate's existing academic credentials, professional qualifications, or work experience, known as educational requirements and screening, to determine whether the candidate is qualified for the job and how long it takes for the candidate to become competent in the job. Higher education generally leads to better production efficiency (Hatch & Dyer, 2004, p. 1158; Hitt et al., 2001, p. 14). All other factors being equal, highly educated candidates were more likely to be hired. Similarly, prior or routine internal training, job rotation, coaching, and knowledge sharing can enrich employees' professional knowledge and experience. When it comes to allocating and deploying human resources across the organization, the richer the prior knowledge of employees (i.e., the higher the level of HR slack), the more flexible the configuration and combination of resources. Business leaders are more agile in making workforce deployment decisions. This means that the more prior expertise employees have, the better their job performance.

Therefore, the following hypotheses are proposed in this paper:

Hypothesis 1c: AHRS with prior expertise has a positive impact on firm performance.

Hypothesis 2c: RHRS with prior expertise has a positive impact on firm performance.

Figure 4

Hypotheses 1c and 2c: AHRS/RHRS with Education Levels and Firm Performance
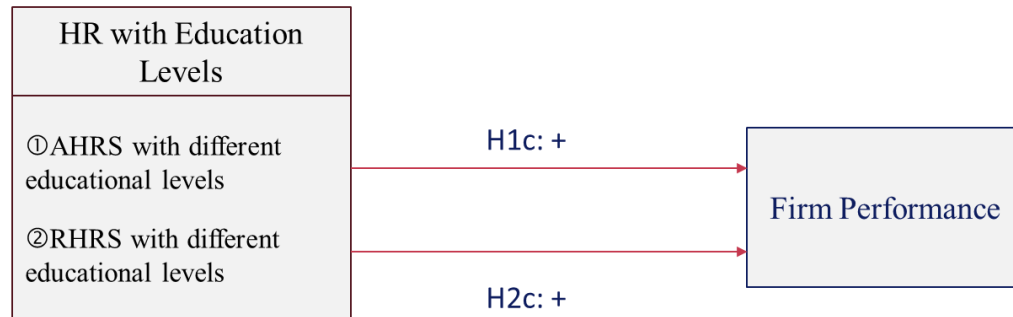
Moderation between HR Slack and Firm Performance

Property rights theory emphasizes the decisive role of property ownership, and differences in property rights structures may affect how firms make decisions and strategies. First, state-owned enterprises (SOEs) typically have greater access to resources, including human resources, due to job security and social networks. This makes SOEs more likely to outperform non-SOEs in terms of HR slack. Second, SOEs and non-SOEs face different decision-making environments and constraints when allocating resources, which may lead to different decisions regarding human capital investment. State-owned enterprises (SOE) are essentially extensions of the government and are therefore responsible for multi-task objectives(Xin et al., 2019). Governments try to steer SOEs to pursue social and political objectives, which can lead to inefficiencies, but they also provide them rents and protection, factors that should lead them to perform as well or better than similar private firms(Lazzarini & Musacchio, 2018). State-owned enterprises (SOEs) may be willing to make more

long-term investments, including investments in human capital, because of factors such as larger size and greater stability, which may make SOEs indicate a stronger influence of the effect of HR slack on firm performance. SOEs have stable annual budgets for investing in staff training and career development, whereas non-SOEs may not. Third, the different natures of property rights imply that firms face different institutional environments. Chinese SOEs may benefit from a more favorable policy and social environment, including preferential access to high-quality human resources and greater investment in human resource development.

Hypothesis 3: The relationship between absolute HR slack (AHRS) and firm performance is moderated by the ownership type of the firm, such that the relationship is stronger when firms are SOEs than non-SOEs.

Figure 5

Hypothesis 3: Ownership as a Moderator for AHRS.
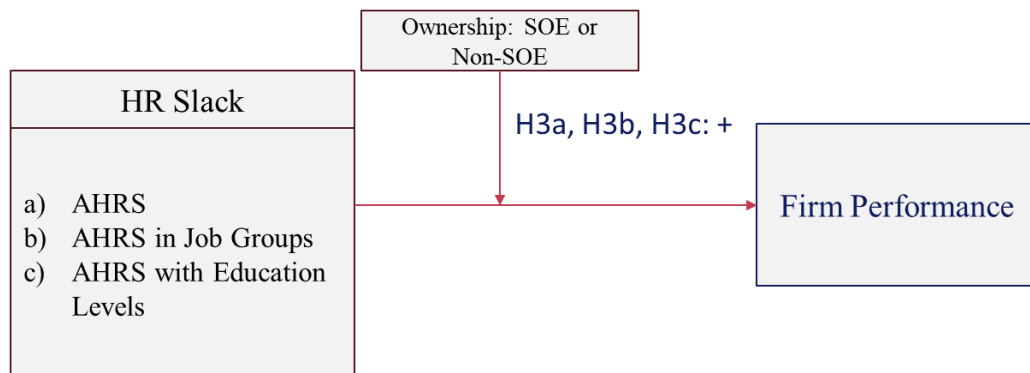
Hypothesis 4: The relationship between relative HR slack (RHRS) and firm performance is moderated by the ownership type of the firm, such that the relationship is stronger when firms are SOEs than non-SOEs.

Figure 6

Hypothesis 4: Ownership as a Moderator for RHRS
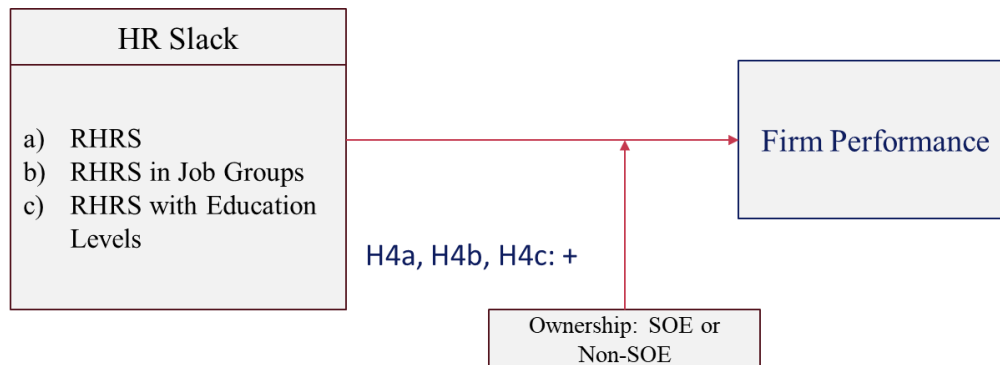
Absorbed slack accounts for a higher ratio of organizational resources in the manufacturing industry than in the non-manufacturing industry, such as equipment, production materials, inventory, and a skill-specific workforce, which are not easily converted into available resources when there are opportunities for new markets and new products. Furthermore, under fierce competition, the manager of the manufacturer prefers holding higher HR slack instead of absorbed slack resources. Manufacturing firm managers know that:

(1) It takes more time and money to recruit newcomers to the labor market for skill-specific jobs. The qualification requirements for manufacturing firms should be more stringent than those for non-manufacturing firms.

(2) It is more difficult to acquire tacit and firm-specific knowledge in a short time in manufacturing firms than in non-manufacturing firms.

(3) Even in the worst cases, management would keep the production lines running at a minimum status rather than shutting down the machines, as restarting the

system and calling in labor would be costly.

Therefore, the following hypotheses are proposed in this paper:

Hypothesis 5: The relationship between AHRS slack and firm performance is
moderated by the industry type of the firm, such that the relationship is stronger when
the firms are in the manufacturing industry than in the non-manufacturing industry.

Hypothesis 6: The relationship between RHRS slack and firm performance is
moderated by the industry type of the firm, such that the relationship is stronger when
the firms are in the manufacturing industry than in the non-manufacturing industry.

Figure 7

Hypotheses 5 and 6: Industry as a Moderator for AHRS/RHRS.
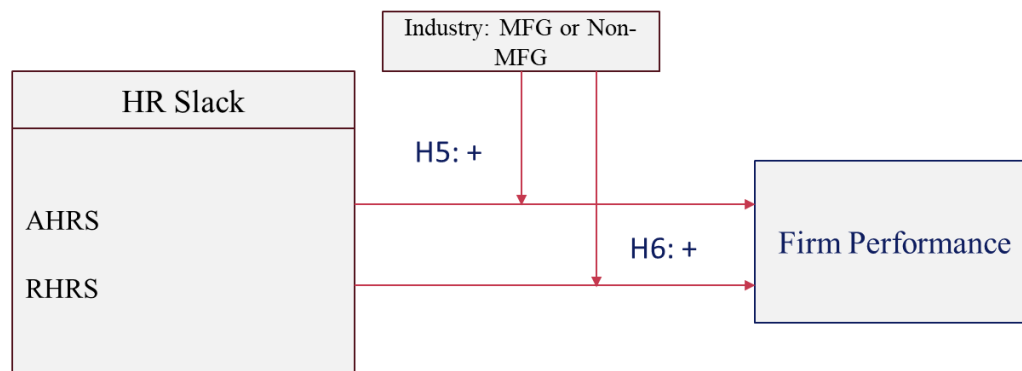
Mediation between HR Slack of Specific Groups and Firm Performance

How does HR slack affect firm performance? Before answering this question, we
consider two premises. First, the HR slack could have a direct effect on firm
performance. Second, HR slack may indirectly affect firm performance.

HR slack may affect firm performance in various ways. For example, in a high-
tech company, more slack in basic research is configured for long-term innovation.

Alternatively, the higher the proportion of highly skilled professional employees, the more likely the firm is perceived as having a high capacity for technological innovation. We cannot understand all the mechanisms mediating the relationship between HR slack and firm performance in all contexts. Although there are multiple paths to the impact of HR slack on firm performance, this study focuses on one mediation path: financial constraints. With staff slack, companies are more likely to take advantage of good investment opportunities that can appeal to potential capital providers and reduce their financial constraints. This factor is more relevant to the Chinese stock market. In addition to technological and innovation factors, China's high-tech listed companies crave financial support from the market. High-tech companies can be recognized by the public through IPOs. They also improve internal management and operations in compliance with regulations, especially regarding firm governance, information disclosure, and social responsibility. Thus, stakeholders should be able to assess and evaluate listed companies objectively, accurately, and comprehensively without information asymmetry. High-tech-listed companies can access financing to fuel their businesses at lower costs.

Therefore, we examined the role of financial constraints in the impact mechanism of HR slack on firm performance.

HR Slack and Information Disclosure

First, what does it mean for an organization to have sufficient staff when dealing with the affairs of the capital market, both in terms of quality and quantity?

Typically, financial staff provide financial support to a business rather than being

directly involved. Financial and nonfinancial information is essential and useful for

organizations. Especially for listed companies, there is a prominent need for

mandatory and voluntary information disclosure, which should be prepared and

analyzed by professional staff, such as finance, planning, and operations staff (Craft,

1981, p. 101). High-tech listed companies require more external capital investments to

support their innovation. These companies typically maintain close communication

with stakeholders such as investors, financial institutions, and regulators to obtain the

funding needed for corporate innovation. Accountants are likely to play a partisan role

and will probably become increasingly involved in a number of support activities in

collective bargaining (Craft, 1981, p. 106). For example, he will help prepare

management and industrial relations staff members for negotiations. This may be

done through the preparation of bargaining fact books of relevant data needed for

negotiation; by developing special reports; by presenting pre-negotiation conferences

for relevant personnel to keep them aware of the current financial practices,

performance, and plans of the firm; and finally by encouraging questions and

remaining responsive to bargaining committee requests for information. In addition,

the accountant may serve on committees used by the bargaining team for advice and

counseling as negotiations progress. In some cases, the accountant may serve on the

bargaining team as an expert on financial matters or as a resource for the team (Craft,

1981, p. 106).

A study on the problems faced in preparing financial reports found that although

all charity organizations submitted their balance sheets to the Registrar of Society

(ROS), the level of reporting practice varied. Only 60% presented cash flow statements, and 59% had their financial reports audited by external auditors (Nasir et al., 2009, p. 19). This is due to a lack of skilled accounting staff and high staff turnover, which calls for the employment of experienced accountants (Rosnia Masruki et al., 2020, p. 352). Heijden and Van (2013) found that accessibility to qualified accountants in large Dutch-registered charities is more likely to result in a higher quality of reporting than in smaller charities (van der Heijden, 2013). The finance staff profile regarding the number of employees and their qualifications can explain the extent of disclosure.

Other staff also provide support for information disclosure. Sometimes, they provide the required data, information, and reports to the financial staff. Technology, production, and other staff are often directly involved in communicating with external stakeholders, which should be more direct, reliable, and effective.

In an imperfect capital market, the information asymmetry between firms and external investors is an important reason for firms' financing constraints (Fazzari et al., 1988). In this study, HR slack includes the number of resources and value of knowledge. Major companies have larger financial and accounting departments as a rule, as well as better qualified staff, and these factors may have a positive impact on the extent of information disclosure (Biaek-Jaworska & Matusiewicz, 2015, p. 476). The renowned "Big Four," with their better-trained staff and experience in the application of IFRS, could provide more effective support to their customers as far as disclosure required by the standards was concerned (Biaek-Jaworska & Matusiewicz,

2015, p. 476). Numerous scholars seek ways to alleviate financing constraints from the perspective of reducing information asymmetry in firms. Thus, the relationship between HR slack and the quality of a firm's information disclosure is significantly positive.

Financing Constraints and Firm Performance

Second, financing constraints are a global problem affecting all aspects of business development. Financing constraints are the difference between the internal and external financing costs of an enterprise (Myers & Majluf, 1984). Enterprise financing channels primarily include internal and external financing. Internal financing is based mainly on the internal surplus of an enterprise, whereas external financing raises funds from financial institutions, individuals, or institutional investors.

Firms often face financial constraints. External financing and active R&D smoothing with cash holdings affect the existence and importance of financing constraints on R&D (Brown et al., 2012, p. 1514). Evidence from China shows that financing constraints can hamper firms' investments in R&D and innovation eventually, in a series study of the role of financing friction in R&D investments (Cui & Yang, 2018, p. 160). High-tech firms may be viewed as presenting additional financing problems compared to other general firms (Westhead & Storey, 1997, p. 197). It is particularly difficult to assess the marketplace because the product or service is novel. In technological areas, products or services have a shorter lifespan than in more conventional sectors. Financing is often required to conduct R&D in the

pre-product or pre-service stage. The growth of high-tech firms is constrained by a lack of access to finance. Financing constraints play a significant role in determining the probability of a firm's survival (Musso & Schiavo, 2008, p. 147).

The measurement proxies for ROA and ROE show significant negative impacts on the relationship between financial constraints and firm performance (Ahamed et al., 2023, p. 1702). When financing constraints are alleviated, firms will accumulate more internal capital and enhance risk tolerance, so that firms can have more funds to expand reproduction and actively carry out technological upgrading and other innovative activities to improve factor productivity and firm performance (X. Wang et al., 2022, p. 4).

Information Disclosure on Financing Constraints

Third, information disclosure can reduce the cost of equity and debt, thereby alleviating financing constraints and releasing cash for investment in R&D projects (Jiang et al., 2016). The mandatory disclosure of operational information can alleviate firms' financing constraints and improve their innovation ability, which in turn increases innovation (Liu et al., 2023, p. 4). First, operational information disclosure reduces the internal and external information asymmetry of firms (Glosten & Milgrom, 1985), increases stock liquidity, and reduces equity costs of equity (Diamond & Verrecchia, 1991). Second, operational information comprises non-financial information such as production and sales volumes, which can predict the future business performance of a firm. Such disclosures help investors and creditors accurately assess a firm's future risk, thereby lowering risky returns and reducing the

costs of equity and debt. Third, the disclosure of information related to investment

projects helps creditors track and monitor the use of project funds, reduces

shareholders' motivation to engage in behaviors detrimental to creditors, and, in turn,

reduces the cost of debt. Operational information is strongly correlated with financial

information. This implies that the mandatory disclosure of operational information

can be used to verify the reliability of accounting information (Brazel et al., 2009;

Dechow et al., 2011;), making it difficult for firms to manipulate accounting numbers.

Mediated Effects of Financing Constraints

Finally, HR slack determines the quality of a firm's information disclosure, which

has an impact on the firm's financing constraints and firm performance. The higher

the HR slack, the better the quality of the firm's information disclosure. The better the

quality of a firm's information disclosure, the lower its financing constraints, and the

better the firm's performance. The mediating effect of financing constraints on the

relationship between HR slack and firm performance is as follows:

Figure 8

Mediation Effect Model by the Financing Constraints.
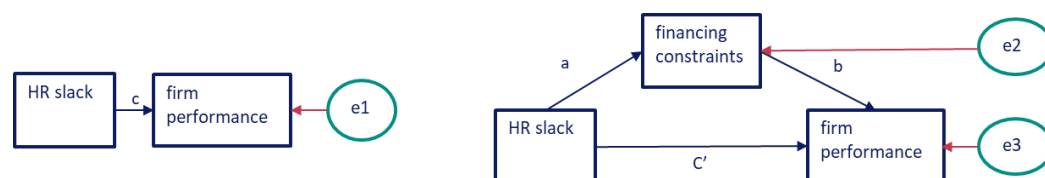
Therefore, the following hypotheses are proposed in this study:

Hypothesis 7: The financial constraint mediates the relationship between AHRS

and firm performance.

Figure 9

Mediation between AHRS and Firm Performance.
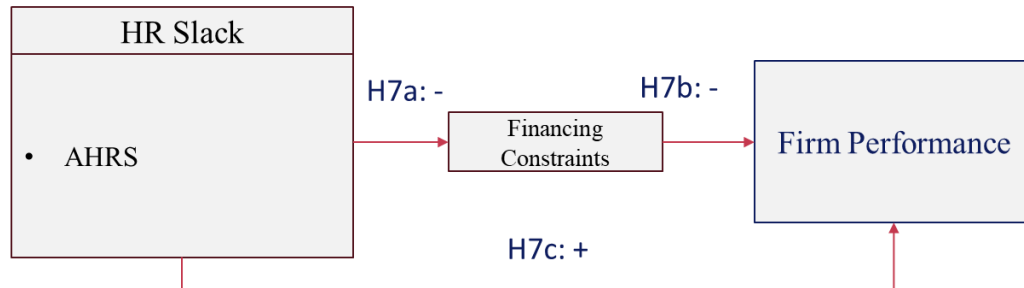
Hypothesis 8: The financial constraint mediates the relationship between RHRS and

firm performance.

Figure 10

Mediation between RHRS and Firm Performance.
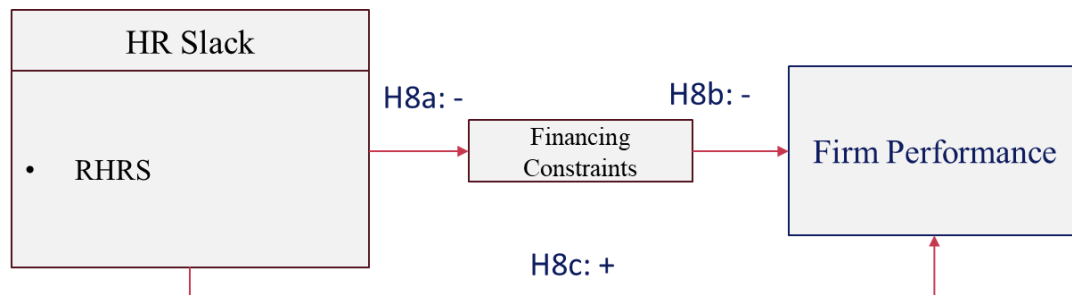
Summary of the Overall Theorical Model and Hypotheses

Due to the different "necessary levels," the absolute HR slack (AHRS) and the

relative HR slack (RHRS) are employed in this study. The theoretical model and

hypotheses are as follows:

Figure 11

Overall Theorical Model and Hypotheses (AHRS)
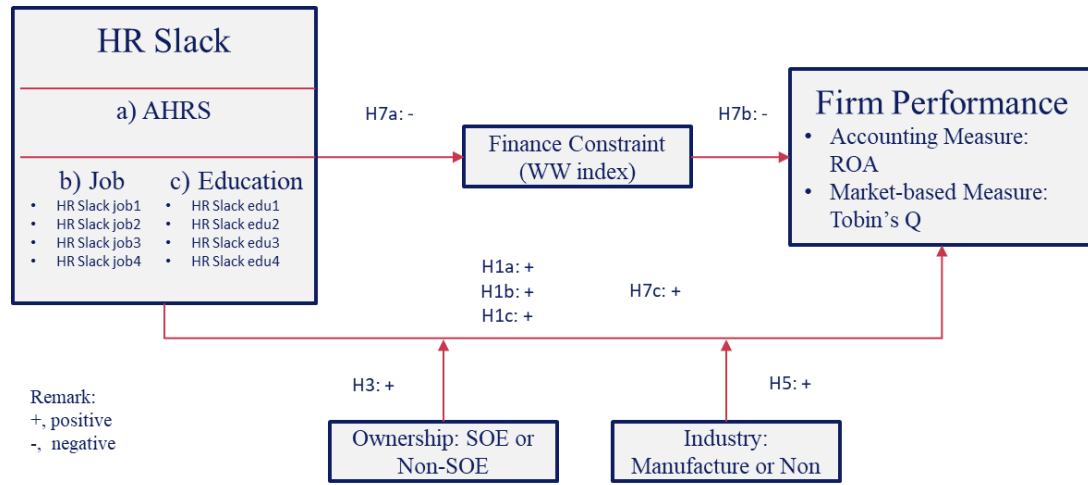
Figure 12

Overall Theorical Model and Hypotheses (RHRS)
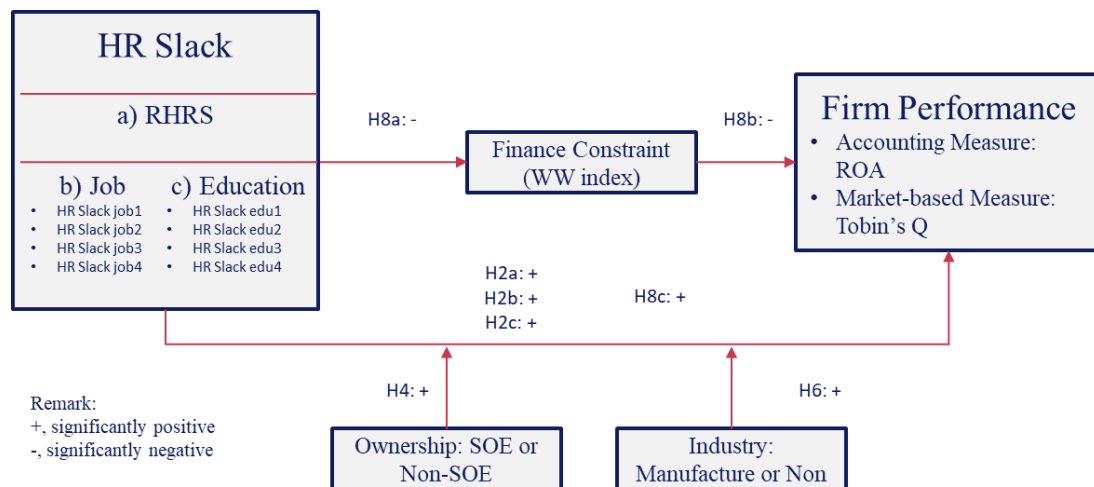
Research Design

Sample and Data

To verify the hypotheses, according to the research purpose of this paper, listed companies in China's Shenzhen and Shanghai A-shares that have obtained high-tech certifications are selected for analysis. In the selection of samples and data, the following screening conditions are considered in this paper:

First, data from 2010 to 2021 is selected. Due to the global financial turmoil in 2008 and 2009, the systematic risk caused by the U.S. subprime financial crisis, and the "rescue" measures taken by China, the operation of listed companies has suffered great fluctuations. Therefore, the starting year of the data is 2010. The end date is set to 2021, mainly because the data required for some variables in this study will only be updated to 2021. Considering that the timeliness of the data in 2021 can still be well met, the end date in this paper is set to 2021.

Second, in the selection of enterprises, "high-tech enterprises" are selected for empirical analysis. The reason for choosing high-tech companies is firstly that they rely on human resources and are knowledge-intensive organizations. The development of high-tech companies mainly depends on their knowledge, skills, and innovation capabilities, which are important components of human resources. The role of HR slack is likely to be more important in these types of companies. Then, high-tech enterprises face fierce competition in technological innovation, which often depends on the company's human resources. HR slack directly affects the innovation capability and market competitiveness of enterprises. Finally, compared to traditional

companies, high-tech companies are more flexible in business processes, management systems and talent flow, and HR slack may be more sensitive. Therefore, in order to study and understand the impact of HR slack on firm performance, the choice of high-tech firms as a research object is conducive.

Third, ST companies are excluded. If a company is recognized as an ST company by the China Securities Regulatory Commission in the market, it indicates that this listed company may have violated regulations and have abnormal financial data, so ST companies are excluded.

Fourth, companies from the financial industry are excluded. The nature and book size of the financial industry is very different from other industries, and the financial industry does not engage in actual production and operations as its business activities and is heavily influenced by economic cycles, politics, and external events.

Fifth, companies that had been listed but delisted during the research period are excluded. The reason is that the financial data of the company at the time of listing and delisting are abnormal. In order to eliminate the adverse effects caused by the abnormal data, such companies are excluded in this paper.

In the data processing, in order to eliminate the heteroscedasticity problem caused by the large range of some variables, the variables are processed by natural logarithm. Tail reduction is also performed at the 0.01 and 0.99 levels of the data to ensure that adverse effects caused by extreme high or low values in the data are eliminated. The final number of samples in this paper is 17446, involving 2544 companies. The financial data of listed companies and some employee data are taken

from the CSMAR database, while employee education and function type data are

taken from the Wind database. The statistical analysis of the data in this paper is done

using STATA software[4] in this paper. The frequency distribution results of the

samples by year are as follows:

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[4] STATA 18.0 SE—Standard Edition.

Table 4

Frequency Distribution Results of Samples

Year	Sample Number	Percentage（%）
2011	888	5.08
2012	1110	6.36
2013	1231	7.05
2014	1223	7.00
2015	1322	7.57
2016	1483	8.49
2017	1621	9.28
2018	1964	11.24
2019	2042	11.69
2020	2158	12.36
2021	2424	13.88

Note. Data sorted out by the author.

The data distribution shows that, although the sample size is relatively small in the early years, it still maintains a sufficient sample size, indicating that the sample size of the data is sufficient to reflect the sample information. Overall, the sample size is sufficient for subsequent empirical analyses.

Variable Measurement

Dependent Variable: Firm Performance

Given the development of Chinese high-tech enterprises over the past decade, firm performance can be measured in terms of profitability and growth, which fully reflect the characteristics of Chinese high-tech enterprises. According to Daniel et al. (2004), 31.7% of the studies used ROA and 9.6% used Tobin's Q as proxies of firm

performance.

Formula 1

ROA

ROA = net profit / average total assets

Formula 2

Tobin's Q

Tobin's Q = market value of an enterprise / replacement cost of assets

ROA, i.e., return on assets, is adopted in this paper as a proxy for the dependent variable (DV). It is a financial ratio that measures a company's profitability by comparing its net income to its total assets. This indicates the efficiency with which a company uses its assets to generate profits. A higher ROA indicates better asset utilization and profitability. ROA=Net profit after tax/total assets, generally expressed as a percentage.

Tobin's Q is a financial ratio developed by economist James Tobin. Tobin's Q is calculated by dividing the market value of a company's assets by their replacement costs. It is used to assess the valuation of a company or the entire market. Simply put, Tobin's Q compares a company's market value to the cost of replacing its assets. If Tobin's Q is greater than one, it suggests that the market value of the company is higher than the cost of replacing its assets, indicating that the company is overvalued. However, if Tobin's Q is less than one, the market value is lower than the replacement cost, indicating undervaluation. Tobin's Q is often used in financial analyses and

investment research to determine whether a company or market is overvalued or undervalued. This study provides insight into the efficiency of investment and capital allocation within a company or industry.

Independent Variable: HR Slack

Carnes et al. (2019, p. 65) conclude that HR slack is generally measured by the ratio of manpower or costs to operating revenue or assets (Carnes et al., 2019, p. 65). and is sometimes measured by the ratios of specific groups of employees within the firm (Powell, 2014; Voss et al., 2008). However, it is common to use employee productivity as a proxy for total operating revenue divided by the number of employees, resulting in per capita operating revenue (Datta et al., 2005; Greenley & Oktemgil, 1998; Huselid, 1995; Koch & McGrath, 1996; Mishina et al., 2004). In the two quotations above, the numerator and denominator are reversed. This creates two indicators with opposing meanings.

Formula 3

Formula for HR slack (a) and (b)

$$HR\ Slack_t = \frac{Employee\ Number_t}{Sales\ _t} \qquad （a）$$

or

$$HR\ Slack_t = \frac{Sales\ _t}{Employee\ Number_t} \qquad （b）$$

When testing linear relationships, indicators (a) and (b) as independent variables mainly change the positive and negative coefficients but do not affect the magnitude and significance of the coefficients. In this study, HR slack is measured as the ratio of

total operating revenue to the number of employees, that is, Formula (b).

Some scholars believe that slack is a value or amount relative to the target level rather than an absolute amount of resources (Bromiley, 1991; Miller & Leiblein, 1996). Moreover, changes over time can be easily observed and measured (Bourgeois & Singh, 1983; Marino & Lange, 1983). With the company's historical level as the target, the increase or decrease in the company's HR slack level over time, known as absolute HR slack (AHRS), can be calculated using the following formula:

Formula 4

Formula for AHRS (Absolute HR Slack)

$$AHRS_t = \frac{\frac{Sales_t}{Employee_t}}{\frac{Sales_{t-1}}{Employee_{t-1}}} - 1$$

where $Sales_t$ is the total operating revenue of the enterprise in year t, $Employee_t$ is the number of employees of the enterprise at the end of year t, and

The difference between the HR slack level of a company and the average level within an industry (Mishina et al., 2004, p. 1188), also known as relative HR slack (RHRS), can be calculated using the following formula:

Formula 5

Formula for RHRS (Relative HR Slack)

$$RHRS_{ti} = \frac{\frac{Sales_{ti}}{Employee_{ti}}}{\frac{\sum Sales_{ti}}{\sum Employee_{ti}}}$$

where Sales$_{ti}$ is the total operating revenue of the enterprise i in the year t;

Employee$_{ti}$ is the number of employees of the enterprise i at the end of the year t;

ΣSales$_{ti}$ is the total operating revenue of enterprise i in the industry in the year t.

ΣEmployee$_{ti}$ is the total number of employees of enterprise i at the end of year t.

Absolute HR slack (AHRS) is the amplitude of change compared to itself;

relative HR slack (RHRS) is the ratio to the industry average level. In an industry with

a mature market and a stable competitive situation, the AHRS proxy can be used to

observe the changes in the HR slack of enterprises in a time series to analyze the

changes in HR slack caused by the company's strategy and operation. In industries

with turbulent markets and intense competition, the RHRS proxy can be used to

horizontally observe the relative level of HR slack between a company and an

industry to analyze the relative position or degree of differentiation of the company in

the industry.

Although AHRS and RHRS have solved the problem of measuring the overall

level of HR slack based on RBV and KBV, there is still a lack of suitable proxies for

practical observation and measurement when further analyzing resource and

knowledge attributes, and it is difficult to obtain suitable samples or data for empirical

research. Thus far, proxies and data collection for HR slack have limited in-depth

empirical research.

As mentioned earlier, HR slack is a relative concept, defined as AHRS when

compared to the historical level of the organization and RHRS when compared to the

industry average level of RHRS. AHRS and RHRS were considered the two major

independent variables (IV) in this study.

For high-tech firms, the knowledge of human resources is extremely important for technological innovation and industrial competitiveness. Generally, the higher the level of education of an employee, the higher the level of prior expertise. Therefore, the types of HR slack in organizations can be classified from the perspective of education level: graduate level and above, undergraduate level, college level, high school level, and below.

High-tech companies often accumulate tacit and firm-specific knowledge about production, technology, and related sales processes. The tacit and firm-specific knowledge distributed in departments, such as production, finance, sales, and technology, represents different core competencies of the enterprise. Therefore, the types of HR slack in companies can also be classified from the perspective of job type, namely production, finance, sales, and technology.

In the actual measurement, regardless of education level or job type, the corresponding number of employees can be used to calculate the corresponding HR slack classification.

Formula 6

Formula for AHRS and RHRS proxies by the educational level.

$$AHRS_{et} = \frac{\dfrac{Sales_t}{Employee_{et}}}{\dfrac{Sales_{t-1}}{Employee_{et-1}}} - 1$$

$$RHRS_{eti} = \frac{\dfrac{Sales_{ti}}{Employee_{eti}}}{\dfrac{\sum Sales_{ti}}{\sum Employee_{eti}}}$$

Wherein:

In the AHRS formula, $Sales_t$ is the business revenue of the enterprise in year t;

$Employee_{et}$ is the number of employees of the enterprise whose education background

is e at the end of the year t; In the RHRS formula, $Sales_{ti}$ is the business revenue of

enterprise i in year t; $Employee_{ti}$ refers to the number of employees with a degree of e

at the end of year t in enterprise i. The value of e in the two formulas is ① graduate

level and above (short for edu1), ② undergraduate level (short for edu2), ③

college level (short for edu3) and ④ high school level and below (short for edu4).

Formula 7

Formula for AHRS and RHRS proxies by the job type.

$$AHRS_{jt} = \frac{\dfrac{Sales_t}{Employee_{jt}}}{\dfrac{Sales_{t-1}}{Employee_{jt-1}}} - 1$$

$$RHRS_{jti} = \frac{\dfrac{Sales_{ti}}{Employee_{jti}}}{\dfrac{\sum Sales_{ti}}{\sum Employee_{jti}}}$$

Wherein:

In the AHRS formula, $Sales_t$ is the business revenue of the enterprise in year t.

$Employee_{jt}$ is the number of employees of the enterprise in department d at the end of

year t. In the RHRS formula, $Sales_{ti}$ is the business revenue of enterprise i in year t,

and Employee$_{jti}$ refers to the number of employees in job j of enterprise i at the end of year t. The values of j in the two equations are production (short for job1), finance (short for job2), sales (short for job3), and technology (short for job4).

Mediator: Financing Constraints

We also discuss the mediating effect of HR slack on firm performance. HR slack influences the extent and quality of a firm's information disclosure, which leads to the relaxation of the firm's financing constraints. Loosened financing constraints improve the performance of high-tech companies (Beck et al., 2005; Boermans & Willebrands, 2018; Campello & Chen, 2010; Chan et al., 2010; Chen & Chen, 2023).

The traditional approach for identifying financially constrained firms dates back to the late 1980s. Fazzari et al. demonstrated that investment spending varies with the availability of internal funding (cash flow) when firms face financial constraints (Fazzari et al., 1988). Whited and Wu used an alternative methodology, the WW index, to classify firms that are financially constrained (Whited & Wu, 2006). The WW index is based on six characteristics associated with financial constraints: firm size, industry sales growth, firm sales growth, cash flow, dividends, and leverage. Several researchers have used the WW index to measure firms' financing constraints (Campello & Chen, 2010, p. 1188; Chan et al., 2010, p. 307; Hennessy et al., 2007, p. 692; Kaplan & Zingales, 1997).

The formular of the WW index is as follows: This study adopts the definition in the User Manual for China Listed Companies' Management Dilemma Research

Database (in Chinese)[5] and the CSMAR Database.

Formula 8

WW Index

$$WW = \beta_1 \times CF_{it} + \beta_2 \times DivPos_{it} + \beta_3 \times Lev_{it} + \beta_4 \times Size_{it} + \beta_5 \times ISG_{it}$$
$$+ \beta_6 \times SG_{it}$$

Wherein:

CF is the ratio of net operating cash flow to total assets. DivPos is a dummy variable for paid cash dividends, where if dividends are paid in cash, its value is 1; otherwise, 0. Lev is the asset–liability ratio. Size is the natural logarithm of total assets. ISG is the industry-average sales growth rate. SG is the sales growth rate.

Control Variables

In this study, proxies such as asset size (Size), asset liability ratio (Lev), total asset turnover (ATO), cash flow level (Cashflow), accounts receivable ratio (REC), inventory ratio (INV), board size (Board), board independence (Indep), equity concentration (Top1), equity balance (Balance1), and firm age (FirmAge) are used as control variables. Please refer to the "Variable Description" table below for further details.

This study adopts two dummy variables: industry and statistical year. Due to significant differences in business models, enterprise nature, and talent composition among industries, this paper categorizes all enterprises into "manufacturing" and "non-manufacturing." According to the *Guidelines for Industry Classification of*

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[5] Please refer to CSMAR Database, *Database Manual of Business Operation Delima in China Listed Company (20230306)*.

Listed Companies (revised in 2012)[6], the selected industry code "C" in the sample is

designated as manufacturing, while other codes are designated as non-manufacturing.

Owing to the turbulence of the external environment, the impact of external factors

such as politics, economics, and society on the operations of companies varies

significantly from one year to the next. Therefore, year is set as a dummy variable that

is conducive to observing the main factors affecting the performance of companies in

the same year.

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[6] Please refer to Announcement of China Securities Regulatory Commission No. 3.
http://www.csrc.gov.cn/csrc/c101864/c1024632/content.shtml

Table 5

Variable Description

Variable Type	Variable Name	Variable Symbol	Variable Description
Dependent variable	Firm performance	ROA	ROA = net profit / average total assets
		Tobin's Q	Tobin's Q = the market value of an enterprise / the replacement cost of its assets
		ROE	ROE = the amount of net income generated as a percentage of shareholders' equity
Independent variable	Absolute HR slack (AHRS)	AHRS	Refer to the previous description, Formula 1
		ahrs eud1	ahrs graduate level and above
		ahrs edu2	ahrs undergraduate level
		ahrs edu3	AHRS college level
		ahrs eud4	ahrs high school level and below
		ahrs job1	ahrs production
		ahrs job2	ahrs finance
		ahrs job3	ahrs sales
		ahrs job4	ahrs technology
	Relative HR slack （RHRS）	RHRS	Refer to the previous description, Formula 1
		rhrs edu1	rhrs postgraduate and above
		rhrs edu2	rhrs undergraduate
		rhrs edu3	rhrs junior college
		rhrs edu4	rhrs senior high school and below
		rhrs job1	rhrs production
		rhrs job2	rhrs finance
		rhrs job3	rhrs sales
		rhrs job4	rhrs technology
Mediation variable	WW index	WW	Financing Constraints, WW index
Moderator variable	Ownership	SOE	The value is 1 if the firm is a state-owned enterprise, or 0 if it is not a stated-owned enterprise (non-SOE).
	Manufacturing industry	MFG	The value is 1 if the firm is in a manufacturing industry or 0 if it is not in a manufacturing industry (non-MFG).
Control variable	Asset size	Size	Natural logarithm of asset size
	Asset liability ratio	Lev	Total liabilities / total assets
	Total assets turnover	ATO	Operating revenue/average total assets
	Cash flow level	Cashflow	Net cash flow from operating activities/ total assets

Accounts receivable ratio	REC	Ratio of net accounts receivable to total assets
Inventory ratio	INV	Ratio of net inventory to total assets
Board size	Board	The number of directors is taken as natural logarithm
Board independence	Indep	Number of independent directors/total number of directors
Equity concentration 1	Top1	Number of shares held by the first largest shareholder/total share capital
Equity concentration 10	Top10	Number of shares held by the Top 10 largest shareholder/total share capital
Equity balance 1	Balance1	The ratio of the shareholding of the second largest shareholder by the shareholding of the first largest shareholder
Equity balance 2	Balance2	The ratio of the total shareholding of 2nd, 3rd, 4th and 5th largest shareholders by the shareholding of the first largest shareholder
Firm age	FirmAge	ln (current year-year of establishment+1)
Industry control	Ind	Dummy variable
Year control	Year	Dummy variable

Note. Data sorted out by the author.

Regression Models

Combined with the previous hypothesis, the influence of HR slack on firm performance is discussed below. The following regression model is based on multiple regression theory.

Main Effect Model

Main effect regression models are shown as follows.

Formula 9

Major Effect Regression Models

$$Y(ROA, \ Tobin's \ Q)_{i,t}$$

$$= \beta_0 + \beta_1 X(AHRS, RHRS)_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 ATO_{i,t} +$$

$$\beta_5 CASHFLOW_{i,t} + \beta_6 REC_{i,t} + \beta_7 INV_{i,t} + \beta_8 BOARD_{i,t} + \beta_9 INDEP_{i,t} +$$

$$\beta_{10} TOP1_{i,t} + \beta_{11} BALANCE_{i,t} + \beta_{12} FIRMAGE_{i,t} + \sum_{j=1}^{J} year_j +$$

$$\sum_{w}^{W} ind_w + \varepsilon_{i,t}$$

Wherein:

Y is a dependent variable with two proxies: ROA and Tobin's Q.

X is an independent variable, including AHRS and RHRS.

βo is constant term of model; β1-β12 are regression coefficient of variables in the

model.

$\sum_{j=1}^{J} year_j$ is year control; $\sum_{w}^{W} ind_w$ is industry control.

$\varepsilon_{i,t}$ is residual term of model.

i is individual firm and t is year.

Moderation Effect Model

The moderator variable does not explain the mechanisms within a relationship,

but rather whether a relationship changes under different conditions. This study

examines whether and why the relationship between HR slack and firm performance

changes under two conditions: the type of firm ownership and the industry in which

the firm operates. Using a sample of Chinese high-tech firms, we examine whether the type of ownership and the type of industry in which the firm operates moderate the relationship between HR slack and firm performance.

Moderation effect regression models are shown as follows.

Formula 10

Moderation Effect Regression Models

$$Y(ROA, Tobin's\ Q)_{i,t}$$
$$= \beta_0 + \beta_1 X(AHRS, RHRS)_{i,t} + \beta_2 Mo(SOE, MFG)_i + \beta_3(X \times Mo)$$
$$+ \beta_4 Control + \sum_{j=1}^{J} year_j + \sum_{w=1}^{W} ind_w + \varepsilon_{i,t}$$

Wherein:

Y is a dependent variable with two proxies: ROA and Tobin's Q.

X is an independent variable, including AHRS and RHRS.

Mo is a moderator variable, including two dummy variables, ownership and industry.

Control refers to the control variables in the model.

β_0 is constant term of model; β_1-β_4 are regression coefficient of variables in the model.

$\sum_{j=1}^{J} year_j$ is year control; $\sum_{w=1}^{W} ind_w$ is industry control.

$\varepsilon_{i,t}$ is residual term of model.

i is individual firm and t is year.

Mediation Effect Model

The mediation effect model was used to analyze how an independent variable affected the dependent variable through one or more mediator variables. By introducing mediator variables, this model helps explain the causal mechanism between independent and dependent variables.

First, a total-effect model was developed, and the total effect of the independent variable X on the dependent variable Y was estimated without considering any mediator variables. That is, $Y = cX + e_1$, where c denotes the total effect of the independent variable on the dependent variable and e_1 denotes the error term.

Second, to establish the first mediation effect, we measured the effect of the independent variable on the mediating variable by introducing the mediating variable M. That is, $M = aX + e_2$, where a denotes the mediation effect of the independent variable on the mediator variable and e_2 denotes the error term.

Third, to establish the second mediation effect by considering the mediating variable M as another independent variable, we measured the effect of the independent variables (X and M) on the dependent variable Y. That is, $Y = c'X + bM + e_3$, of which c' denotes the direct effect of the independent variable X on the dependent variable Y, b denotes the mediation effect of the mediator variable M on the dependent variable Y, e_3 for the error term.

Fourth, to calculate and test the mediation effect, it was calculated as the product of a and b.

There are three types of effects: total, direct, and mediation. In a regression

model, the estimated value c represents the total effect of the independent variable on the dependent variable, including direct and indirect effects, by introducing the mediator variable. The estimation value, c' represents the effect of the independent variable directly on the dependent variable without the mediation effect of the mediator variable. The ab value represents the mediating effect of the independent variable on the dependent variable through the mediating variable. We used a three-step analysis to test the mediation effect.

Mediation effect regression models are shown as follows:

Formula 11

Mediation Effect Regression Models

$$Me(WW)_{i,t}$$
$$= \beta_0 + \beta_1 X(AHRS, RHRS)_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 ATO_{i,t} +$$
$$\beta_5 CASHFLOW_{i,t} + \beta_6 REC_{i,t} + \beta_7 INV_{i,t} + \beta_8 BOARD_{i,t} + \beta_9 INDEP_{i,t} +$$
$$\beta_{10} TOP1_{i,t} + \beta_{11} BALANCE_{i,t} + \beta_{12} FIRMAGE_{i,t} + \sum_{j=1}^{J} year_j +$$
$$\sum_{w}^{W} ind_w + \varepsilon_{i,t}$$

$$Y(ROA, Tobin's Q)_{i,t}$$
$$= \beta_0 + \beta_1 X(AHRS, RHRS)_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 ATO_{i,t} +$$
$$\beta_5 CASHFLOW_{i,t} + \beta_6 REC_{i,t} + \beta_7 INV_{i,t} + \beta_8 BOARD_{i,t} + \beta_9 INDEP_{i,t} +$$
$$\beta_{10} TOP1_{i,t} + \beta_{11} BALANCE_{i,t} + \beta_{12} FIRMAGE_{i,t} + \beta_{13} Me(WW)_{i,t} +$$
$$\sum_{j=1}^{J} year_j + \sum_{w}^{W} ind_w + \varepsilon_{i,t}$$

Wherein:

Me is a mediator variable using WW as the proxy.

Y is a dependent variable with two proxies: ROA and Tobin's Q.

X is an independent variable, including AHRS and RHRS.

βo is constant term of model; β_1-β_{12} are regression coefficient of variables in the model.

$\sum_{j=1}^{J} year_j$ is year control; $\sum_{w}^{W} ind_w$ is industry control.

$\varepsilon_{i,t}$ is residual term of model.

i is individual firm and t is year.

The Sobel and Bootstrap methods should be introduced. The core idea of the Sobel test is based on two basic regression equations: one describing how the independent variable affects the mediating variable, and the other describing how the mediating variable affects the dependent variable. The test uses regression coefficients from these two equations and their standard errors to calculate a Sobel statistic that tests the significance of the mediating effect. If the value of the Sobel statistic exceeds the threshold for a given level of significance, the mediating effect can be considered significant. The Sobel statistic is calculated as follows:

Formula 12

Sobel statistic

$$Sobel = \frac{a \times b}{\sqrt{a^2 + se_a^2} + \sqrt{b^2 + se_b^2}}$$

Wherein:

a is the regression coefficient of the independent variable on the mediator

variable.

b is the regression coefficient of the mediator variable on the dependent variable.

se is the standard error of the coefficient.

The Sobel statistic can be compared with the t-distribution to determine the

significance of the mediation effect. If the absolute value of the Sobel statistic was

greater than the threshold of the t-distribution at a given level of significance, the

mediation effect was considered significant. In practice, bias may exist when the

distribution of the mediation effect is not normal. Therefore, the Bootstrap methods

should also be considered to assess the significance of the mediation effect (方杰 et

al., 2012).

The Bootstrap method is a non-parametric resampling technique used to estimate

the distribution of statistics. The Bootstrap method has been widely used to test for

mediation effects, especially when the data do not satisfy the assumption of a normal

distribution or when the sample size is small. The Bootstrap method provides the

empirical distribution of a statistic by obtaining a series of new samples through

multiple draws from the original sample and calculating the statistics for these new

samples. This method provides a confidence interval for the estimate of the mediation

effect, and the mediation effect can be considered significant if this confidence

interval does not contain zero. The main disadvantage of this method is that the

results are generated by resampling; therefore, the confidence interval results are not

fixed for each sampling. In this study, 500 samples were resampled.

Regression Result Analysis

Descriptive Statistical Analysis

The statistical results for the total sample are as follows: Appendix A provides

the descriptive statistical results.

Table 6

Statistical Result of Total Sample Description

Variable	Observations	Mean	Std. dev.	Min	Max	CV
ROA	16,903	0.0452	0.0626	-0.2315	0.2134	1.385
TobinQ	16,903	2.1620	1.2873	0.9064	8.2643	0.595
WW	16,824	-1.0141	0.0572	-1.1805	-0.8659	-0.0564
ahrs	16,903	0.0915	0.2759	-0.5310	1.3109	3.016
ahrsedu1	11,864	0.0740	0.3878	-0.6786	1.8697	5.244
ahrsedu2	14,610	0.0676	0.3105	-0.5771	1.5124	4.596
ahrsedu3	13,651	0.1091	0.3711	-0.5930	2.0128	3.402
ahrsedu4	7,595	0.1264	0.4130	-0.7617	2.2808	3.267
ahrsjob1	14,390	0.1267	0.3855	-0.6328	2.1764	3.042
ahrsjob2	14,457	0.1040	0.3456	-0.5853	1.6950	3.322
ahrsjob3	15,371	0.1305	0.4365	-0.6918	2.2786	3.344
ahrsjob4	15,698	0.1088	0.4336	-0.6641	2.4558	3.987
rhrs	16,903	1.0193	0.7829	0.1802	4.9058	0.768
rhrsedu1	12,859	2.1233	2.7778	0.1142	16.9075	1.308
rhrsedu2	15,581	1.1311	0.9424	0.1487	5.8220	0.833
rhrsedu3	14,720	1.1025	0.9964	0.1251	6.5155	0.904
rhrsedu4	8,691	1.6007	2.2850	0.1010	15.5637	1.427
rhrsjob1	15,424	1.6143	2.6509	0.1323	20.0143	1.642
rhrsjob2	15,615	0.9827	0.8188	0.1238	4.8160	0.833
rhrsjob3	16,389	1.7437	2.2246	0.0967	13.7950	1.276
rhrsjob4	16,679	1.1487	1.0980	0.1255	7.1751	0.956
Size	16,903	21.9692	1.0889	20.0649	25.2458	0.0496
Lev	16,903	0.3817	0.1869	0.0491	0.8388	0.490
ATO	16,903	0.6286	0.3416	0.1316	2.0940	0.543
Cashflow	16,903	0.0481	0.0627	-0.1285	0.2206	1.305
REC	16,903	0.1479	0.0969	0.0039	0.4667	0.655
INV	16,903	0.1299	0.0865	0.0007	0.4550	0.666
Board	16,903	2.1061	0.1877	1.6094	2.5649	0.0891
Indep	16,903	0.3769	0.0533	0.3333	0.5714	0.141
Top1	16,903	0.3265	0.1383	0.0848	0.6999	0.424
Balance1	16,903	0.3832	0.2868	0.0150	0.9997	0.748
FirmAge	16,903	2.8519	0.3298	1.7918	3.4965	0.116

Note. Data sorted out by the author.

AHRS is the overall proxy of a firm's HR slack compared to their historic level.

It could be further classified by education levels and job types in Chinese high-tech

enterprises.

(1)   For overall AHRS, the mean value is 0.0915; the standard deviation is 0.2759; and the variable coefficient is 3.016, which indicates that there are significant differences among companies by the value of AHRS.

(2)   It can be seen from analysis result of AHRS in terms of education level that, AHRS mean value of postgraduate and above(edu1), bachelor holders (edu2), junior college education holders (edu3) and holders of high school degree and below (eud4) is respectively 0.0740, 0.0676, 0.1091 and 0.1264, and the standard deviation is respectively 0.3837, 0.3105, 0.3711 and 0.4130. It can be seen from mean value that, AHRS of holders of high school degree and below is the highest, followed by junior college education holders. AHRS of bachelor holders and postgraduate and above is relatively lower.

(3)   In terms of job type, the mean value of HR slack in groups of production (Job1), finance (Job2), sales (Job3) and technology (Job4) are respectively 0.1267, 0.1040, 0.1305 and 0.1088 and the standard deviation is respectively 0.3855, 0.3456, 0.4365 and 0.4336. It can be seen from mean value that, AHRS of sales and production staff is higher, followed by technology and finance personnel. This may reflect main operation mode and composition of human resources of Chinese high-tech companies.

RHRS is the overall proxy of a firm's HR slack compared to the industrial average level that is considered as a necessary level. It could be further classified by

education levels and job types in Chinese high-tech enterprises.

(1)   Relative to the industry, the mean value of RHRS is 1.0193; the standard

deviation is 0.7829 and the variable coefficient is 0.768, which indicates that

overall HR slack is almost equal to the industry average level, and but there is

significant difference among companies.

(2)   The mean values of RHRS of postgraduate and above(eud1), bachelor

holders(eud2), junior college education holders(eud3) and holders of high

school degree and below(eud4) are respectively 2.1233, 1.1311, 1.1025 and

1.6007. This indicates that relative to industry average level, companies have

higher demands in talents with the education level of postgraduate and above

as well as high school degree and below. While companies have lower

demands in talents with the education level of bachelor and junior college

relative to industry average level. Analysis result of the standard deviation and

the variable coefficient also indicates that there is significant difference in

demands of talents at different educational levels among different companies.

(3)   It can be seen from RHRS analysis result in terms of job type relative to

industry average level that, the mean value of RHRS of production (Job1),

finance (Job2), sales (Job3) and technology (Job4) personnel are respectively

1.6143, 0.9827, 1.7437 and 1.1487, which indicates that companies have

higher demands in sales and production personnel and have lower demands in

finance and technology talents. Similarly, the standard deviation and the

variable coefficient also indicate that there are significant differences in

demands of talents at different functional types among different companies.

Data analysis for dependent variables and control variables include analysis of company profitability, asset structure, operation ability, cash flow level, accounts receivable ratio, inventory ratio and corporate governance.

(1)   ROA: The mean value of return on assets (ROA) for firm performance is 0.0452, which indicates that the enterprise has general profitability. The standard deviation is 0.0626 and the variable coefficient is 1.385, which indicates that there is significant difference in profitability among companies, namely, some companies have very high profitability and other companies have lower profitability.

(2)   Size: The mean value of asset size is 21.9692, which indicates that enterprises have larger average asset size. And the variable coefficient is 0.0496, which indicates that Chinese high-tech enterprises have relatively close asset size.

(3)   Lev: The mean value of asset liability ratio is 0.3817 and the variable coefficient is 0.490, which indicates that liability level of enterprises is higher as a whole and there is difference in liability level among companies, namely, some companies have lower liability ratio, and some companies have higher liability ratio.

(5)   ATO: The mean value of total assets turnover is 0.6286 and the variable coefficient is 0.543, which indicates that enterprises have general operation ability and there is certain difference among companies.

(6)   CashFlow: The mean value of cash flow level is 0.0481 and the variable

coefficient is 1.305, which indicates that cash flow level of enterprises is

general as a whole and but there is significant difference among them.

(7)   REC and INV: The mean value of accounts receivable ratio and goods in stock

is respectively 0.1479 and 0.1299, and the variable coefficient is respectively

0.655 and 0.666, which indicates that enterprises are under a general condition

in terms of accounts receivable and goods in stock and there is certain

difference among companies.

(8)   Board, Indep, Balance1, Top1: The mean value of board size, board

independence, equity concentration and equity balance are respectively

2.1061, 0.3769, 0.3265 and 0.3832, and the variable coefficient is respectively

0.0891, 0.141, 0.424 and 0.748, which indicates that there is certain difference

in corporate governance among companies, namely, some companies are

under a good governance condition and some companies need to be improved

in terms of governance.

(9)   FirmAge: The mean value of enterprise age is 2.8519; the standard deviation

is 0.3298 and the variable coefficient is 0.116, which indicates that a majority

of enterprises have been established for a shorter time among those high-tech

enterprises, which meets characteristics of high-tech enterprises. The variable

coefficient is relatively small, which means that there is minor difference in

terms of establishment time of those companies.

Figure 13

Scatter Plots for HR Slack (AHRS/RHRS) and Firm Performance
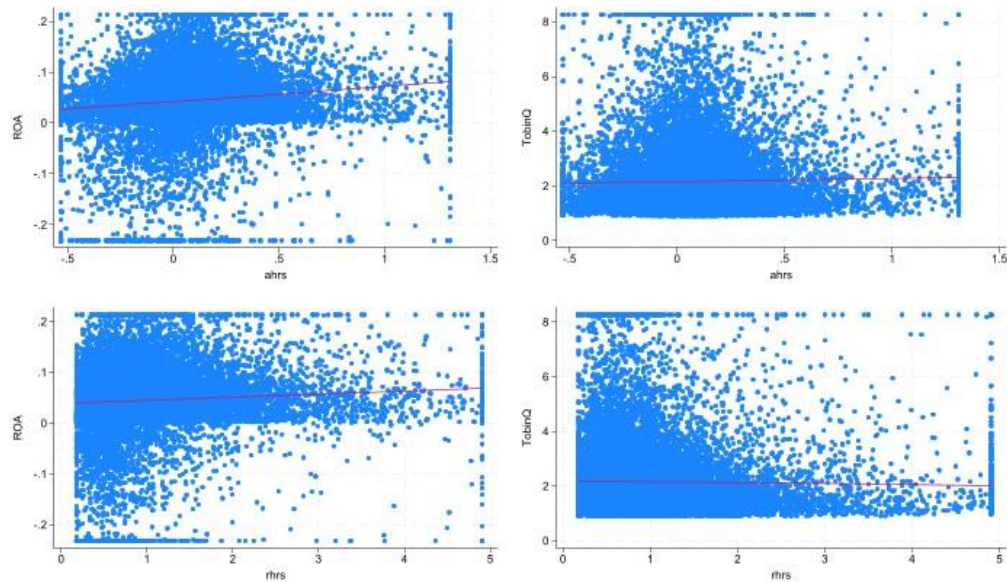
Note. Data sorted out by the author.

On the whole, there are significant differences in terms of profitability, operation

ability and cash flow level among those high-tech enterprises, which may reflect

competitive situation of this field and also reflect difference between business strategy

and operation. In terms of asset size and firm age, there is less difference among those

companies, which may reflect entry threshold and grade of maturity of this field. In

terms of corporate governance, the difference in board size, board independence,

equity concentration and equity balance indicate that there is certain difference in

corporate governance and practice among those companies, which may have

influence on financial performance and risk tolerance of those companies. In addition,

difference in accounts receivable ratio and goods in stock may reflect difference in

supply chain management and sales strategy among those companies. For example, some companies may pay more attention to expanding market share. Therefore, they are willing to accept longer collection period or keep higher level of goods in stock. While some enterprise may pay more attention on management of cash flow. Therefore, they prefer to rapid collection and reduction of goods in stock.

Basic Inspection

Correlation Analysis

The study carries out correlation analysis for two purposes. Firstly, to observe whether there is correlation among dependent variables, independent variables, and control variables. Because correlation is the basis of regression analysis, although this condition is not strictly valid under panel data, it still has value for reference. Secondly, to observe whether there is relative Independence among variables through magnitude of absolute value of correlation coefficients.

Among correlation analysis methods, Pearson correlation coefficient is more suitable for normal data and Spearman correlation coefficient is more suitable for non-normal data. This paper needs to further select suitable correlation analysis model to carry out analysis in combination with normality test. In terms of normality test methods, the paper selects skewness and kurtosis indicator to carry out test according to test rule that it can considered that data can be subject to good normal distribution when absolute value of skewness is less than 3 and the kurtosis value is less than 10 at the same time. It can be known from the result analysis that variables can meet basic

normal distribution. Therefore, the paper carries out analysis by adopting Pearson correlation coefficient. Correlation analysis result is arranged as follows:

It can be seen from analysis of regression result that,

(1)   Return on assets (ROA): AHRS, RHRS, total assets turnover (ATO), cash flow level (Cashflow) and equity concentration (Top1) are positively correlated with return on assets (ROA). This indicates that the above factors may generate positive influence on return on assets. For example, operating revenue growth of enterprises may increase profits of enterprises, thereby improving return on assets. While abundant human resources and higher cash flow level may be contributive to improving operation efficiency and profitability of enterprises.

(2)   Return on assets (ROA): Size, Asset liability ratio (Lev), accounts receivable ratio (REC), inventory ratio (INV), board size (Board), board independence (Indep) and firm age (FirmAge) are negatively correlated with return on assets (ROA). This indicates that these factors may generate negative influence on return on assets. For example, higher asset liability ratio may mean that enterprises will face higher financial risk, and may reduce profitability of enterprises. As well, higher accounts receivable ratio and goods in stock may mean that enterprises are under cash flow dilemma and may affect profitability of enterprises.

(3)   Tobin's Q: AHRS, cash flow (CashFlow), and equity balance (Balance1) are positively correlated with Tobin's Q. This indicates that these factors may be

contributive to Tobin's Q value of enterprises. For example, abundant human resources may be contributive to improving operation efficiency and innovation ability of enterprises, thereby promoting Tobin's Q. While less assets in high-tech firms may reduce CAPEX investment and save the cashflow.

(4)   WW: Financial constraints (WW) is negatively correlated with most of variables. This may because less financial constraints may alleviate the pressure to get the finance support from the market. Accordingly, it should improve the value of the firms.

In high-tech enterprises, there is significant positive relationship between HR slack and firm performance. Core competitiveness of high-tech enterprises is innovation. While innovation depends on abundant human resources in most cases, including specialized knowledge, experience and innovative thinking of technical personnel. Therefore, high-tech enterprises with high level of HR slack are more likely to generate innovation, thereby improving firm performance.

This paper carries out analysis by using Pearson correlation coefficient and sorts out correlation analysis result as follows:

Table 7

Result of Pearson Correlation Analysis

	ROA	TobinQ	WW	ahrs	rhrs	Size	Lev	ATO	Cashflow	REC	INV	Board	Indep	Top1	Balance1	FirmAge
ROA	1															
TobinQ	0.237***	1														
WW	-0.262***	0.170***	1													
ahrs	0.133***	0.029***	-0.145***	1												
rhrs	0.076***	-0.026***	-0.220***	0.206***	1											
Size	-0.00600	-0.282***	-0.729***	0.039***	0.266***	1										
Lev	-0.353***	-0.272***	-0.256***	0.051***	0.176***	0.516***	1									
ATO	0.212***	-0.041***	-0.202***	0.152***	0.286***	0.154***	0.229***	1								
Cashflow	0.416***	0.154***	-0.229***	0.026***	0.00400	0.064***	-0.172***	0.161***	1							
REC	-0.077***	-0.00700	0.083***	0.0120	0.056***	-0.105***	0.159***	0.092***	-0.265***	1						
INV	-0.080***	-0.079***	-0.0110	0.026***	0.040***	0.039***	0.264***	0.168***	-0.205***	0.018**	1					
Board	0.015*	-0.094***	-0.168***	-0.014*	0.041***	0.224***	0.130***	0.062***	0.029***	-0.046***	0.022***	1				
Indep	-0.022***	0.031***	0.016**	0.00100	-0.022***	-0.020***	-0.0120	-0.048***	-0.013*	-0.00600	-0.016**	-0.591***	1			
Top1	0.135***	-0.067***	-0.139***	-0.0110	0.039***	0.082***	0.00700	0.079***	0.072***	-0.082***	0.049***	-0.023***	0.054***	1		
Balance1	-0.00900	0.019**	0.041***	0.014*	-0.030***	-0.058***	-0.067***	-0.068***	-0.00600	0.040***	-0.066***	0.00700	-0.019**	-0.606***	1	
FirmAge	-0.069***	-0.00700	-0.128***	0.014*	0.034***	0.198***	0.147***	0.029***	0.060***	-0.030***	0.026***	0.018**	0.00600	-0.083***	0.0100	1

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Multicollinearity Test

The paper carries out multicollinearity test for variables by adopting VIF value, so as to guarantee that there is good relative independence among variables in regression as well as the result is correct. The paper considers the condition that VIF value is less than 10 as the standard to judge that multicollinearity exists seriously, namely, it can be considered that there is good multicollinearity among variables when VIF value is less than 10. Test result is as shown in Table 8. VIF value of all variables is less than 10, and overall VIF value is equal to 1.59 and this value is less than 10. In conclusion, it can conclude that there is good multicollinearity among variables.

Table 8

Result of Multicollinearity Test

Viable	VIF	1/VIF
Size	3.220	0.310
WW	2.520	0.397
Lev	1.730	0.578
Top1	1.670	0.600
Board	1.660	0.601
Balance1	1.610	0.623
Indep	1.580	0.635
Cashflow	1.300	0.771
ATO	1.260	0.791
Rhrs	1.200	0.835
REC	1.180	0.847
INV	1.160	0.859
Ahrs	1.090	0.920
FirmAge	1.060	0.940
MeanVIF	1.590	N.A.

Note. Data sorted out by the author.

HR Slack and Firm Performance

This study discusses the impacts of AHRS and RHRS on firm performance. The details of the optimal model identification test are provided in Appendix B. The optimal model was the fixed effects model. The paper will carry out Regression analysis was performed by adopting a fixed-effects model. The results of the main regression are as follows:

Table 9

Regression Result of AHRS and RHRS on Firm Performance

Model	(1)	(2)	(3)	(4)
Variables	ROA	TobinQ	ROA	TobinQ
ahrs	0.0246***	0.1426***		
	(17.3651)	(4.5250)		
rhrs			0.0025***	0.0905***
			(4.5518)	(7.5202)
Size	0.0116***	-0.2850***	0.0110***	-0.3031***
	(25.6506)	(-28.3704)	(23.5804)	(-29.4071)
Lev	-0.1597***	-0.8938***	-0.1584***	-0.8777***
	(-59.4920)	(-14.9542)	(-58.5360)	(-14.7003)
ATO	0.0369***	0.0929***	0.0385***	0.0521*
	(28.9260)	(3.2702)	(29.1048)	(1.7858)
Cashflow	0.3314***	3.0953***	0.3349***	3.1593***
	(48.2341)	(20.2325)	(48.3039)	(20.6551)
REC	0.0639***	0.0349	0.0616***	-0.0161
	(14.1599)	(0.3467)	(13.4973)	(-0.1597)
INV	0.0442***	0.3710***	0.0445***	0.3721***
	(8.7165)	(3.2871)	(8.7113)	(3.2999)
Board	0.0042	0.0314	0.0042	0.0477
	(1.5838)	(0.5293)	(1.5466)	(0.8054)
Indep	0.0013	0.5017**	0.0021	0.5473***
	(0.1493)	(2.5112)	(0.2278)	(2.7410)
Top1	0.0482***	-0.4374***	0.0474***	-0.4459***
	(13.5004)	(-5.4995)	(13.1623)	(-5.6127)
Balance1	0.0126***	-0.1544***	0.0129***	-0.1539***
	(7.4934)	(-4.1287)	(7.5987)	(-4.1195)
FirmAge	-0.0071***	0.0445	-0.0078***	0.0438
	(-5.2635)	(1.4797)	(-5.7289)	(1.4602)
N	16903	16903	16903	16903
R^2	0.381	0.275	0.371	0.277
adj. R^2	0.380	0.273	0.370	0.275
IndControl	YES	YES	YES	YES
YearControl	YES	YES	YES	YES

Note. * $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Note. Data sorted out by the author.

This study analyzes the impacts of HR slack on firm performance.

(1) HR slack's impact on firm performance

From Table 9, it can be seen that AHRS has a significant positive influence on ROA in Model 1, with a coefficient of 0.0246 and a t value of 17.3651. The results were considered statistically significant. This indicates that an increase in AHRS will significantly increase the ROA of the enterprise. In Model 2, AHRS had a significant positive influence on Tobin's Q, with a coefficient of 0.1426 and a t-value of 4.5250. The results were considered statistically significant. This indicates that an increase in AHRS will significantly increase the Tobin's Q of the enterprise. In Model 3, RHRS had a significant positive influence on ROA, with a coefficient of 0.0025 and a t-value of 4.5518. The results were considered statistically significant. This indicates that an increase in RHRS will significantly increase the ROA of the enterprise relative to other enterprises in the industry. In Model 4, RHRS had a significant positive influence on Tobin's Q, with a coefficient of 0.0905 and a t-value of 7.5202. The results were considered statistically significant. This indicates that an increase in RHRS will significantly increase the operating revenue growth of the enterprise relative to other enterprises in the industry.

HR slack is important in terms of the following points in Chinese high-tech enterprises: First, the competitiveness of high-tech enterprises comes mainly from their technological innovation abilities, which largely depend on their HR slack. Employees with high levels of education and professional skills are more likely to generate new and innovative ideas and promote an enterprise's technical progress.

Second, high-tech enterprises face complex problems. They require a higher level of professional knowledge and the ability to solve problems. Abundant HR Slack level can play a role of "buffer," which is conductive to enterprises to effectively copy with internal and external challenges and increase firm performance. Third, high-quality human resources can help enterprises accumulate professional skills and knowledge bases, promote the establishment of learning organizations, and improve learning efficiency, thereby increasing their overall performance. Therefore, HR slack has a significant and positive influence on the business performance of Chinese high-tech enterprises.

In a resource-based view (RBV), the organization has a unique set of resources and capabilities, and differences among organizations in resources and abilities are a major factor in deciding organization performance, including human resources. In knowledge-based theory (KBV), knowledge is considered a core resource of an enterprise that directly affects its innovation, learning, and performance. Human resources capture the characteristics of these two major categories in Chinese high-tech enterprises. HR slack is characterized by uniqueness, rarity, and irreplaceability. First, uniqueness. The uniqueness of resources is key for enterprises to generate a competitive advantage. The knowledge, skills, experience, and innovation abilities of human resources are unique and difficult for competitors to replicate. Therefore, high-tech enterprises with high levels of HR slack generally have powerful competitive advantages that increase their performance. Secondly, rareness. HR slack comprises a relatively high-quality workforce, which is rare. If enterprises have more high-quality

manpower, they gain a competitive advantage, thereby increasing their performance.

Third, Irreplaceability. Owing to the characteristics of implicit and proprietary

knowledge possessed by humans, it is highly challenging for enterprises to find other

manpower to replace them within a short period of time. Therefore, high-tech

enterprises with abundant HR slack are likely to maintain competitive market

positions.

 (2) The different impacts of AHRS and RHRS on firm performance

From the analysis in the table, it can be seen that the influence of AHRS and

RHRS on ROA was significantly lower than that on Tobin's Q. The first factor is time.

ROA is a proxy for enterprise profitability, and Tobin's Q is a proxy for a firm's value

in markets. The influence of ROA must be reflected after a certain period. Tobin's Q

is likely to be volatile in the short term. The second category includes complexity and

diversity. Market value is shaped by multiple factors in a comprehensive manner,

including market demand, the competitive environment, and technological change.

HR slack was the only factor. The third category includes industrial characteristics.

Significant differences exist in the operational characteristics and environments of

enterprises in different industries. Thus, HR slack may have different influences on

firm performance. In labor-intensive industries, ROA may be influenced by market

demand, cost controls, and asset configurations. The fourth is the difference in

measurement proxies. ROA and Tobin's Q are different performance proxies, and

there are also differences in what they measure. In terms of ROA, attention is paid to

enterprises' efficiency and profitability in terms of asset utilization. In terms of

Tobin's Q, attention is paid to market recognition and asset value. In conclusion, differences in the influence of HR slack on ROA and Tobin's Q may be caused by time factors, complexity and diversity, industrial characteristics, and different measurement proxies.

From the view of the influence of AHRS and RHRS on ROA, AHRS has greater influence (0.0246>0.0025). From the view of the influence of AHRS and RHRS on Tobin's Q, AHRS has greater influence (0.1426>0.0905). First, a higher AHRS indicates that the enterprise has more employees with richer professional knowledge, thereby having the potential to gain an advantage in market competition. These competitive advantages are reflected in innovation ability, product quality, and customer service, which improve a firm's performance. A higher AHRS means that the enterprise has more human resources for the optimization of resource configuration. The enterprise can distribute manpower more flexibly to match the strategic target and business demands of the organization. Enterprises can improve production efficiency, reduce costs, and increase innovation ability by optimizing resource configuration, thereby generating a larger influence on firm performance. Second, a higher AHRS score is conducive to promoting internal knowledge sharing and learning. Employees with rich knowledge are more likely to positively participate in knowledge communication and sharing to improve the internal learning and innovation abilities of the organization. Such internal knowledge sharing and learning can accelerate knowledge transformation and application and generate a larger positive influence on firm performance. Finally, the differences in RHRS provide

integration advantages for external resources. When an enterprise has higher HR slack in the industry, it can better attract and retain high-quality employees and establish good relationships with suppliers, partners, and customers, thus gaining the advantage of resource integration. Such an ability to integrate external resources is conducive for enterprises to gain more market opportunities and reduce trading costs, thereby generating a greater influence on firm performance.

（3）Analysis for influence of control variables on firm performance

a) Asset size (Size):

It can be seen from result analysis of control variable that regression coefficients of asset size are 0.0116, -0.2850, 0.0110, -0.3031. T values of all models (26.6506, -28.3704, 23.5804, and -29.4071) is greater than 1.96 or less than 1.96 and significance level is 1%. Asset size has significant positive impact on ROA and negative impact on Tobin's Q respectively.

b) Asset liability ratio (Lev):

Regression coefficients of asset liability ratio are -0.1597, -0.8938, -0.1584, -0.8777. T value of all models (-59.4920, -14.95422, -58.5360 and -14.7003) is less than -1.96 and significance level is 1%. Asset liability ratio has significant negative influence on return on assets and Tobin's Q, which indicates that overburdened debt will reduce profitability and market value of enterprises.

c) Total assets turnover (ATO):

Regression coefficients of total assets turnover are 0.0369, 0.0929, 0.0385, 0.0521, which indicates that return on assets and Tobin's Q will respectively increase

by 0.0369-0.0929 units when total assets turnover increases by 1 unit. T value of 3

models (28.9260, 3.2702, 29.1048) is greater than 1.96 and significance level is 1%,

except model 4 (1.7858). Total assets turnover has significant positive influence on

return on assets and Tobin's Q in all models, which indicates that higher asset use

efficiency may cause higher profitability and growth.

d) Accounts receivable ratio (REC):

Regression coefficients of accounts receivable ratio are0.0639m 0.0349, 0.0616,

-0.0161. In terms of influence from return on assets, t values of 4 models are 14.1599,

0.3467, 13.4973, -0.1597. In model 1 and 3 (ROA), the significance level is 1%.

However, in terms of Tobin's Q, t absolute values of Model 2 and 4 are less than 1.96,

which indicates that accounts receivable ratio has inconsistent influence on Tobin's Q.

Accounts receivable ratio has significant positive influence on return on assets, but

has no significant influence on Tobin's Q. This may reflect that higher accounts

receivable ratio may have positive influence on profitability. But it may be unrelated

to Tobin's Q.

e) Inventory ratio (INV):

Regression coefficients of inventory ratio are 0.0442, 0.3710, 0.0445, 0.3721.

T values of 4 models (8.7165, 3.2871, 8.7113, 3.2999) indicates that inventory ratio

has statistically significant influence on ROA and Tobin's Q, and the significance

level is 1%.

f) Board size (Board):

Regression coefficients of board size are 0.0042, 0.0314, 0.0042, 0.0477.   T

values of all models (1.5838, 0.5293, 1.5466, 0.8054) has no significant influence on r

ROA and Tobin's Q.

g) Board independence (Indep):

Regression coefficients of board independence are 0.0013, 0.5017, 0.0021,

0.5473. T values of all models (-0.1493, 2.5112, 0.2278, 2.7410) has no significant

influence on ROA, but Tobin's Q.

h) Equity concentration（TOP1）:

Regression coefficients of equity concentration are 0.0482, -0.4374, 0.0474, -

0.4459. T absolute values of all models (13.5004, -5.4995, 13.1623, -5.6127) are

greater than 1.96. The significance level is 1%. It indicates that equity concentration

has positive significant influence on ROA and negative influence on Tobin's Q.

i) Equity balance (Balance1):

Regression coefficients of equity balance are 0.0126, -0.1544, 0.0129, -0.1539. T

absolute values of all models (7.4934, -4.1287, 7.5987, -4.1195) are greater than 1.96,

which indicates that equity balance has statistically significant positive influence on

ROA and negative influence on Tobin's Q. The significance level is 1%.

j) Firm age (FirmAge):

Regression coefficients of firm age are -0.0071, 0.445, -0.0078, 0.0438. T values

in model 1 and 3 (-5.2635, 1.4797, -5.7289, 1.4602) is less than -1.96, which indicates

that firm age has statistically significant negative influence on ROA. The significance

level is 1%. But Firm age has no influence on Tobin's Q in model 2 and 4.

Summarizing the above results, Chinese-listed high-tech enterprises are affected

by financial and corporate governance factors in terms of firm performance, where the financial factor seems to have a greater influence on the operational performance of enterprises. These results have important practical implications for investors and enterprise managers. They must focus on and optimize the key factors affecting firm performance to improve operational efficiency, profitability, and market value.

Endogenous Test and Robustness Test

Two tests were conducted for two-way causality and missing-variable endogeneity. Please refer to Appendix C for an endogeneity test. The results show that AHRS and RHRS have a significant influence on these two dependent variables in terms of ROA, or Tobin's Q, which indicates that HR slack is an important factor affecting firm performance.

This study also uses a substitution variable method for further robustness tests. Appendix D presents the details of the substitution variable tests.

(1) Dependent variable: ROA replaced by ROE.

(2) Independent variable: AHRS/RHRS replaced by AHRS1/RHRS1.

(3) Independent variable: AHRS/RHRS modified by AHRS2/RHRS2.

(4) Control variable: Top 1 replaced by Top 10.

After modifying the dependent, independent, and control variables, the results showed that the relationships between HR slack and firm performance were statistically significant, and the model met the robustness test conditions.

Sub–HR Slack and Firm Performance

Different Types of AHRS on Firm Performance (ROA)

In the previous section, further classification was conducted for the types of HR slack based on education level and function. This section discusses the influence of different education levels and different function types of AHRS on firm performance. First, the influence of different types of AHRS on return on assets (ROA) is analyzed. The results were as follows:

Table 10

Different Types of AHRS on Firm Performance (ROA)

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
ahrsedu1	0.0104***							
	(8.5600)							
ahrsedu2		0.0170***						
		(12.4569)						
ahrsedu3			0.0125***					
			(10.6136)					
ahrsedu4				0.0137***				
				(9.6761)				
ahrsjob1					0.0140***			
					(12.9930)			
ahrsjob2						0.0213***		
						(17.1212)		
ahrsjob3							0.0116***	
							(12.3444)	
ahrsjob4								0.0083***
								(8.8924)
Size	0.0114***	0.0113***	0.0109***	0.0119***	0.0110***	0.0113***	0.0115***	0.0114***
	(21.0844)	(23.1857)	(21.3316)	(17.7593)	(22.7813)	(22.9849)	(23.9911)	(23.9439)
Lev	-0.1639***	-0.1609***	-0.1560***	-0.1553***	-0.1575***	-0.1577***	-0.1601***	-0.1593***
	(-50.1177)	(-54.7812)	(-51.2143)	(-39.0020)	(-54.3693)	(-53.3329)	(-55.6826)	(-56.1939)
ATO	0.0437***	0.0418***	0.0405***	0.0348***	0.0377***	0.0373***	0.0397***	0.0397***
	(27.2964)	(28.9811)	(28.1342)	(18.7479)	(27.0316)	(26.4723)	(28.7965)	(29.1566)
Cashflow	0.3262***	0.3322***	0.3348***	0.3448***	0.3359***	0.3295***	0.3383***	0.3343***
	(38.3744)	(43.9749)	(42.8881)	(33.2586)	(44.7338)	(43.3659)	(45.8792)	(45.8510)
REC	0.0506***	0.0565***	0.0514***	0.0550***	0.0558***	0.0545***	0.0605***	0.0588***
	(9.3030)	(11.5910)	(10.0213)	(7.9620)	(11.1143)	(10.9243)	(12.5690)	(12.3671)
INV	0.0477***	0.0420***	0.0407***	0.0341***	0.0445***	0.0420***	0.0473***	0.0445***
	(7.6640)	(7.5753)	(7.1447)	(4.4974)	(8.0166)	(7.5488)	(8.6752)	(8.2635)
Board	0.0045	0.0060**	0.0031	-0.0043	0.0056*	0.0030	0.0047	0.0051*
	(1.3943)	(2.0598)	(1.0227)	(-1.0589)	(1.9332)	(1.0229)	(1.6285)	(1.7856)
Indep	-0.0010	0.0025	-0.0012	-0.0103	0.0004	-0.0065	0.0020	0.0042
	(-0.0908)	(0.2545)	(-0.1128)	(-0.7533)	(0.0414)	(-0.6510)	(0.2121)	(0.4424)
Top1	0.0458***	0.0530***	0.0502***	0.0478***	0.0493***	0.0534***	0.0516***	0.0503***
	(10.5915)	(13.5782)	(12.4233)	(9.1116)	(12.8528)	(13.5145)	(13.4173)	(13.2757)
Balance1	0.0107***	0.0141***	0.0129***	0.0125***	0.0134***	0.0145***	0.0135***	0.0133***
	(5.2638)	(7.6683)	(6.8082)	(5.0302)	(7.3914)	(7.8160)	(7.4858)	(7.5043)
FirmAge	-0.0081***	-0.0085***	-0.0089***	-0.0078***	-0.0076***	-0.0088***	-0.0082***	-0.0082***
	(-4.7776)	(-5.6729)	(-5.7411)	(-3.7164)	(-5.1088)	(-5.6440)	(-5.5359)	(-5.6536)
N	11864	14610	13651	7595	14390	14457	15371	15698
R^2	0.378	0.382	0.377	0.392	0.387	0.380	0.377	0.373

adj. R^2	0.375	0.381	0.375	0.389	0.385	0.379	0.376	0.371
IndControl	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

According to the regression results in Table 10, different education levels and job types of AHRS have a significant influence on the return on assets of enterprises, which indicates that AHRS indeed have an important influence on the return on assets (ROA) of enterprises, and different education levels and function types of AHRS have different degrees of influence.

First, AHRS with postgraduate and above (edu1), bachelor (edu2), junior college degree (edu3), high school and below (edu4) have significant positive influence on ROA, where AHRS with bachelor has the largest influence on ROA, which is 0.0170; AHRS with high school and below ranks second in terms of its influence, which is 0.0137; AHRS with education level of junior college degree ranks third in terms of its influence, which is 0.0125; AHRS with postgraduate and above ranks the last in terms of its influence, which is 0.0104. Among listed high-tech enterprises, HR slack with a bachelor's degree may have the largest influence on enterprises' ROA. Regarding the level of general knowledge mastered by employees before joining, employees with a bachelor's degree generally master professional knowledge and skills; employees with an education level of postgraduate or above generally undertake deeper study in a specific field; employees with an education level of junior college focus on proficiency in professional skills; and employees with high school education and

below may lack the necessary professional knowledge. After joining, employees with

an education level of postgraduate and above are excessively segmented and difficult

to match; employees with an education level of bachelor's degree are easily matched.

Therefore, employees with a bachelor's degree may meet enterprises' diversified

demands for a "wide range of expertise and profound study of specific fields," thereby

generating a larger impact on return on assets (ROA). Additionally, the "cost" of

employees with bachelor's degrees may be more suitable for Chinese high-tech

enterprises in terms of the initial salary of employees with different education levels.

In summary, the AHRS of employees with a bachelor's degree may have a greater

impact on the ROA of enterprises.

Second, the AHRS of production (job1), finance (job2), sales (job3), and

technology (job4) staff have significant positive influences on return on assets (ROA).

where the AHRS of financial personnel has the largest impact on ROA (0.0213), the

AHRS of production personnel ranks second in terms of influence on ROA (0.0140),

the AHRS of sales personnel ranks third in terms of influence on ROA (0.0116), and

the AHRS of technology personnel ranks last in terms of influence on ROA (0.0083).

This indicates that financial personnel are of greater importance in listed high-tech

enterprises because information disclosure and financial report compliance

requirements, market financing, and relationships with investors are of great

importance for the market value, reputation, and financial condition of listed

companies. Listed companies need more standardized and effective finance specialty

management.

Figure 14

Coefficients of Sub-AHRS on the Firm Performance (ROA)
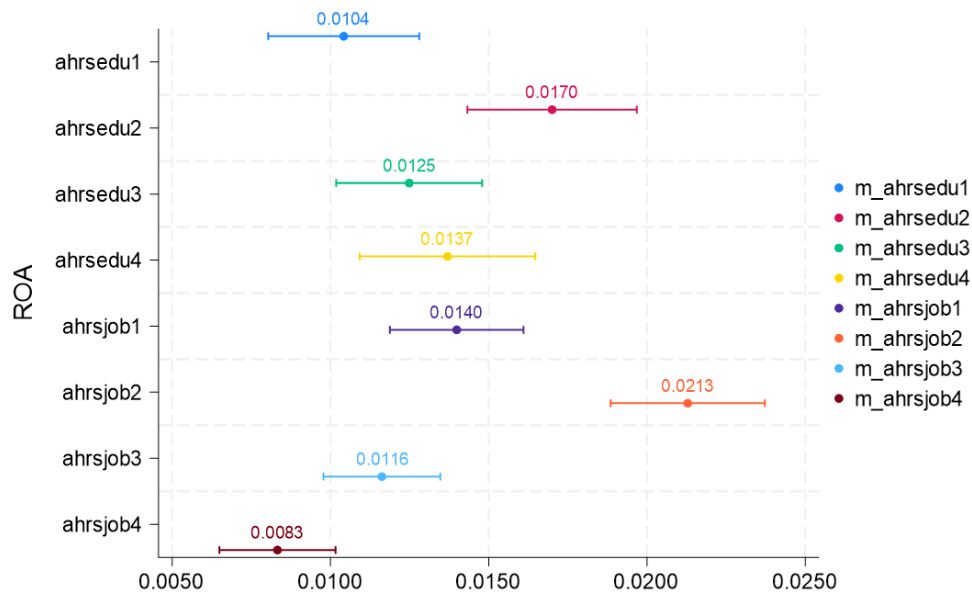
Note. Data sorted out by the author.

In summary, these regression results show that the ROA of listed high-tech enterprises is significantly influenced by AHRS with different education levels and job types, but the degree of influence differs. Hypotheses 2 and 3 were supported when the independent variable was the AHRS.

Different Types of AHRS on Firm Performance (Tobin's Q)

Continue to analyze the influence of AHRS of different types on Tobin's Q. The regression results are arranged as follows:

Table 11

Different Types of AHRS on Firm Performance (Tobin's Q)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ
ahrsedu1	0.0681**							
	(2.4996)							
ahrsedu2		0.1340***						
		(4.3575)						
ahrsedu3			0.1077***					
			(4.2297)					
ahrsedu4				0.0821***				
				(2.6997)				
ahrsjob1					0.0924***			
					(3.9028)			
ahrsjob2						0.2011***		
						(7.3626)		
ahrsjob3							0.1065***	
							(5.0510)	
ahrsjob4								0.0450**
								(2.1616)
Size	-0.2696***	-0.2888***	-0.3238***	-0.2954***	-0.2789***	-0.2970***	-0.2913***	-0.2926***
	(-22.2079)	(-26.2579)	(-29.3915)	(-20.5971)	(-26.3652)	(-27.5425)	(-27.0857)	(-27.7388)
Lev	-1.0924***	-0.9637***	-0.7407***	-1.0638***	-0.9310***	-0.9354***	-0.9599***	-0.9267***
	(-14.9186)	(-14.5622)	(-11.2383)	(-12.4396)	(-14.6110)	(-14.3983)	(-14.9080)	(-14.6905)
ATO	0.1231***	0.1244***	0.1004***	0.1041***	0.0334	0.0526*	0.0774**	0.0807***
	(3.4312)	(3.8283)	(3.2247)	(2.6103)	(1.0894)	(1.7017)	(2.5082)	(2.6646)
Cashflow	3.4034***	3.0608***	2.9649***	2.6623***	2.9632***	2.7934***	3.0768***	3.0157***
	(17.8829)	(17.9842)	(17.5507)	(11.9572)	(17.9421)	(16.7330)	(18.6339)	(18.5934)
REC	-0.0464	-0.0889	-0.0149	0.1140	0.2026*	-0.0374	-0.0232	-0.0390
	(-0.3808)	(-0.8091)	(-0.1342)	(0.7690)	(1.8357)	(-0.3409)	(-0.2154)	(-0.3690)
INV	0.4888***	0.2523**	0.2002	0.7585***	0.3935***	0.2928**	0.2980**	0.2976**
	(3.5083)	(2.0184)	(1.6261)	(4.6538)	(3.2228)	(2.3932)	(2.4426)	(2.4859)
Board	0.0720	0.0283	0.0343	-0.1036	0.0495	-0.0017	0.0236	0.0275
	(0.9895)	(0.4338)	(0.5202)	(-1.1958)	(0.7841)	(-0.0268)	(0.3665)	(0.4353)
Indep	0.5767**	0.5102**	0.5959***	0.3020	0.4813**	0.3217	0.4360**	0.4738**
	(2.3807)	(2.3144)	(2.6766)	(1.0253)	(2.2623)	(1.4754)	(2.0153)	(2.2328)
Top1	-0.5505***	-0.3945***	-0.2178**	0.0728	-0.3569***	-0.3360***	-0.4220***	-0.4287***
	(-5.6797)	(-4.4896)	(-2.4908)	(0.6461)	(-4.2319)	(-3.8688)	(-4.9033)	(-5.0869)
Balance1	-0.1712***	-0.1247***	-0.0984**	0.0432	-0.1082***	-0.0887**	-0.1345***	-0.1363***
	(-3.7582)	(-3.0027)	(-2.3912)	(0.8067)	(-2.7224)	(-2.1691)	(-3.3342)	(-3.4494)
FirmAge	-0.0009	0.0062	0.0604*	0.0875*	0.0302	0.0360	0.0209	0.0234
	(-0.0235)	(0.1833)	(1.7972)	(1.9336)	(0.9199)	(1.0506)	(0.6330)	(0.7265)
N	11864	14610	13651	7595	14390	14457	15371	15698
R^2	0.277	0.273	0.289	0.292	0.257	0.261	0.271	0.272

adj. R^2	0.274	0.271	0.287	0.288	0.255	0.259	0.270	0.270
IndControl	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Figure 15

Coefficients of Sub-AHRS on the Firm Performance (Tobin's Q)
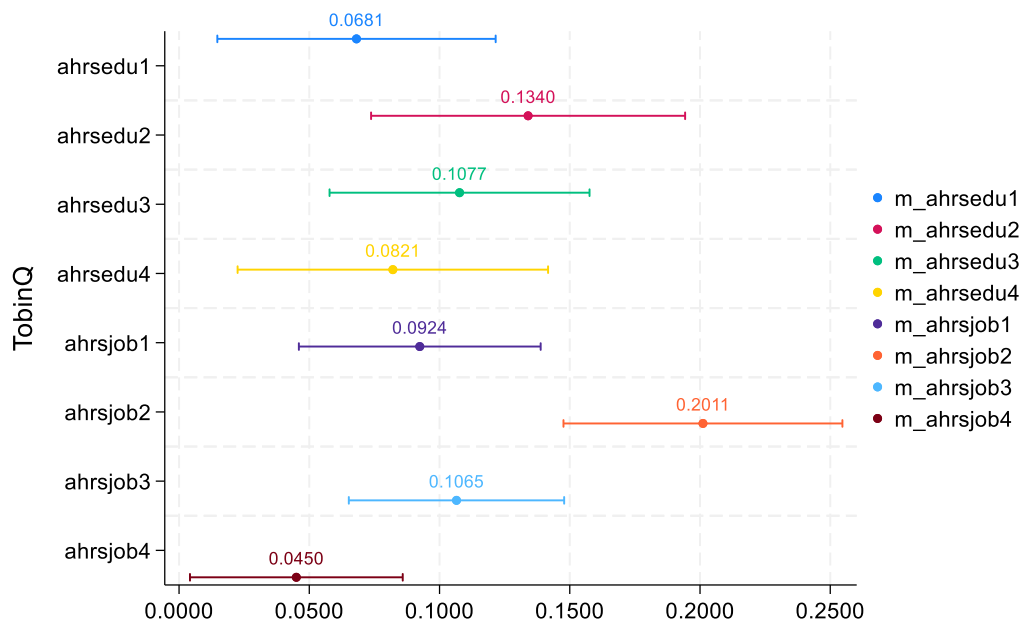
Note. Data sorted out by the author.

AHRS with an education level of postgraduate and above (edu1), bachelor's degree (edu2), junior college degree (edu3), and high school and below (edu4) have a significant positive influence on Tobin's Q. Here, AHRS with a bachelor's degree have the largest influence on Tobin's Q, at 0.1340. AHRS for junior college education ranked second at 0.1077. AHRS with an educational level of postgraduate degree and below ranks last at 0.0681.

AHRS of production (job1), finance (job2), sales (job3) and technology (job4) personnel had a significant positive influence on growth. The AHRS of financial personnel has the largest influence on growth, at 0.2011; the AHRS of sales personnel ranks second, at 0.1065; the AHRS of production personnel follows, at 0.0924; and the AHRS of technical personnel ranks last, at 0.0450.

Among the different job types, the AHRS of finance personnel has the largest influence on Tobin's Q, the effect of which is obviously higher than that of production, sales, and technology personnel. This may be because the professional knowledge and skills of finance personnel in listed companies have a more significant influence on compliance, financing, information disclosure, and relationships with investors of listed enterprises, thereby generating a larger positive influence on operating revenue growth.

In summary, these regression results show that Tobin's Q in listed high-tech enterprises is significantly influenced by AHRS for different education levels and job types, but the degree of influence differs. Hypotheses 2 and 3 were supported when the independent variable was the AHRS.

Different Types of RHRS on Firm Performance (ROA)

This section discusses the influence of RHRS with different educational levels and job types. First, we analyzed the influence of RHRS on return on assets (ROA). The results were as follows:

Table 12

Different Types of RHRS on Return on Assets (ROA)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ROA	ROA	ROA	ROA	ROA	ROA	ROA	ROA
rhrsedu1	-0.0005***							
	(-3.1024)							
rhrsedu2		-0.0011**						
		(-2.4313)						
rhrsedu3			0.0015***					
			(3.4222)					
rhrsedu4				0.0004*				
				(1.7081)				
rhrsjob1					0.0001			
					(0.4175)			
rhrsjob2						0.0052***		
						(9.1673)		
rhrsjob3							0.0007***	
							(3.7593)	
rhrsjob4								-0.0011***
								(-2.7412)
Size	0.0112***	0.0115***	0.0106***	0.0115***	0.0112***	0.0101***	0.0113***	0.0117***
	(21.4630)	(24.0159)	(21.2727)	(18.2771)	(23.8236)	(20.2481)	(23.9430)	(25.1015)
Lev	-0.1611***	-0.1595***	-0.1549***	-0.1517***	-0.1575***	-0.1574***	-0.1599***	-0.1583***
	(-51.2266)	(-56.2192)	(-53.2065)	(-41.5134)	(-56.5339)	(-55.6423)	(-57.8969)	(-58.0582)
ATO	0.0446***	0.0437***	0.0394***	0.0347***	0.0387***	0.0361***	0.0399***	0.0411***
	(28.6252)	(30.6042)	(27.9995)	(20.6123)	(29.0122)	(26.1744)	(30.5206)	(30.5715)
Cashflow	0.3281***	0.3332***	0.3359***	0.3399***	0.3349***	0.3294***	0.3378***	0.3331***
	(40.5572)	(45.8721)	(45.1605)	(35.8526)	(46.4912)	(45.4071)	(47.8063)	(47.6412)
REC	0.0567***	0.0601***	0.0543***	0.0582***	0.0606***	0.0563***	0.0633***	0.0619***
	(10.8459)	(12.6927)	(11.0250)	(9.1296)	(12.4832)	(11.7446)	(13.6105)	(13.4721)
INV	0.0483***	0.0436***	0.0416***	0.0328***	0.0457***	0.0438***	0.0476***	0.0447***
	(8.1063)	(8.1295)	(7.6359)	(4.7225)	(8.5764)	(8.2145)	(9.1027)	(8.6467)
Board	0.0028	0.0043	0.0018	-0.0069*	0.0052*	0.0037	0.0046*	0.0038
	(0.9041)	(1.5250)	(0.6065)	(-1.8445)	(1.8900)	(1.3041)	(1.6721)	(1.3848)
Indep	-0.0008	-0.0008	-0.0046	-0.0161	-0.0015	-0.0039	0.0031	0.0004
	(-0.0813)	(-0.0826)	(-0.4650)	(-1.2816)	(-0.1651)	(-0.4113)	(0.3308)	(0.0402)
Top1	0.0441***	0.0497***	0.0470***	0.0437***	0.0474***	0.0502***	0.0476***	0.0478***
	(10.6468)	(13.2171)	(12.2048)	(9.0740)	(12.8700)	(13.2704)	(12.9298)	(13.1522)
Balance1	0.0112***	0.0137***	0.0128***	0.0117***	0.0133***	0.0139***	0.0130***	0.0131***
	(5.7656)	(7.6919)	(7.0535)	(5.1034)	(7.6356)	(7.8319)	(7.5235)	(7.6943)
FirmAge	-0.0080***	-0.0083***	-0.0077***	-0.0062***	-0.0077***	-0.0087***	-0.0077***	-0.0082***
	(-4.9644)	(-5.8448)	(-5.3154)	(-3.2843)	(-5.4546)	(-5.9417)	(-5.5008)	(-5.9588)
N	12859	15581	14720	8690	15424	15615	16389	16679
R^2	0.372	0.375	0.371	0.383	0.380	0.372	0.373	0.371

adj. R^2	0.370	0.373	0.370	0.380	0.379	0.370	0.371	0.369
IndControl	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Figure 16

Coefficients of Sub-RHRS on the Firm Performance (ROA)
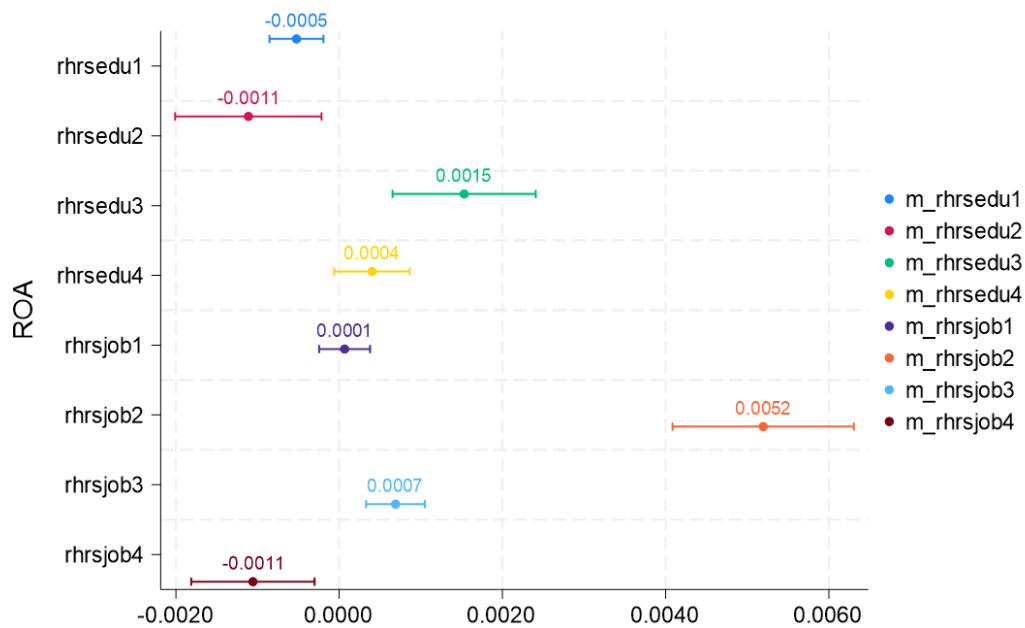
Note. Data sorted out by the author.

Some changes have occurred. Although all significance levels were 1%, 5%, or 10% (except for Model 5), the coefficients in Models 1, 2, and 8 were negative, whereas those in Models 3, 4, 6, and 7 were positive.

The RHRS with edu1 and edu2 may have a negative influence on ROA. This indicates that, compared with the industrial level, holding too many staff with postgraduate and bachelor's degrees may reduce ROA, while an increase in junior

college and high school staff might be beneficial to ROA.

The coefficients of RHRS for job2 and job3 are 0.0052 and 0.0007, respectively, with a significance level of 1%. However, the coefficient of RHRS for job4 is -0.0011 with a significance level of 1%. The T-value of the coefficient of RHRS with Job1 was 0.4175, which was less than 1.96, indicating that there was no significant impact on ROA.

Different Types of RHRS and Firm Performance (Tobin's Q)

We analyzed the influence of RHRS with different educational levels and function types on Tobin's Q. The regression results are arranged as follows:

Table 13

Different Types of RHRS on Tobin's Q

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ	TobinQ
rhrsedu1	-0.0426***							
	(-11.4477)							
rhrsedu2		-0.0757***						
		(-7.4356)						
rhrsedu3			0.0623***					
			(6.4696)					
rhrsedu4				0.0425***				
				(8.3820)				
rhrsjob1					0.0363***			
					(10.5161)			
rhrsjob2						0.0615***		
						(4.9540)		
rhrsjob3							0.0179***	
							(4.3884)	
rhrsjob4								-0.0125
								(-1.4692)
Size	-0.2798***	-0.2771***	-0.3305***	-0.3176***	-0.2935***	-0.3129***	-0.2960***	-0.2886***
	(-24.2108)	(-26.1117)	(-30.7887)	(-23.4579)	(-28.7108)	(-28.6963)	(-28.2341)	(-27.9393)
Lev	-0.9570***	-0.9191***	-0.7142***	-0.9303***	-0.8335***	-0.9027***	-0.9118***	-0.8811***
	(-13.7906)	(-14.5710)	(-11.4038)	(-11.8235)	(-13.7768)	(-14.5646)	(-14.8623)	(-14.6316)
ATO	0.2278***	0.2111***	0.0614**	0.0729**	0.0166	0.0477	0.0938***	0.1111***
	(6.6261)	(6.6576)	(2.0294)	(2.0097)	(0.5738)	(1.5778)	(3.2270)	(3.7432)
Cashflow	3.3650***	3.0844***	3.0331***	2.7765***	3.1486***	2.9532***	3.1439***	3.0748***
	(18.8524)	(19.0964)	(18.9545)	(13.6050)	(20.1288)	(18.5727)	(20.0270)	(19.9137)
REC	-0.0446	-0.0425	-0.0161	0.0265	0.1608	0.0323	0.0298	0.0115
	(-0.3870)	(-0.4042)	(-0.1519)	(0.1933)	(1.5262)	(0.3077)	(0.2884)	(0.1132)
INV	0.4955***	0.3533***	0.2625**	0.7373***	0.5076***	0.3526***	0.3768***	0.3711***
	(3.7660)	(2.9627)	(2.2401)	(4.9338)	(4.3872)	(3.0195)	(3.2425)	(3.2504)
Board	0.0216	-0.0092	0.0485	-0.0893	0.0802	0.0183	0.0397	0.0308
	(0.3136)	(-0.1483)	(0.7756)	(-1.1154)	(1.3354)	(0.2958)	(0.6474)	(0.5125)
Indep	0.4487*	0.3956*	0.5607***	0.2457	0.5004**	0.4267**	0.4933**	0.4972**
	(1.9588)	(1.8808)	(2.6622)	(0.9059)	(2.4805)	(2.0565)	(2.3989)	(2.4639)
Top1	-0.5357***	-0.4101***	-0.2912***	-0.0814	-0.3559***	-0.3686***	-0.4630***	-0.4388***
	(-5.8653)	(-4.9052)	(-3.5119)	(-0.7855)	(-4.4457)	(-4.4488)	(-5.6588)	(-5.4621)
Balance1	-0.1864***	-0.1427***	-0.1262***	-0.0218	-0.1126***	-0.1107***	-0.1568***	-0.1516***
	(-4.3341)	(-3.6035)	(-3.2295)	(-0.4405)	(-2.9826)	(-2.8359)	(-4.0772)	(-4.0205)
FirmAge	0.0242	0.0211	0.0798**	0.1004**	0.0456	0.0466	0.0465	0.0434
	(0.6820)	(0.6674)	(2.5460)	(2.4750)	(1.4887)	(1.4529)	(1.5002)	(1.4347)
N	12859	15581	14720	8690	15424	15615	16389	16679
R^2	0.282	0.275	0.288	0.293	0.267	0.275	0.273	0.272

adj. R^2	0.280	0.273	0.286	0.290	0.266	0.273	0.271	0.270
IndControl	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Figure 17

Coefficients of Sub-RHRS on the Firm Performance (Tobin's Q)
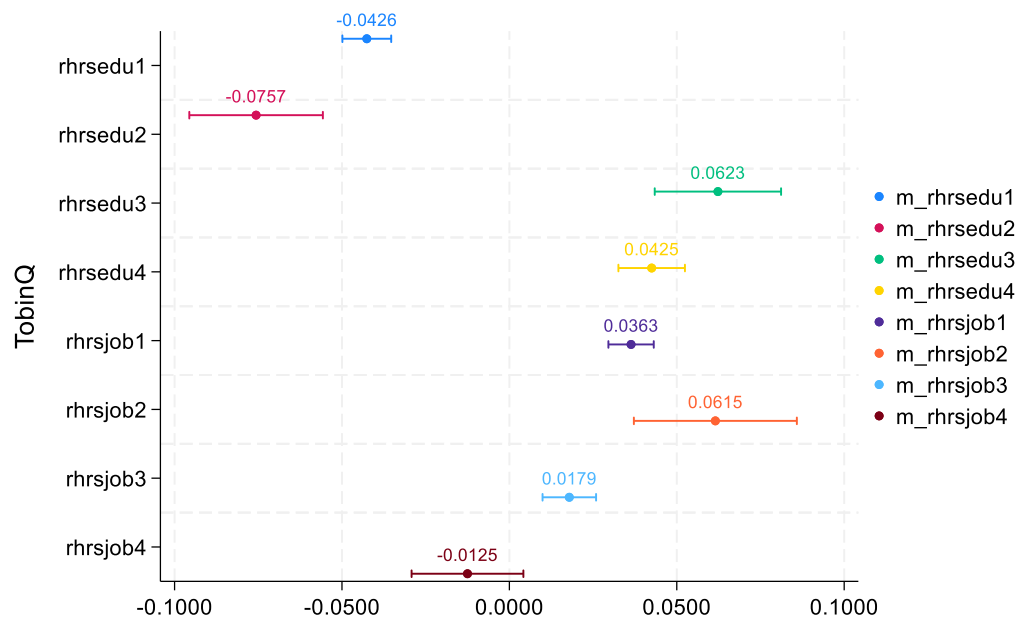
Note. Data sorted out by the author.

The coefficients in Models 1 and 2 are negative, whereas those in Models 3, 4, 5, 6, and 7 are positive, with a significance level of 1%. The T-value of the coefficient in Model 8 is -1.4692 but greater than -1.95, meaning that there is no significant impact on Tobin's Q. The RHRS with a bachelor's degree and financial job have a more positive impact than other types on Tobin's Q.

In summary, relative to the industry-average level, not all types of HR slack

positively affect firm performance. Regardless of whether the dependent variables are

ROA or Tobin's Q, the relative HR slack of postgraduates and bachelor's degrees

shows a negative relationship with firm performance. The coefficients of RHRS with

production jobs (Job1) on ROA and RHRS with technology jobs (Job4) on Tobin's Q

are not significant. This means that only some types of HR slack configured in the

organization lead to changes in firm performance in competitive scenarios.

Moderation Effect Analysis

Ownership: SOE and Non-SOE

Based on Formula 10, the Moderating Effect Regression Models, the regression

results with ownership type as a moderator (SOE or non-SOE firms) are as follows:

Table 14

Moderation Effect Test (Ownership: SOE and non-SOE)

	1a	1b	2a	2b	3a	3b	4a	4b
	ROA	ROA	TobinQ	TobinQ	ROA	ROA	TobinQ	TobinQ
ahrs	0.0243***	0.0253***	0.147***	0.161***				
	(17.1875)	(16.0451)	(4.6617)	(4.5783)				
rhrs					0.00263***	0.00291***	0.0885***	0.105***
					(4.8334)	(4.5426)	(7.3579)	(7.3935)
SOE	-0.0074***	-0.0070***	0.114***	0.119***	-0.0081***	-0.0071***	0.105***	0.162***
	(-7.1648)	(-6.5293)	(4.9214)	(4.9860)	(-7.7470)	(-4.4730)	(4.5339)	(4.6059)
ahrsSOE		-0.00493		-0.0682				
		(-1.4556)		(-0.9048)				
rhrsSOE						-0.000887		-0.0515*
						(-0.8206)		(-2.1571)
N	16903	16903	16903	16903	16903	16903	16903	16903
R^2	0.383	0.383	0.276	0.276	0.373	0.373	0.277	0.278
adj. R^2	0.382	0.382	0.274	0.274	0.372	0.372	0.276	0.276
CV Controlled	YES	YES	YES	YES	YES	YES	YES	YES
IndControl	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

The interaction terms in Table 14 are multiplications of an independent variable
and a moderator. Among the four interaction terms (ahrsSOE on ROA, rhrsSOE on
ROA, ahrsSOE on Tobin's Q, and rhrsSOE on Tobin's Q), only the coefficient of
rhrsSOE on Tobin's Q (-0.0515) is significant at the 10% level. In the same model, the
coefficients of both rhrs and SOE were significant at the 1% level. Thus, the
moderating effect of ownership is significant only when the dependent variable is
Tobin's Q and the independent variable is the RHRS (see Figure 18). They are not
statistically significant when the independent variables are AHRS or when the

independent variable is RHRS and the dependent variable is ROA.

Figure 18

Interact Plot of the Moderation Effect (Ownership) for Tobin's Q and RHRS
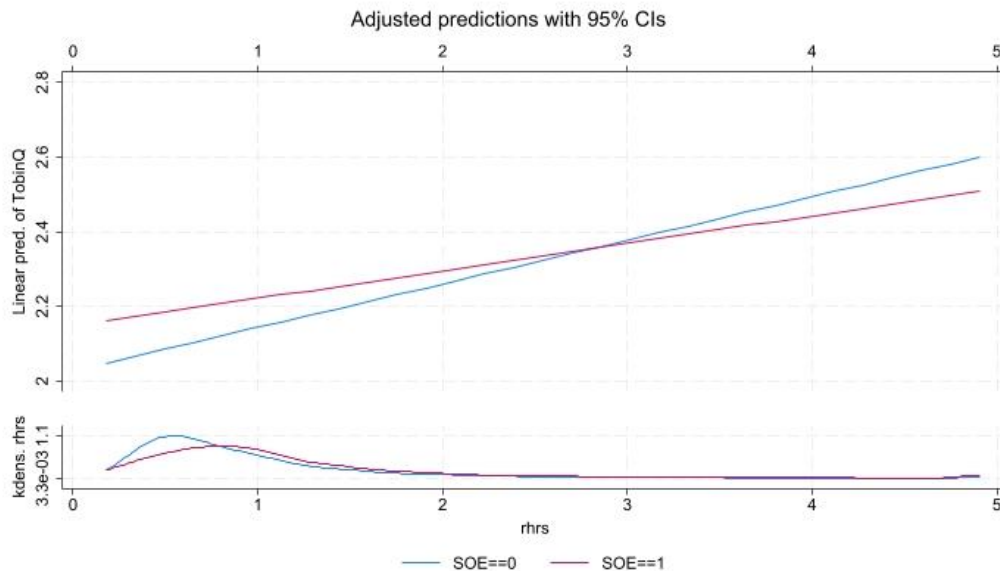
Only in the paired models 4a and 4b in Table 14 is the relationship between

RHRS and market value (Tobin's Q) moderated by the ownership type of firms, such

that the relationship is weaker (not stronger) when the firms are SOEs than non-SOEs.

The moderation effects are not significant in the other paired models (Models 1a and

1b, Models 2a and 2b, and Models 3a and 3b in Table 14).

Why are the impacts on firm performance not significant? The key is that SOEs

have multiple performance's objectives, not just ROA or Tobin's Q. SOEs prioritize

their social and political objectives especially when they face shocks, such as during

severe recessions. We argue that if the performance proxies don't encompass the

multiple objectives pursued by SOEs, the distinctive impacts over non-SOEs will not

be identified. Thus, Hypothesis 3 was not supported. Hypothesis 4 is partially

supported only when the dependent variable is Tobin's.

Industry: Manufacture and Non-Manufacture

Based on Formula 10, the Moderating Effect Regression Models, the regression

results with industry type as a moderator (manufacturing or non-manufacturing firms)

are as follows:

Among the four interaction terms (c_ahrsMFG for ROA, c_rhrsMFG for ROA,

c_ahrsMFG for Tobin's Q, and c_rhrsMFG for Tobin's Q), only the coefficient of

c_rhrsMFG for Tobin's Q was significant at the 1% level. In the same model, the

coefficients of both rhrs and MFG were significant at the 1% level. The coefficient of

c_rhrsMFG is positive (0.107).

The moderation effect of ownership is significant only when the dependent

variable is Tobin's Q and the independent variable is RHRS (see Figure 19). They are

not statistically significant when independent variables are AHRS or when the

independent variable is RHRS, and the dependent variable is ROA.

Figure 19

Interact Plot of the Moderation Effect (Industry) for Tobin's Q and RHRS
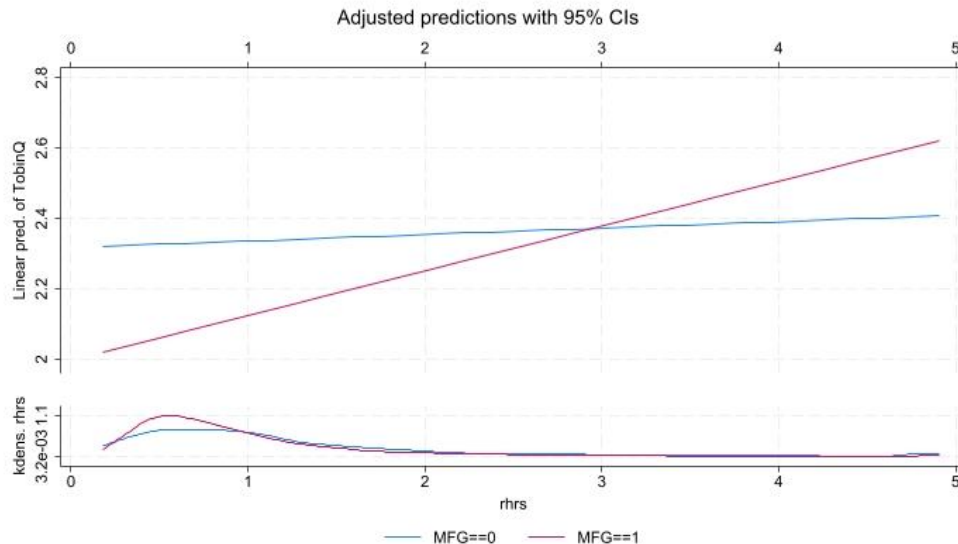
Only in the paired models 4a and 4b in Table 15 is the relationship between

RHRS and market value (Tobin's Q) moderated by the industry type of firms, such

that the relationship is stronger when the firms are in the manufacturing industry

compared to those in the non-manufacturing industry[7]. The moderation effects are not

significant in the other paired models (Models 1a and 1b, Models 2a and 2b, and

Models 3a and 3b in Table 15).

In practical business decisions, managers in most cases make decisions about the

quantity (rather than the quality or structure) of the workforce, using established

human resource policies and methods, based on relatively short-term annual business

objectives. The type of industry is not emphasized as a dominant factor in the

decision-making process. In this way, the differences in HR slack across industries are

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[7] In Appendix E, Manufacture and Non-Manufacture Groups, a subgroup regression method is employed by dividing the sample into two groups: firms in the manufacturing industry and those in the non-manufacturing industry. However, the coefficient of rhrs on Tobin's Q in the non-manufacture group is not significant (the T value is 1.6376).

not pronounced. This may be one reason why the moderating effect of industry types is not significant. Thus, Hypothesis 5 was not supported. Hypothesis 6 is supported only when the dependent variable is Tobin's.

Table 15

Moderation Effect Test (Industry: Manufacture and non-Manufacture)

	1a	2b	2a	2b	3a	3b	4a	4b
	ROA	ROA	TobinQ	TobinQ	ROA	ROA	TobinQ	TobinQ
ahrs	0.0240^{***}	0.0243^{***}	0.144^{***}	0.148^{***}				
	(16.840)	(16.946)	(4.5286)	(4.6231)				
rhrs					0.0034^{***}	0.0034^{***}	0.0831^{***}	0.100^{***}
					(6.2489)	(5.9941)	(6.9902)	(8.0430)
MFG	-0.00027	-0.00027	-0.225^{***}	-0.225^{***}	0.000586	0.000565	-0.202^{***}	-0.216^{***}
	(-0.2653)	(-0.2735)	(-10.097)	(-10.102)	(0.5742)	(0.5486)	(-8.9527)	(-9.4910)
c_ahrsMFG		0.00626		0.0868				
		(1.8919)		(1.1783)				
c_rhrsMFG						0.000159		0.107^{***}
						(0.1479)		(4.5233)
N	16903	16903	16903	16903	16903	16903	16903	16903
R^2	0.367	0.368	0.257	0.258	0.358	0.358	0.259	0.260
adj. R^2	0.367	0.367	0.256	0.256	0.357	0.357	0.258	0.259
CV Controlled	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. The values of variables ahrs, rhrs, and MFG were centralized using STATA. The values of c_ahrsMFG are the products of the centralized ahrs and MFG, and c_rhrsMFG is the product of the centralized rhrs and MFG. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

In summary, not fully consistent with assumptions, the moderating effects are not significant or robust when ownership and industry are considered as moderators. Thus, hypotheses 4a and 4b were not fully supported.

Mediation Effect Analysis

Mediation Model

To test the mediation effect between the HR slack of a specific group and firm performance, we designed a mediation model as follows (David. MacKinnon, 2008; Wood et al., 2008).

Figure 20

Mediation Model
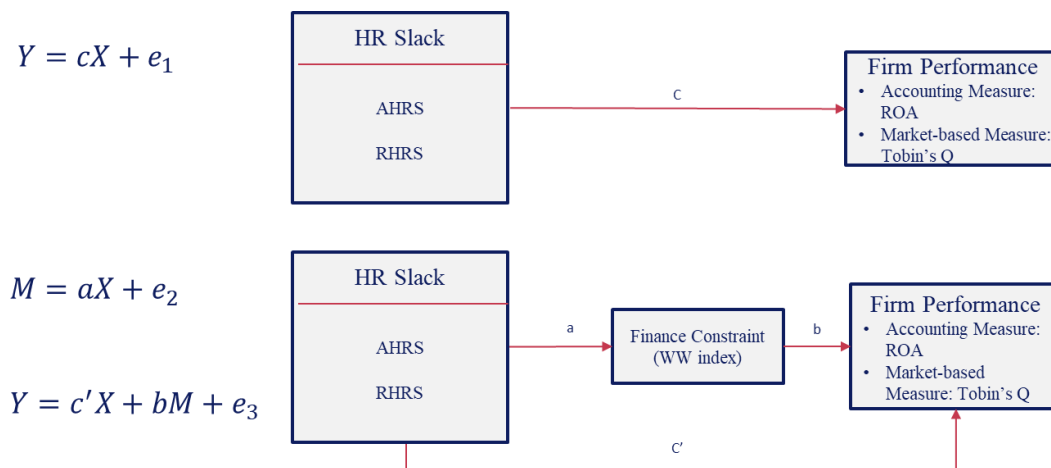
See Formula 9,

$$Firm\ Performance = c \times HR\ slack + e1$$

$$Financing\ Constraints = a \times HR\ slack + e2$$

$$Firm\ Performance = c' \times HR\ slack + b \times Financing\ Constraints + e3$$

In this study, we used step regression and the Bootstrap method to test the model's significance (Alfons et al., 2022; Mackinnon et al., 2007). Numerous methods have been proposed to test the significance of mediation effects in the literature (D. P. MacKinnon et al., 2004; Wood et al., 2008). Bootstrapping, a

computer-intensive resampling technique, is superior to other methods (Alfons et al., 2022). Bootstrapping provides generic ways to reliably construct confidence intervals for indirect effects (Mackinnon et al., 2007; Preacher & Hayes, 2008).

Both overall HR slack and sub-HR slack (educational level and job type) are discussed.

Mediation Effect Result for AHRS and RHRS

In the Mediation Effect Formula (See Formula 11), the dependent variable, Firm Performance, uses ROA and Tobin's Q as proxies. The independent variable, HR slack, uses proxies for AHRS and RHRS. The mediator (financing constraints) uses a proxy for WW.

Step Regression: Sobel Test.

As the relationship between HR slack and Firm Performance ($Firm\ Performance = c \times HR\ slack + e1$) was tested in the previous section, the relationship between HR slack and financial constraints ($Financing\ Constraints = a \times HR\ slack + e2$) is tested in this section.

Table 16

Regression Results of Mediation Variables (WW)

Model	(1)	(2)	(3)	(4)	(5)	(6)
Variable	WW	WW	ROA	TobinQ	ROA	TobinQ
ahrs	-0.0259***		0.0147***	0.1243***		
	(-26.8052)		(10.5387)	(3.8405)		
rhrs		-0.0018***			0.0018***	0.0893***
		(-4.8719)			(3.3432)	(7.3814)
WW			-0.3874***	-0.7397***	-0.4094***	-0.8679***
			(-35.4657)	(-2.9230)	(-38.1312)	(-3.5040)
N	16824	16824	16824	16824	16824	16824
R^2	0.657	0.643	0.425	0.275	0.422	0.276
adj. R^2	0.656	0.642	0.424	0.273	0.420	0.275
CV Controlled	YES	YES	YES	YES	YES	YES
IndControl	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

In Table 16, the coefficients of AHRS and RHRS on WW were -0.0259 and -0.0018, respectively, and the corresponding t-values were -26.8052 and -4.8719, respectively, both significant at the 1% level.

When AHRS is the explanatory variable, the coefficients of financing constraints (WW) on the impact of ROA and Tobin's Q are -0.3874 and -0.7397, respectively, with corresponding T-values of -35.4657 and -2.9230, respectively; all are significant at the 1% level.

When RHRS is the explanatory variable, the coefficient of financing constraints (WW) on the impact of ROA and Tobin's Q are -0.4094 and -0.8679, respectively, and the corresponding T-values are -38.1312 and -3.5040, respectively, both significant at

the 1% level.

The Sobel test was performed, and the results are presented as follows. The results show that for all paths, the Sobel statistic exceeds the threshold of 1.96 at the 1% level, which indicates that the mediation effect is significant in all cases.

Table 17

Sobel Statistics for Mediation Effect (Overall AHRS and RHRS)

Effect	Direct Effect: a	Direct Effect: Std. err for a	Indirect Effect: b	Indirect Effect: Std. err for b	Sobel Statistic
ahrs->WW->ROA	-0.0259***	0.00097	-0.3874***	0.0109	21.3792
ahrs->WW->Tobin's Q	-0.0259***	0.00097	-0.7397***	0.2531	2.9058
rhrs->WW->ROA	-0.0018***	0.00038	-0.4094***	0.0107	4.8330
rhrs->WW->Tobin's Q	-0.0018***	0.00038	-0.8679***	0.2477	2.8447

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Bootstrap Test.

The Bootstrap test sets the number of resamples to 500 and the results are as follows:

Table 18

Bootstrap Test of Mediation Effect (AHRS)

IV: AHRS	Effect	Coeff.	Bootstrap std. error	z	p	95% conf. interval	
ROA	Direct Effect	0.0147	0.0017	8.70	0.00	0.0114	0.0180
	Indirect Effect: WW	0.0100	0.0007	15.25	0.00	0.0087	0.0113
	Total Effect	0.0248	0.0018	14.00	0.00	0.0213	0.0282
Tobin's Q	Direct Effect	0.1243	0.0345	3.60	0.00	0.0567	0.1919
	Indirect Effect: WW	0.0192	0.0074	2.58	0.01	0.0046	0.0337
	Total Effect	0.1434	0.0332	4.32	0.00	0.0784	0.2085

Note. Data sorted out by the author.

Table 19

Bootstrap Test of Mediation Effect (RHRS)

IV: RHRS	Effect	Coeff.	Bootstrap std. error	z	p	95% conf. interval	
ROA	Direct Effect	0.0018	0.0006	2.7	0.007	0.0005	0.0030
	Indirect Effect: WW	0.0008	0.0002	4.12	0.000	0.0004	0.0011
	Total Effect	0.0025	0.0007	3.77	0.000	0.0012	0.0038
Tobin's Q	Direct Effect	0.0893	0.0146	6.13	0.000	0.0607	0.1178
	Indirect Effect: WW	0.0016	0.0006	2.46	0.014	0.0003	0.0029
	Total Effect	0.0909	0.0146	6.22	0.000	0.0622	0.1195

Note. Data sorted out by the author.

From the results in Table 19, not all confidence intervals at the 95% level cross the value of zero, indicating that the mediation effect is significant. In terms of the

mediation share, the value in AHRS-WW-ROA is (0.0100/0.0248) =40.53%, and that in AHRS-WW-Tobin's Q is (0.0192/0.1434) =13.36%. The one in RHRS-WW-ROA is (0.0008/0.0025) = 30.00%. The value of RHRS-WW-Tobin's Q was (0.0016/0.0909) =1.75%.

Step regression and bootstrapping methods were used to test the mediation effect. Hypotheses 7 and 8 are supported; that is, financial constraints mediate the relationship between overall HR slack (AHRS/RHRS) and firm performance (ROA/Tobin's Q). The mediation effect shares were calculated as partial mediation effects.

Summary for Mediation Effect

To summarize the above tests, the results are sorted as follows: First, we examine the mediation effect on the relationship between AHRS and firm performance (ROA and Tobin's Q).

Table 20

A Summary of AHRS-WW-ROA/Tobin's Q Mediation Effect

Dependent Variable	Independent Variable	Mediation Effect			Sobel Statistics	Bootstrap Test
		Direct	Indirect (WW)	Total		
ROA	AHRS	***	***	***	***	Yes
Tobin's Q	AHRS	***	**	***	***	Yes

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Second, we examined the mediation effect on the relationship between RHRS and firm performance (ROA and Tobin's Q).

Table 21

A Summary of RHRS-WW-ROA/Tobin's Q mediation Effect

Dependent Variable	Independent Variable	Mediation Effect			Sobel Statistics	Bootstrap Test
		Direct	Indirect (WW)	Total		
ROA	RHRS	***	**	***	***	Yes
Tobin's Q	RHRS	***	***	***	***	Yes

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Therefore, Hypotheses 7 and 8 are supported. Financing constraints mediate the impact of HR slack on firm performance.

Summary for Result Analysis

This chapter presents an extensive analysis of the regression results for HR slack and firm performance. This study used two indicators as independent variables: AHRS and RHRS. The former refers to the change in the HR slack of firms compared to their own historical levels, and the latter refers to the proportion of firms relative to the industry average. This study also uses two indicators as dependent variables: ROA and Tobin's Q. Correlation, multicollinearity, endogeneity, and robustness tests were performed, as well as descriptive statistics. The regression results show that AHRS and RHRS have a significant positive influence on firm performance (i.e., both ROA and Tobin's Q). Therefore, Hypotheses 1 and 2 were strongly supported by the linear regression results.

Based on RBV and KBV, this study indicates that HR slack exists in different

departments and staff groups. After classifying employees into groups, we further

segmented HR slack by education level and job type. Hypotheses 1a, 1b, 1c, 2a, 2b,

and 2c were tested, and the results showed that the relationships were significantly

positive. HR slack at different educational levels and job groups has different degrees

of influence on firm performance.

Neither ownership nor industry type as a moderator has a significant impact on

the relationship between AHRS and firm performance. Nevertheless, it is weakly

significant only when the independent variable is RHRS and the dependent variable is

Tobin's Q. The moderating effect is neither significant nor robust.

Financing constraint theory states that because of information asymmetry, the

more information that is disclosed, the less the financing constraint. The alleviated

financing constraints will be beneficial for listed firms to receive more financial

support from the market and further improve their performance. We use step

regression and bootstrap methods to test the mediation effect of financing constraints.

The results show that the mediation effect was significant with the mediator proxy for

WW.

Figure 21

Hypothesis Summary when the Independent Variable is AHRS
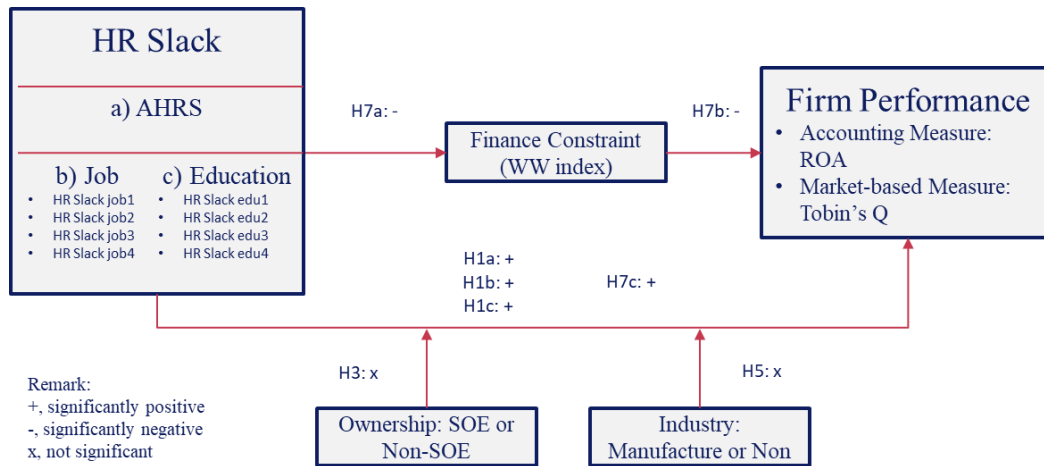
Figure 22

Hypothesis Summary when the Independent Variable is RHRS
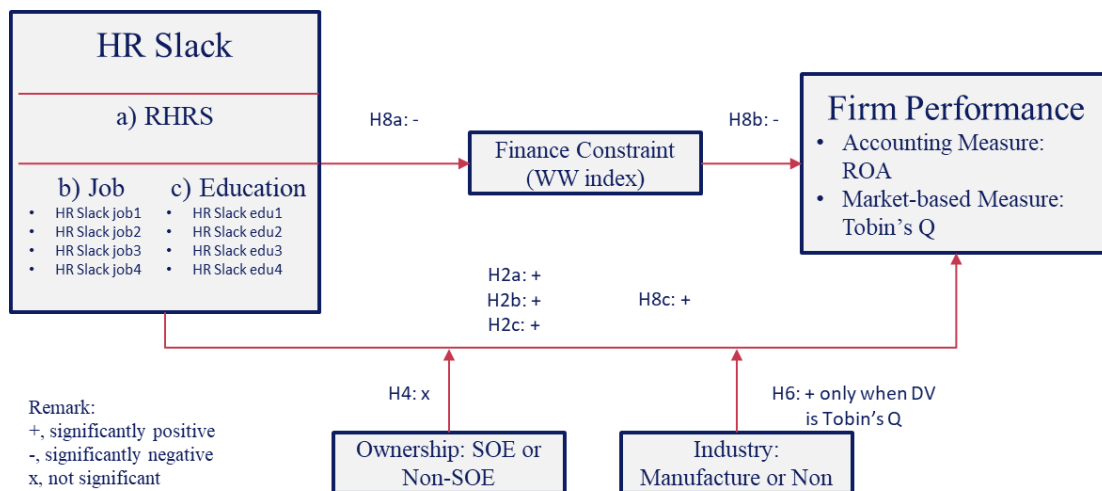
Table 22

A Summary on the Main Models and the Hypothesis

Hypothesis	DV: Firm Performance	IV: HR Slack	Significant or not	Positive or Negative
H1a	ROA, Tobin's Q	AHRS	Yes	Positive
H1b	ROA, Tobin's Q	AHRS in job type	Yes	Positive
H1c	ROA, Tobin's Q	AHRS with education level	Yes	Positive
H2a	ROA, Tobin's Q	RHRS	Yes	Positive
H2b	ROA, Tobin's Q	RHRS in job type	Yes	Positive
H2c	ROA, Tobin's Q	RHRS with education level	Yes	Positive

Note. Data sorted out by the author.

Regarding the sample of this study, there are some distinctive characteristics in the nature and type of firms, such as SOEs and non-SOEs, and manufacturing and non-manufacturing industries. Considering that the nature of a firm's ownership and industry attributes affect the strategic direction and resource allocation decisions of the firm's management, which in turn affect the firm's performance, this study hypothesizes that the nature of ownership and industry attributes, as moderator variables, might affect the extent to which HR slack impacts firm performance. However, Hypotheses 3 and 5 were not supported by the test results, whereas Hypotheses 4 and 6 were partially supported when the dependent variable was Tobin's Q.

Table 23

A summary on the Moderation Models and the Hypothesis

Hypothesis	DV: Firm Performance	IV: HR Slack	Moderator	Significant or not	Positive or Negative
H3	ROA, Tobin's Q	AHRS	Ownership: SOE or non-SOE	Not	N.A.
H4	ROA, Tobin's Q	RHRS	Ownership: SOE or non-SOE	Only when DV is Tobin's Q	Negative when DV is Tobin's Q
H5	ROA, Tobin's Q	AHRS	Industry: MFG or non-MFG	Not	N.A.
H6	ROA, Tobin's Q	RHRS	Industry: MFG or non-MFG	Only when DV is Tobin's Q	Positive when DV is Tobin's Q

Note. Data sorted out by the author.

Once listed, high-tech Chinese companies can access lower-cost financing through public markets to support technological innovation and business operations. This study analyzes whether human resource (HR) slack affects the performance of high-tech listed firms through various financing channels. First, HR Slack provides a relaxed environment that frees practitioners from maintaining appropriate and effective communication with stakeholders through various types of information disclosure, thereby reducing financial constraints due to information asymmetry. Second, previous studies show that alleviating financial constraints can improve firm performance. Financial constraints affect firm performance negatively. Thus, financial constraints mediate the total effect of HR slack on firm performance. Hypotheses 7 and 8 were verified using the Sobel and bootstrap methods and supported by the regression results.

Table 24

A Summary on the Mediation Models and the Hypothesis

Hypothesis	DV: Firm Performance	IV: HR Slack	Mediator: Financing Constraints	Significant or not	Full or partial Mediation (%)
H7	ROA	AHRS	WW	Sobel: *** Bootstrap: ***	40.53%
H7	Tobin's Q	AHRS	WW	Sobel: *** Bootstrap: ***	13.36%
H8	ROA	AHRS	WW	Sobel: *** Bootstrap: ***	30.00%
H8	Tobin's Q	AHRS	WW	Sobel: *** Bootstrap: ***	1.75%

Note. Data sorted out by the author.

Discussion

Theoretical Contribution

This study is one of the most recent academic studies on Chinese high-tech listed companies in the HR slack domain. It considers the theories of RBV and KBV and expands the connotation of HR slack by focusing not only on the quantity but also on the quality of HR. In particular, for high-tech companies, tacit knowledge, firm-specific knowledge, and professional ability development of employees before and after joining the company are key to gaining a competitive advantage and improving company performance. Research on the quantity and quality of HR slack has rarely been conducted.

This study measures HR slack in various ways, which are more conducive to observing and studying HR slack in the real world. Early literature recognized that

HR slack is not as easy to observe and measure as financial slack and thus adopted a "relative change" approach to measuring HR slack. Through a robustness test, this study develops multiple indicators for HR slack by swapping the numerator and denominator and replacing employee numbers with employee salary amounts. As mentioned, almost all groups of firms have their own specific or tacit knowledge. Thus, HR slack in different groups may affect firm performance to varying extents, leading to an optimal HR configuration. The question is how to measure the HR slack in different groups. Based on education level and job types, this study classifies overall HR slack into sub-HR slacks. This is the first time in the literature that HR slack proxies have been developed to measure HR slack in different company groups.

This is the first study to use a mediation effect model to test how HR slack affects firm performance under financing constraints. The listed companies must comply with external regulations and guidelines. When allocating human resources, certain positions or departments must have specific configurations of human resources. Conversely, high-tech companies also need "tacit knowledge" and "proprietary knowledge" when disclosing information. They must maintain adequate and effective communication with external stakeholders while simultaneously and strictly protecting the company's trade secrets. This study argues that loose HR slack can lead to better-quality information disclosure for listed firms, which can allow relevant stakeholders to better perceive the value of the firm, reduce information asymmetry, and thus alleviate financing constraints, which is conducive to improving firm performance.

This study is the first to use ten-year (2011–2021) panel data on Chinese listed companies, including more than 2,000 listed companies and 17,000 observations. This finding enriches empirical studies on HR slack.

Practice Implications

The era in which China's high-tech enterprises live is a "nonlinear era," and the high-tech industry is an industry full of uncertainty (technological uncertainty and business uncertainty). The trajectory of the industry's evolution shows an "S-curve." Under the influence of technological advances, policies, institutions, customer demand, force majeure, and other factors, the paradigm shift has become even more abrupt, leapfrogging, discontinuous, and unpredictable. Theory C claims that a successful business must often treat uncertainty as the norm, and a business can only embrace uncertainty as a positive because it is more of a window of opportunity that contains strength and hope(WU, Xiaobo et al., 2021).

This paradigm shift (Dosi et al., 1988) poses a challenge to the allocation of human resource inputs to firms. Traditional businesses are no longer growing at a fast pace and are about to enter a relatively smooth maturity phase, while new strategic businesses are about to fly but are not sure which way to go. In the paradigm shift window of opportunity, resource constraints force managers to make new resource allocation decisions: reduce investment in businesses entering a declining phase and increase investment in businesses entering a growth phase. However, the resources (including financial, human, and other resources) absorbed by different groups in the

organization are not available or recoverable and are subject to organizational

constraints. Therefore, the allocation and configuration of organizational resources

must depend on the type and level of organizational slack, whether it is currently

available, recoverable, etc. (Bourgeois & Singh, 1983; Carnes et al., 2019; Daniel et

al., 2004).

Frequent technological paradigm shifts in high-tech industries, coupled with the

uncertainties of China-US technological decoupling and reverse globalization, require

companies to "reserve" more people, "transform" their skills more agilely, and

allocate their human resource investment portfolios more efficiently across windows

of opportunity such as markets, technologies, and policies.   Therefore, it is necessary

to develop long-term mechanisms for coping with "frequent paradigm shifts."

In Section 1, Motivation, Huawei's strategic reserve teams are discussed. The

roles and values of a strategic team are recognized as a type of HR slack. It can play

roles and provide value to the organization, as follows:

(1) A pool for manager's candidates.

(2) A pool for new strategic business.

(3) A training center for skill and knowledge's transformation.

(4) A buffer for structural staffing changes amid uncertainty, such as natural

disasters, wartime chaos, or organizational adjustments.

(5) A waiting pool for ineligible managers to be subject to screening.

Through the mechanism of strategic reserves, Huawei squeezes out some of the

slack that previously existed in various departments, and then, through a series of

skills and knowledge transformations and practices in real business, turns this

potential, unrecoverable, low discretion HR slack into available, recoverable, and high

discretion HR slack, thus improving productivity.

Figure 23

Strategic Reserve Team as a Type of Recognizable HR Slack.

Values	The Strategic Reserve is a forward-looking capacity-building mechanism that enables rapid transformation of knowledge and efficient redeployment of personnel.

Management candidates

Reserve team for new strategic business —Sharpening and screening→ **strategic reserve team**

Organized by the Strategic Reserve, the top 30% of personnel are selected for the toughest and most challenging projects to improve their skills and gain experience.

Hands-on training for capacity & knowledge transformation —Skill and knowledge transformation→ To reinvigorate outstanding cadres and specialists, as well as staff in hardship regions, and to learn how to win new business with the latest weapons.

Pool of dispatch buffers amid uncertainty Effective support for major strategic redeployments globally in response to major risks and uncertainties.

—Redirection for job and business→

A waiting pool for incompetent or ineligible managers Allow incompetent or ineligible cadres with negative incidents to "take a bath", reflect on their shortcomings, motivate them and give them the opportunity to return to their posts.

—recommendation→ **New Department** — New positions

Note that a strategic reserve mechanism is unsuitable for all companies. Inspired

by and combined with the strategic reserve mechanism, this study's findings may

inspire managers in organizations.

First, as a unique core competitive resource of knowledge-intensive companies,

the overall configuration of human resources must be not only up to you but also up to

the competition, that is, compared to the industry level. Managers need to keep an eye

on what their industry competitors are doing in terms of HR strategies and actual

deployment.

Second, tacit and firm-specific knowledge are sources of competitive advantage.

Companies must protect and consolidate HR slack and improve their level when coping with external risks or market opportunities. Sometimes, it costs a lot, both time and financially, to recruit new staff from the labor market. Why do you not hold slack in a firm during normal times?

Third, managers must consider an agile approach to HR slack creation, development, and configuration. (1) To create an atmosphere for staff learning and development. All employees should formulate professional development plans based on baselines and competencies. Managers should empower employees to improve their professional skills by setting competency standards, providing training projects, and offering learning incentives through comprehensive policies and budgets. (2) Mastering multiple skills makes employees applicable in a wider range of jobs. Employees with multiple skills in various areas can foster innovation. Managers can encourage employees to master "one speciality with multiple skills," i.e., capabilities in interdisciplinary. (3) Companies must achieve digital knowledge management, including shared communities, processes, systems, platforms, and tools to facilitate internal knowledge learning. (4) Talent flow and work shifts promote knowledge sharing and make implicit knowledge closely related to departments and posts learned by more people, as well as an interdisciplinary capability policy to be implemented in practice. (5) Planning for the future and beginning in the present. Companies can plan the necessary "strategic reserve team" at the strategic level to convert and update the skills of employees in normal times and be deployed on the frontlines as a strategic resource in times of war.

The above measurements can increase the agility of HR slack development in a more economical manner, thereby increasing organizations' ability to manage risks and opportunities.

Limitation

A limitation of this study is that the research object was Chinese high-tech listed companies only. Its generalization to other fields or enterprises must be further verified through additional empirical studies. For examples, when we discuss the moderating effect, we could expand our study to other firm/industry types, rather than high-tech industry or manufacturing industry. Organizational attributes and business environment factors are also worth considering as moderating factors, such as strategic orientation, management risk appetite, market competition. Generalizing the research objects by extending the industries, regions and economies could provide more rewarding insights.

Second, the study has not determined whether the relationship between HR slack and firm performance is still positive over its entire range or, as posited in previous research, whether it becomes curvilinear after a critical point. In this study, the test results were consistent with both RBV and KBV, suggesting a positive relationship. At extremely high levels, HR slack may deleteriously affect the firm's performance. For example, whether excessive HR in an idle state leads to low efficiency or excessively high HR slack could also prevent managers from responding to changing environmental demands, which, in turn, could reduce a firm's long-term performance.

Therefore, the "excessive" problem of HR slack can be considered in the future study.

Third, we only consider two contexts (ownership and industry) when studying the moderation effects. There are still many contexts in which to explore the limits and scope of the relationship between HR slack and performance. For example, strategic types, i.e., "Defenders, Analyzers, and Prospectors", a widely recognized strategic categorization (Miles et al., 1978, p. 550). Each type has a particular configuration of resource, technology, structure, and process that is consistent with its market strategy. The Defender's primary risk is that of ineffectiveness, i.e., being unable to respond to a major shift in its market environment. The Prospector enacts an environment that is more dynamic than those of other types of organizations within the same industry. In contrast to the Defender, the Prospector's descriptive catchword throughout its administrative as well as entrepreneurial and engineering solutions is "flexibility". Thus, the relationship between HR slack and firm performance might be moderated by the type of organization's strategy.

Beside financing constraints, organization flexibility could also be recognized as one of mediators in the relationship of HR slack and firm performance. The organization flexibility can help high-tech firms to issue a quick response in time under the challenging scenario. A flexible organization is conducive to absorbing tacit knowledge, technology and know-how and then improve the ability to integrate the company's resources. The exchange of information can increase the sensitivity and initiative of high-tech companies in the face of changes in the business environment and actively counteract factors that are unfavorable to their development(Hu et al.,

2022, p. 11). This is conducive to responding to external threats and risks and subsequently improving the performance of the companies(Jiao et al., 2022).

This study investigates the relationship between HR slack and firm performance. The results help clarify this relationship. This study proposes several fruitful research directions for examining the slack–performance relationship in the future.

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Appendix A

Descriptive Statistical Results

Table A1

Distribution of Mean Values from 2011 to 2021

Year	ROA	TobinQ	WW	ahrs	rhrs	ahrsedu1	ahrsedu2	ahrsedu3	ahrsedu4
2011	0.0576	1.763	-0.978	0.101	1.032	0.125	0.0370	0.197	.
2012	0.0469	1.587	-1.001	0.00700	1.005	-0.0419	-0.0177	0.00110	0.0832
2013	0.0477	1.933	-1.001	0.0688	0.973	0.0386	0.0533	0.0725	-0.330
2014	0.0475	2.259	-1.012	0.0763	0.999	0.0393	0.0373	0.0956	0.113
2015	0.0432	3.325	-1.019	0.0378	1.028	-0.0206	0.0149	0.0738	0.0653
2016	0.0479	2.590	-1.014	0.111	1.032	0.0797	0.0794	0.146	0.152
2017	0.0508	2.120	-1.025	0.164	1.044	0.136	0.145	0.199	0.231
2018	0.0404	1.619	-1.022	0.101	1.005	0.0754	0.0739	0.117	0.143
2019	0.0385	1.945	-1.029	0.0727	1.014	0.0522	0.0447	0.0802	0.133
2020	0.0431	2.242	-1.029	0.0501	1.019	0.0502	0.0285	0.0649	0.0946
2021	0.0449	2.390	-0.999	0.160	1.042	0.183	0.140	0.171	0.220
Total	0.0452	2.162	-1.014	0.0915	1.019	0.0740	0.0676	0.109	0.126

Year	ahrsjob1	ahrsjob2	ahrsjob3	ahrsjob4	rhrsedu1	rhrsedu2	rhrsedu3	rhrsedu4	rhrsjob1
2011	0.629	0.0957	0.0844	-0.0257	2.345	1.165	1.102	1.763	1.357
2012	0.0336	-0.00780	0.0250	0.0148	2.345	1.115	1.058	1.552	1.507
2013	0.0840	0.0609	0.110	0.0873	2.143	1.095	1.083	1.472	1.425
2014	0.111	0.0745	0.103	0.0884	2.199	1.110	1.110	1.530	1.508
2015	0.0722	0.0221	0.0662	0.0832	2.059	1.121	1.099	1.527	1.619
2016	0.159	0.116	0.144	0.127	2.018	1.157	1.117	1.682	1.688
2017	0.205	0.165	0.203	0.195	1.994	1.151	1.151	1.663	1.698
2018	0.150	0.100	0.134	0.110	2.100	1.125	1.086	1.512	1.607
2019	0.116	0.0729	0.106	0.0774	2.051	1.123	1.096	1.572	1.673
2020	0.0721	0.0840	0.106	0.0696	2.077	1.119	1.088	1.584	1.692
2021	0.187	0.200	0.209	0.176	2.212	1.156	1.123	1.755	1.674
Total	0.127	0.104	0.131	0.109	2.123	1.131	1.103	1.601	1.614

Year	rhrsjob2	rhrsjob3	rhrsjob4
2011	1.112	1.725	1.234
2012	1.159	1.690	1.165
2013	1.097	1.652	1.131
2014	1.134	1.712	1.152

2015	1.000	1.766	1.183
2016	0.963	1.705	1.149
2017	0.975	1.739	1.170
2018	0.905	1.700	1.125
2019	0.914	1.718	1.119
2020	0.941	1.805	1.129
2021	0.946	1.845	1.151
Total	0.983	1.744	1.149

Note. Data sorted out by the author.

It can be seen in the table that, return on assets (ROA) showed a stable positive trend from 2011 to 2021. This indicates that Chinese high-tech enterprises showed a stable positive trend in terms of overall firm performance in the period of ten years. Such factors as policy encouragement and market environment improvement may play a positive role.

AHRS with different education levels and job types showed an obvious positive trend from 2011 to 2021. Where, AHRS with high school degree and below as well as holding sales jobs showed particularly obvious growth. This may reflect companies have increasing demands in human resources with high quality, especially demands in talents with expert skills or knowledge along with development of product and market. RHRS with different education levels and different job types showed a steady rising trend as a whole from 2011 to 2021. Where, RHRS with postgraduate degree and above as well as sales job showed particularly obvious growth. This may mean that high-tech enterprises are more and more inclined to talents with high academic qualifications as well as sales position in terms of configuration of human resources, which may also reflect that these companies pay attention to technical research and development as well

as market promotion in market. In general, those trends reflect that Chinese high-tech enterprises were improved in terms of firm performance and HR slack in the past ten years. They have paid more and more attention to human resources with high academic qualifications and specific type of knowledge and skills, which also indicates development trend and strategic center of gravity of Chinese high-tech enterprises.

By comparing manufacturing industry and non-manufacturing industry, we would understand difference well in the firm strategy, human resources management and market competition positioning between these two kinds of industries. The manufacturing industry is generally labor-intensive or capital-intensive and pays attention on production efficiency and cost control. Therefore, its firm performance is closely related to production efficiency and market demands in most cases. Firm performance of non-manufacturing industry (such as service industry) mostly depends on service quality, innovation ability and market positioning. The manufacturing industry is labor-intensive or capital-intensive and generally has higher demands in low-skilled labors. Therefore, its HR slack may be relatively lower; while the non-manufacturing industry, especially knowledge-intensive industry has more demands in human resources with high skills and high quality. Therefore, its HR slack may be relatively higher. By comparing HR slack, it is reflected that there is difference in demands of human resources and human resources management strategy among different industries. And it also can provide policy makers with information about how to improve firm performance and human resources management effectiveness of different industries. For example, for the manufacturing industry, it may be needed to

improve production efficiency and employees' skills through technical improvement and function training; For the non-manufacturing industry, it may be needed to improve service quality and attract high-quality talents through innovation incentive and talent attraction strategy. Sort and summarize the mean value results, as follows.

ROA in the manufacturing industry is significantly higher than that in the non-manufacturing industry, reason of which may be that the manufacturing industry generally involves in high-amount investment in fixed assets, such as, mechanical equipment and plant building. While the non-manufacturing industry, such as service industry and technical research is inclined to the operation mode of achieving profit growth by improving production efficiency and scale economy.

The result shows that HR slack at all levels of the manufacturing industry is generally lower than that of the non-manufacturing industry. It may be because the non-manufacturing industry is more dependent on input in human resources in the competition, and the manufacturing industry may be more dependent on innovation and "hard" machines. In general, these data may reflect rapid development and quantity demand in human resources of Chinese manufacturing industry.

Table A2

Mean Values in Manufacturing Industry and non-Manufacturing Industry

Variables	Non-MFG	Mean1	MFG	Mean2	MeanDiff
ROA	3222	0.0360	13681	0.0470	-0.012***
TobinQ	3222	2.265	13681	2.138	0.127***
WW	3201	-1.010	13623	-1.015	0.005***
ahrs	3222	0.0910	13681	0.0920	-0.00100
ahrsedu1	2629	0.0800	9235	0.0720	0.00800
ahrsedu2	2903	0.0790	11707	0.0650	0.015**
ahrsedu3	2443	0.129	11208	0.105	0.024***
ahrsedu4	1050	0.170	6545	0.119	0.050***
ahrsjob1	1819	0.168	12571	0.121	0.047***
ahrsjob2	2639	0.106	11818	0.104	0.00200
ahrsjob3	2767	0.151	12604	0.126	0.025***
ahrsjob4	2927	0.123	12771	0.105	0.018**
rhrs	3222	1.241	13681	0.967	0.274***
rhrsedu1	2806	1.742	10053	2.230	-0.487***
rhrsedu2	3072	1.275	12509	1.096	0.179***
rhrsedu3	2628	1.274	12092	1.065	0.209***
rhrsedu4	1220	2.235	7471	1.497	0.738***
rhrsjob1	2016	3.056	13408	1.398	1.658***
rhrsjob2	2841	1.098	12774	0.957	0.142***
rhrsjob3	2940	1.863	13449	1.718	0.145***
rhrsjob4	3104	1.394	13575	1.093	0.301***

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Then the samples are divided into two groups, SOE and Non-SOE by the ownership. Majority of the variable's mean values in SOE group are greater than the ones in non-SOE while the mean value of WW and RHRS with all education levels and job types in SOE are less than the ones in non-SOE. When comparing these two groups, the differences are significant.

Table A3

Mean values in SOE and non-SOE

Variables	SOE	Mean1	Non-SOE	Mean2	MeanDiff
ROA	12996	0.0490	3907	0.0340	0.014***
TobinQ	12996	2.235	3907	1.920	0.314***
WW	12935	-1.008	3889	-1.034	0.027***
ahrs	12996	0.0950	3907	0.0800	0.015***
ahrsedu1	8967	0.0890	2897	0.0260	0.063***
ahrsedu2	11349	0.0740	3261	0.0440	0.031***
ahrsedu3	10643	0.114	3008	0.0910	0.023***
ahrsedu4	5583	0.129	2012	0.119	0.0100
ahrsjob1	11127	0.130	3263	0.115	0.016**
ahrsjob2	11168	0.111	3289	0.0820	0.029***
ahrsjob3	12049	0.139	3322	0.101	0.038***
ahrsjob4	12214	0.116	3484	0.0840	0.032***
rhrs	12996	0.971	3907	1.180	-0.209***
rhrsedu1	9660	2.247	3199	1.750	0.497***
rhrsedu2	11997	1.124	3584	1.155	-0.032*
rhrsedu3	11366	1.049	3354	1.283	-0.234***
rhrsedu4	6343	1.491	2348	1.896	-0.405***
rhrsjob1	11811	1.545	3613	1.840	-0.295***
rhrsjob2	11976	0.921	3639	1.187	-0.266***
rhrsjob3	12718	1.639	3671	2.105	-0.466***
rhrsjob4	12846	1.100	3833	1.311	-0.210***

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Appendix B

Optimal Model Identification Test

Data structure constructed in this paper is panel data, including two features, namely individual and time. For panel regression, it includes three models in total, namely, Pool Effect model, Fixed Effect model and Random Effect model. It is needed to identify the optimal model through three tests according to the test path in the following block diagram.

It can be seen from the test process displayed in the block diagram of procedure that, F test and BP test (Breuch-Pagan Lagrange multiplier test) are adopted firstly to identify optimality of Pool Effect model, Fixed Effect model and Random Effect model. Under the premise that Fixed Effect model and Random Effect model are better than Pool Effect model, Hausman test will be carried out for both of them to obtain the optimal model, namely, Fixed Effect model (FE) is the final model adopted by the paper. Test results are as the table below:

Figure 24

Test Procedure of Panel Regression Model.
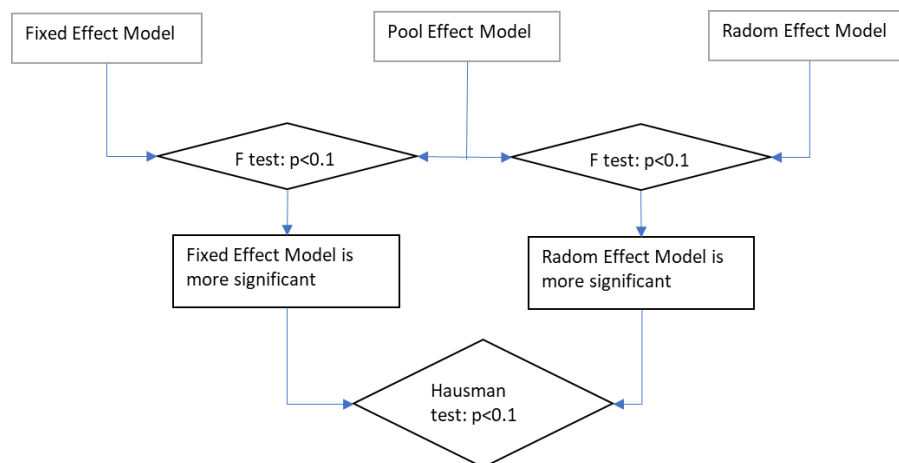
Note. Data sorted out by the author.

From the table, three tests reject original assumption and identify the best model is fixed effect model. The paper will carry out regression analysis by adopting fixed effect model, so as to ensure optimality of model.

Table B2

Optimal Model Identification Test Results

Model	F test	BP test	Hausman test	Optimal model
ROA-AHRS	3.86***	3070.35***	1838.02***	Fixed effect model
Tobin's Q-AHRS	5.62***	7757.42***	464.64***	Fixed effect model
ROA-RHRS	3.86***	2899.19***	2006.97***	Fixed effect model
Tobin's Q-RHRS	5.59***	7715.11***	500.50***	Fixed effect model

Note. Data sorted out by the author.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Appendix C

Endogenous Test

Two endogeneity related problems are discussed in the paper, as shown below:

The first problem is two-way causal endogeneity problem. Analysis carried out in the paper is causal inference. In the causal inference, the "cause" should affect the "effect", and not the "effect" affects the "cause". That is to say that there should be a prerequisite for unidirectional influence. On the one hand, enterprises' resources (including human resources) are a key factor to achieve competitive advantages and excellent performance based on RBV. HR slack provides enterprises with a "strategic reserve" can be deployed flexibly and used in a variety of situations. Meanwhile, employees with tacit and firm-specific knowledge can obtain competitive advantages for enterprises based on KBV. Staff with high academic qualifications or with rich prior expertise is beneficial for the managers to make the best HR allocation decision by multivariate combinations. On the other hand, higher firm performance will attract more excellent talents, and can make enterprises provide more general skills or on-the-job professional trainings for employees, thereby improving HR slack and forming positive feedback. Logically, it can be deduced that it is possible that there is two-way causal endogeneity between HR slack and firm performance. Therefore, it is needed to consider two-way causal endogeneity problem between both of them under current model.

The second problem is missing variable endogeneity problem of firm performance. Influence of previous firm performance on current or future firm performance can be

elaborated from the perspective of endogenous growth of enterprises. Endogenous growth means that enterprises promote their own growth and development during operation activities by accumulating and utilizing internal resources and ability. On the one hand, good firm performance in the past means that enterprises have accumulated better capital, technologies, brand reputation and customer relations. Accumulation of resources and ability provides a basis for enterprises to more effectively carry out operation activities in the future and is conductive to further improving firm performance. On the other hand, good firm performance in the past can provide more learning and innovation opportunities. By learning previous lessons, enterprise can better understand market demands, customers' preference and competition environment, thereby make strategic adjustment and create continuous innovation. Improvement of such learning and innovation ability is conductive to enterprises to continue to keep competitive advantages and improve firm performance. Therefore, there is the possibility that: Previous firm performance has significant positive influence on current and future firm performance independent from HR slack or other factors. Therefore, it is needed to consider whether firm performance has endogenous problem under current model.

Next, tests will be carried out for two-way causal endogeneity problem and missing variable endogeneity problem of dependent variable.

Dynamic system GMM model for two-way causal endogeneity test

Firstly, selection of model and instrumental variable is instructed. By comparing

the foregoing static panel regression model, dynamic panel regression model will be introduced when endogenetic analysis is carried out. In the form of dynamic panel regression model[8], dynamic system GMM model covers advantages of dynamic differential GMM and dynamic hydraulic GMM model. The paper adopts system GMM model. In this model, the paper adopts lagging phase 1-2 of dependent variable as instrumental variable and include it into model analysis.[9] In terms of model estimation, twostep is adopted to carry out estimation and robust estimation treatment is carried out. Sargan test is adopted to carry out overidentification for instrumental variables, and residual series two-order autocorrelation test is carried out for the model. Regression result is arranged as follows:

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[8] Dynamic panel regression model includes three forms, namely, dynamic system GMM model, dynamic differential GMM model and dynamic level GMM model.

[9] Refer to instruction about the order "xtdpdsys" made by STATA authority.

Table C1

Regression Result of Dynamic System GMM Model

Model	(1)	(2)	(3)	(4)
Variable	ROA	TobinQ	ROA	TobinQ
L.ROA	0.2348***		0.2391***	
	(10.2794)		(10.3733)	
L2.ROA	0.0260		0.0455**	
	(1.4255)		(2.4779)	
L.TobinQ		0.4711***		0.4725***
		(28.4291)		(28.5044)
L2.TobinQ		-0.1184***		-0.1187***
		(-8.5985)		(-8.6399)
L.ahrs	-0.0085***	-0.0032		
	(-3.5121)	(-0.1045)		
L.rhrs			-0.0095***	-0.0377
			(-4.1242)	(-1.4878)
Size	0.0394***	-0.7983***	0.0393***	-0.7923***
	(10.6313)	(-15.1763)	(10.5058)	(-14.9235)
Lev	-0.2040***	0.0470	-0.2046***	0.0434
	(-15.9229)	(0.2777)	(-15.8502)	(0.2568)
ATO	0.1501***	0.8219***	0.1494***	0.8161***
	(19.8356)	(7.3335)	(19.6175)	(7.2863)
Cashflow	0.1192***	0.9747***	0.1186***	0.9742***
	(8.7167)	(5.1661)	(8.6471)	(5.1699)
REC	-0.0108	0.5661*	-0.0108	0.5884*
	(-0.4482)	(1.7578)	(-0.4479)	(1.8270)
INV	-0.0011	0.8204***	-0.0022	0.8232***
	(-0.0530)	(2.8767)	(-0.1108)	(2.8905)
Board	-0.0106	-0.1562	-0.0094	-0.1546
	(-1.1026)	(-1.1064)	(-0.9764)	(-1.0923)
Indep	-0.0334	0.2706	-0.0331	0.2684
	(-1.2506)	(0.7000)	(-1.2395)	(0.6937)
Top1	0.0582***	0.2041	0.0577***	0.1961
	(3.0678)	(0.5113)	(3.0316)	(0.4915)
Balance1	-0.0062	0.0739	-0.0060	0.0692
	(-0.8685)	(0.6284)	(-0.8309)	(0.5879)
FirmAge	-0.0266	-0.2210	-0.0221	-0.2081
	(-1.5091)	(-0.7604)	(-1.2649)	(-0.7163)
_cons	-0.9237***	18.4566***	-0.9294***	18.2944***
	(-8.1972)	(12.3766)	(-8.3361)	(12.2196)
N	11579	11579	11579	11579
IndControl	YES	YES	YES	YES
YearControl	YES	YES	YES	YES
arm1	-14.2211***	-14.7874***	-14.0894***	-14.7906***

arm2	2.1622**	6.9933***	1.5950	7.0197***
sargan	113.5034***	376.3756***	113.7366***	376.3213***

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Analysis is carried out for dynamic system GMM model result.

(1)   For residual series two-order autocorrelation test, the original hypothesis model

has no self-correlation problem. T values of corresponding arm1 are

respectively equal to (-14.2211, -14.7874, -14.0894, -14.7906), which are

greater than 1.96. Moreover, T values of corresponding arm2 are respectively

equal to (2.1622, 6.9933, 1.5950, 7.0197), which are greater than 1.96 except

Model 3 (L.rhrs on ROA). The original hypothesis is accepted, which indicates

that there is no residual series two-order autocorrelation in the model.

(2)   For instrumental variable overidentification test, there is no instrumental

variable overidentification problem in the original hypothesis model. T values

of corresponding Sargan test are respectively equal to (113.5034, 376.3756,

113,7366, 376.3213), which are greater than 1.96. The original hypothesis is

accepted, which indicates that there is no instrumental variable

overidentification.

AHRS and RHRS have significant influence on these two dependent variables in

terms of return on assets or Tobin's Q, which indicates that HR slack is an important

factor to affect their firm performance. In addition, these two dependent variables are

affected by their own lagged item, which indicates that there is a certain continuity in

return on assets and Tobin's Q of enterprises.

Two-step Effect Model for Missing Variable Endogeneity Test

Table C2

Regression Result of Two-step Effect Test

Model	(1)	(2)	(3)	(4)
Variable	ROA	TobinQ	ROA	TobinQ
L.ahrs	0.0525***	1.1014***		
	(4.7087)	(4.4610)		
L.rhrs			0.0315***	0.1553
			(6.1779)	(1.5075)
Size	0.0129***	-0.3090***	0.0069***	-0.3349***
	(24.8897)	(-26.9692)	(6.0629)	(-14.5209)
Lev	-0.1615***	-1.0789***	-0.1580***	-1.0377***
	(-52.0662)	(-15.7053)	(-47.5640)	(-15.4642)
ATO	0.0350***	0.0308	0.0234***	0.0448
	(20.2554)	(0.8051)	(7.7475)	(0.7352)
Cashflow	0.3294***	3.0007***	0.3580***	3.2204***
	(41.0088)	(16.8686)	(38.2664)	(17.0412)
REC	0.0588***	0.1026	0.0428***	0.0236
	(11.3554)	(0.8944)	(6.9774)	(0.1904)
INV	0.0406***	0.3313***	0.0434***	0.3375***
	(7.0868)	(2.6127)	(7.0451)	(2.7145)
Board	0.0062**	0.0537	0.0119***	0.0480
	(2.0086)	(0.7859)	(3.3927)	(0.6776)
Indep	0.0027	0.7386***	0.0191*	0.7278***
	(0.2597)	(3.2160)	(1.6495)	(3.1054)
Top1	0.0460***	0.0047	0.0402***	-0.0671
	(11.0059)	(0.0507)	(9.0025)	(-0.7437)
Balance1	0.0101***	-0.0258	0.0099***	-0.0265
	(5.2109)	(-0.6034)	(4.8042)	(-0.6340)
FirmAge	-0.0041**	0.0764**	-0.0055***	0.0445
	(-2.5248)	(2.1020)	(-3.2080)	(1.2803)
_cons	-0.2510***	8.5063***	-0.1678***	9.0836***
	(-18.1194)	(27.7276)	(-8.9295)	(23.9249)
N	14055	14055	14055	14055
R^2	0.336	0.246	0.238	0.280

adj. R^2	0.335	0.244	0.236	0.278
IndControl	YES	YES	YES	YES
YearControl	YES	YES	YES	YES
widstat	310.0659	310.0659	245.6795	245.6795
idstat	304.1567	304.1567	242.0852	242.0852
idp	0.0000	0.0000	0.0000	0.0000

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

The two-step effect test is shown as above. In the two-step regression analysis, the instrumental variable identification test consists of two tests in total, namely the instrumental variable no-identification test and the instrumental variable weak identification test. First, the Anderson canon corr. LM statistic is used to test for non-identification of instrumental variables. This test focuses on whether the instrumental variables in the model are correlated with the endogenous explanatory variables. If the instrumental variables are not correlated with the endogenous variables, then the model parameters are not identifiable. The Anderson canon. corr. LM statistic provides a test statistic to assess whether the instrumental variables provide enough information to identify the model parameters. If the statistic is significant, it indicates that the instrumental variables are sufficiently correlated with the endogenous variables and therefore identify the model parameters. Second, Cragg-Donald Wald F statistic and Stock-Yogo weak ID test critical values were used to test the weak identification problem with instrumental variables. Weak identification refers to the fact that the instrumental variables are not strongly enough correlated with the endogenous variables, resulting in imprecise or unstable estimated parameters. The Cragg-Donald Wald F

statistic provides a test statistic for assessing the strength of the correlation of the instrumental variables, while the Stock-Yogo test sets different thresholds for determining whether the instrumental variables are strong enough for valid estimation. If the Cragg-Donald Wald F statistic is below the threshold of the Stock-Yogo test, this indicates a weak identification problem.

For the instrumental variable identification test, the results of Idstat (Anderson canon. corr. LM statistic) show statistics equal to 304.1567 and 242.0852, and $p<0.01$, indicating that the instrumental variables are not unidentifiable. The statistics of Widstat (Cragg-Donald Wald F statistic) showed statistics equal to 310.0659 and 245.6795, both of which are greater than the 10% critical value of Stock-Yogo weak ID test critical values of 16.38, indicating that the instrumental variable passed the weak identification test.

The regression results shows that the regression coefficients of the AHRS in models 1 and 2, RHRS in model 3 are equal to 0.0525, 1.1014, 0.0315, which show significance at the 1% level. This indicates that the hypotheses of this paper are still significantly supported after correcting for bidirectional causal endogeneity for Model 1, 2 and 3. However, T value in Model 4 (1.5075) is less than 1.96, which means no significance on Tobin's Q.

Regarding two-way causal endogeneity problem and missing variable endogeneity problem of dependent variables, the result shows that AHRS and RHRS still have significant positive influence on firm performance. The results are consistent with the foregoing analysis, which indicates that the model meets robustness condition.

Appendix D

Test Results of Substitution Variable Method

Dependent Variable: ROA Replaced by ROE

Next, the robustness test is carried out by substituting dependent variable, namely, substituting the original return on assets (ROA) with return on equity (ROE). ROE stands for Return on Equity. It is a financial ratio that measures a company's profitability by calculating the amount of net income generated as a percentage of shareholders' equity. In other words, it shows how effectively a company is utilizing its shareholders' investments to generate profits. ROE is an important metric for investors as it helps them evaluate the company's ability to generate returns on their investment.

The result is arranged as follows:

Table D1

Substitution of Dependent Variables, ROA Replaced by ROE

Model	(1)	(2)
Variable	ROE	ROE
ahrs	0.0480***	
	(18.0487)	
rhrs		0.0039***
		(3.7635)
Size	0.0244***	0.0235***
	(28.7577)	(26.7301)
Lev	-0.2083***	-0.2060***
	(-41.2814)	(-40.4438)
ATO	0.0701***	0.0738***
	(29.2026)	(29.6533)
Cashflow	0.5095***	0.5158***
	(39.4430)	(39.5334)
REC	0.1143***	0.1102***
	(13.4690)	(12.8370)
INV	0.1008***	0.1014***
	(10.5727)	(10.5466)
Board	0.0062	0.0058
	(1.2365)	(1.1575)
Indep	0.0047	0.0056
	(0.2797)	(0.3283)
Top1	0.0830***	0.0815***
	(12.3666)	(12.0252)
Balance1	0.0197***	0.0203***
	(6.2404)	(6.3614)
FirmAge	-0.0113***	-0.0126***
	(-4.4354)	(-4.9398)
N	16903	16903
R^2	0.292	0.279
adj. R^2	0.290	0.277
IndControl	YES	YES
YearControl	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Independent Variable: AHRS/RHRS Replaced by AHRS1/RHRS1

Third, robustness test is carried out by substituting independent variables. There are two indicators on HR slack shown in Formula 1① and Formula 1②. In the above analysis, we adopt the Formula 1② as the main independent variable. Here, we will use Formula 9 to define AHRS1 and RHRS1, i.e., swapping the numerator and denominator.

Formula D113

AHRS1 and RHRS1

$$AHRS_t = \frac{\frac{Sales_t}{Employee_t}}{\frac{Sales_{t-1}}{Employee_{t-1}}} - 1, \quad \rightarrow \quad AHRS1_t = \frac{\frac{Employee_t}{Sales_t}}{\frac{Employee_{t-1}}{Sales_{t-1}}} - 1$$

Wherein: Sales$_t$ is the total operating revenue of the enterprise in year t; Employee$_t$ is the number of employees of the enterprise at the end of the year t;

And

$$RHRS_{ti} = \frac{\frac{Sales_{ti}}{Employee_{ti}}}{\frac{\sum Sales_{ti}}{\sum Employee_{ti}}}, \quad \rightarrow \quad RHRS1_{ti} = \frac{\frac{Employee_{ti}}{Sales_{ti}}}{\frac{\sum Employee_{ti}}{\sum Sales_{ti}}}$$

Wherein: Sales$_{ti}$ is the total operating revenue of the enterprise i in the year t; Employee$_{ti}$ is the number of employees of the enterprise i at the end of the year t; ΣSales$_{ti}$ is the total operating revenue of enterprise i in the industry in the year t. ΣEmployee$_{ti}$ is the total number of employees of enterprise i at the end of year t.

The result is present as follows:

Table D2

Substitution of Independent Variables, AHRS1 and RHRS1

Model	(1)	(2)	(3)	(4)
Variable	ROA	TobinQ	ROA	TobinQ
ahrs1	-0.0302***	-0.1026***		
	(-19.5506)	(-2.9743)		
rhrs1			-0.0049***	-0.0226**
			(-11.2200)	(-2.3441)
Size	0.0115***	-0.2855***	0.0102***	-0.2912***
	(25.5087)	(-28.4088)	(21.9396)	(-28.1316)
Lev	-0.1584***	-0.8872***	-0.1580***	-0.8850***
	(-59.1805)	(-14.8426)	(-58.5720)	(-14.8000)
ATO	0.0363***	0.0987***	0.0373***	0.0987***
	(28.4974)	(3.4664)	(28.8794)	(3.4435)
Cashflow	0.3266***	3.0840***	0.3318***	3.0996***
	(47.5892)	(20.1280)	(48.0419)	(20.2503)
REC	0.0622***	0.0263	0.0561***	-0.0028
	(13.8178)	(0.2611)	(12.2569)	(-0.0278)
INV	0.0423***	0.3655***	0.0430***	0.3659***
	(8.3593)	(3.2359)	(8.4310)	(3.2387)
Board	0.0032	0.0266	0.0039	0.0290
	(1.2181)	(0.4483)	(1.4434)	(0.4894)
Indep	-0.0005	0.4940**	0.0014	0.5011**
	(-0.0518)	(2.4720)	(0.1520)	(2.5071)
Top1	0.0476***	-0.4411***	0.0481***	-0.4390***
	(13.3642)	(-5.5447)	(13.3849)	(-5.5168)
Balance1	0.0125***	-0.1538***	0.0126***	-0.1537***
	(7.4738)	(-4.1124)	(7.4920)	(-4.1090)
FirmAge	-0.0074***	0.0414	-0.0076***	0.0411
	(-5.5328)	(1.3772)	(-5.6260)	(1.3676)
N	16903	16903	16903	16903
R^2	0.384	0.275	0.375	0.274
adj. R^2	0.383	0.273	0.374	0.273
IndControl	YES	YES	YES	YES
YearControl	YES	YES	YES	YES

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

In accordance with mathematical logic, the coefficients of the independent variables in all models are negative, as the numerator and denominator have been swapped, i.e., -0.0302, -0.1026, -0.0049, -0.0226. The T values of all models are less than -1.96. As a conclusion, even when the numerator and denominator in IVs (Independent Variable) are swapped, i.e., from AHRS/RHRS to AHRS1/RHRS1, the model meets the robustness condition. Hypothesis 1a and 1b are supported.

Independent Variable: AHRS/RHRS Replaced by AHRS2/RHRS2

Fourth, robustness test is carried out by modifying independent variables. HR slack is measured by the ratio of "manpower" or "cost" to operating revenue or assets (Carnes et al., 2019, p. 65). In above analysis, we adopt "manpower" in the formulas. Here, we will use "cost" instead. "SalaryToPay" refers to the amount of money that a company owes to its employees for work performed. It represents the wages or salaries that have been earned by employees. This can include regular salaries, bonuses, commissions, and any other forms of compensation owed to employees.

Formula D2

AHRS2 and RHRS2

$$AHRS2_t = \frac{\frac{Sales_t}{SalaryToPay_t}}{\frac{Sales_{t-1}}{SalaryToPay_{t-1}}} - 1 ①$$

Wherein: $Sales_t$ is the total operating revenue of the enterprise in year t; $SalaryToPay_t$ is total compensation paid to employees of the enterprise at the end of the year t;

And

$$RHRS2_{ti} = \frac{\frac{Sales_{ti}}{SalaryToPay_{ti}}}{\frac{\sum Sales_{ti}}{\sum SalaryToPay_{ti}}} ②$$

Wherein: $Sales_{ti}$ is the total operating revenue of the enterprise i in the year t; $SalaryToPay_{ti}$ is the total compensation paid to employees of the enterprise i at the end of the year t; $\sum Sales_{ti}$ is the total operating revenue of enterprise i in the industry in the year t. $\sum SalaryToPay_{ti}$ is the total compensation paid to employees of enterprise i at the end of year t.

The result is present as follows:

Table D3

Substitution of Independent Variables, AHRS2 and RHRS2

Model	(1)	(2)	(3)	(4)
Variable	ROA	TobinQ	ROA	TobinQ
ahrs2	0.0109***	0.1044***		
	(12.3132)	(5.2788)		
rhrs2			0.0001	0.0074***
			(0.8508)	(4.7299)
Size	0.0114***	-0.2862***	0.0115***	-0.2864***
	(25.1421)	(-28.2693)	(25.0997)	(-28.3249)
Lev	-0.1588***	-0.8885***	-0.1588***	-0.8893***
	(-58.5833)	(-14.7275)	(-58.4362)	(-14.7673)
ATO	0.0391***	0.0977***	0.0403***	0.1034***
	(30.5169)	(3.4281)	(31.4380)	(3.6384)
Cashflow	0.3384***	3.1554***	0.3340***	3.1448***
	(48.6949)	(20.4002)	(47.9336)	(20.3707)
REC	0.0633***	0.0167	0.0619***	0.0036
	(13.8340)	(0.1635)	(13.4970)	(0.0356)
INV	0.0446***	0.3862***	0.0443***	0.3678***
	(8.6633)	(3.3740)	(8.5871)	(3.2165)
Board	0.0024	0.0371	0.0026	0.0341
	(0.8745)	(0.6176)	(0.9431)	(0.5689)
Indep	-0.0013	0.5134**	-0.0015	0.4949**
	(-0.1416)	(2.5455)	(-0.1668)	(2.4575)
Top1	0.0480***	-0.4424***	0.0477***	-0.4397***
	(13.3226)	(-5.5203)	(13.2285)	(-5.4983)
Balance1	0.0131***	-0.1589***	0.0132***	-0.1568***
	(7.7592)	(-4.2139)	(7.7397)	(-4.1644)
FirmAge	-0.0080***	0.0358	-0.0080***	0.0328
	(-5.8610)	(1.1810)	(-5.8678)	(1.0860)
N	16691	16691	16741	16741
R^2	0.376	0.273	0.371	0.273
adj. R^2	0.375	0.271	0.369	0.272
IndControl	YES	YES	YES	YES
YearControl	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

The coefficients of the independent variables are 0.0109, 0.1044, 0.0001, 0.0074. The T values of model 1, 2 and 4 (12.3132, 5.2788, 4.7299) are great than 1.96, except model 3 (0.8508<1.96). As a conclusion, when IVs are modified, i.e., from AHRS/RHRS to AHRS2/RHRS2, Model 1, 2 and 4 meets the robustness condition. Hypothesis 1a and 1b are supported except model 3.

Control Variable: Top 1 Replaced by Top 10

In this section, robustness test is carried out with substitution variable method. The substitution variable method is to firstly substitute shareholding ratio of the largest shareholder to be shareholding ratio of top 10 shareholders, substitute measurement way of equity balance to be the sum of shareholding ratio of shareholders ranking the second to the fifth dividing by shareholding ratio of the largest shareholder, and then carry out regression analysis with fixed effect model. The result is arranged as follows:

Table D4

Substitution of Control Variables, Top 1 Replaced by Top 10

Model	(1)	(2)	(3)	(4)
Variable	ROA	TobinQ	ROA	TobinQ
ahrs	0.0243***	0.1449***		
	(17.3366)	(4.5986)		
rhrs			0.0024***	0.0905***
			(4.5159)	(7.5247)
Size	0.0116***	-0.2873***	0.0111***	-0.3055***
	(26.0729)	(-28.6648)	(23.9790)	(-29.6984)
Lev	-0.1542***	-0.9126***	-0.1529***	-0.8962***
	(-57.5891)	(-15.1588)	(-56.6279)	(-14.9022)
ATO	0.0359***	0.0933***	0.0375***	0.0527*
	(28.4078)	(3.2819)	(28.5994)	(1.8041)
Cashflow	0.3276***	3.0961***	0.3310***	3.1600***
	(48.1264)	(20.2335)	(48.1863)	(20.6546)
REC	0.0637***	0.0451	0.0613***	-0.0058
	(14.2297)	(0.4487)	(13.5681)	(-0.0577)
INV	0.0443***	0.3686***	0.0446***	0.3694***
	(8.8268)	(3.2667)	(8.8151)	(3.2774)
Board	0.0046*	0.0338	0.0045*	0.0502
	(1.7406)	(0.5703)	(1.6996)	(0.8464)
Indep	0.0008	0.4864**	0.0014	0.5316***
	(0.0867)	(2.4355)	(0.1596)	(2.6630)
Top10	0.0625***	-0.3384***	0.0625***	-0.3416***
	(22.5438)	(-5.4303)	(22.3517)	(-5.4882)
Balance2	-0.0006	-0.0121	-0.0003	-0.0107
	(-0.8989)	(-0.8671)	(-0.4365)	(-0.7701)
FirmAge	-0.0043***	0.0334	-0.0050***	0.0327
	(-3.2211)	(1.1028)	(-3.6738)	(1.0828)
N	16903	16903	16903	16903
R^2	0.393	0.275	0.383	0.277
adj. R^2	0.392	0.273	0.381	0.275
IndControl	YES	YES	YES	YES
YearControl	YES	YES	YES	YES

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

In the model 1, return on assets (ROA) will increase by 0.0243 percent points when AHRS increases by 1 unit and this relationship is highly significant (P<0.01); and t value is 17.3366, which indicates that there is significant positive correlation between AHRS and ROA. In the model 2, Tobin's Q will increase by 0.1449 percent points when AHRS increases by 1 unit and this relationship is highly significant (P<0.01); and t value is 4.5986, which indicates that there is significant positive correlation between AHRS and Tobin's Q. In the model 3, ROA will increase by 0.0024 percent points when RHRS increases by 1 unit and this relationship is highly significant (P<0.01); and t value is 4.5159, which indicates that there is significant positive correlation between RHRS and ROA. In the model 4, Tobin's Q will increase by 0.0905 percent points when RHRS increases by 1 unit and this relationship is highly significant (P<0.01); and t value is 7.5247, which indicates that there is significant positive correlation between RHRS and Tobin's Q.

According to the above analysis, AHRS and RHRS have significant influence on return on assets and Tobin's Q, which indicates importance of HR slack on firm performance. After substitution of control variable, the result is still consistent with the foregoing analysis, which indicates that the model meets the robustness condition.

Appendix E

Moderation Effect Regression Results for Sub-HR Slack

SOE and non-SOE Groups

Table E1

Subgroups of SOE and Non-SOE

Model Variable	SOE ROA	Non-SOE ROA	SOE TobinQ	Non-SOE TobinQ	SOE ROA	Non-SOE ROA	SOE TobinQ	Non-SOE TobinQ
ahrs	0.0249***	0.0238***	0.166**	0.141***				
	(9.4757)	(14.4533)	(2.7333)	(3.8815)				
rhrs					0.00490***	0.00188**	0.0765***	0.0868***
					(5.7416)	(2.7560)	(3.9255)	(5.8235)
Size	0.0113***	0.0132***	-0.343***	-0.272***	0.0100***	0.0129***	-0.362***	-0.287***
	(15.2211)	(23.4028)	(-20.0189)	(-21.8147)	(12.9282)	(22.1471)	(-20.3913)	(-22.5668)
Lev	-0.145***	-0.165***	-1.393***	-0.799***	-0.143***	-0.164***	-1.372***	-0.782***
	(-32.6952)	(-49.8858)	(-13.6792)	(-10.9436)	(-32.0068)	(-49.0915)	(-13.4792)	(-10.7237)
ATO	0.0214***	0.0449***	0.0132	0.117**	0.0209***	0.0472***	-0.0176	0.0780*
	(11.2068)	(27.6550)	(0.2990)	(3.2677)	(10.5524)	(27.9803)	(-0.3890)	(2.1111)
Cashflow	0.273***	0.338***	1.729***	3.436***	0.277***	0.341***	1.752***	3.510***
	(22.2836)	(41.6963)	(6.1278)	(19.1636)	(22.4726)	(41.5770)	(6.2196)	(19.5507)
REC	0.0727***	0.0542***	0.282	-0.0864	0.0675***	0.0518***	0.207	-0.121
	(9.3297)	(9.9127)	(1.5711)	(-0.7159)	(8.5659)	(9.4115)	(1.1483)	(-0.9997)
INV	0.0291***	0.0503***	1.093***	-0.0143	0.0288***	0.0507***	1.075***	0.00559
	(3.4782)	(8.1750)	(5.6656)	(-0.1055)	(3.4152)	(8.1727)	(5.5788)	(0.0412)
Board	0.00267	0.0114***	0.160	-0.0616	0.00467	0.0115***	0.197	-0.0517
	(0.6152)	(3.4299)	(1.6012)	(-0.8364)	(1.0610)	(3.4335)	(1.9589)	(-0.7021)
Indep	-0.0352*	0.0272*	1.022**	0.385	-0.0337*	0.0286*	1.066**	0.420
	(-2.4792)	(2.4320)	(3.1206)	(1.5567)	(-2.3528)	(2.5340)	(3.2566)	(1.6981)
Top1	0.0136*	0.0614***	-0.114	-0.518***	0.0120	0.0610***	-0.139	-0.510***
	(2.1942)	(14.1302)	(-0.8017)	(-5.3988)	(1.9185)	(13.9387)	(-0.9757)	(-5.3162)
Balance1	0.00128	0.0144***	-0.0931	-0.122**	0.00144	0.0146***	-0.0914	-0.123**
	(0.4284)	(7.1733)	(-1.3536)	(-2.7486)	(0.4798)	(7.2383)	(-1.3294)	(-2.7673)
FirmAge	-0.00115	-0.00654***	-0.00144	0.0361	-0.00116	-0.00718***	-0.00280	0.0369
	(-0.4047)	(-4.1902)	(-0.0220)	(1.0452)	(-0.4057)	(-4.5656)	(-0.0428)	(1.0695)
N	3907	12996	3907	12996	3907	12996	3907	12996
R^2	0.395	0.386	0.358	0.264	0.386	0.377	0.360	0.265
adj. R^2	0.389	0.384	0.352	0.262	0.380	0.375	0.353	0.263

IndControl	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

This study splits the sample into SOE and Non-SOE for group regression

analysis. The regression results as above.

Figure E1

AHRS on Firm Performance Moderated by the Ownership, SOE and Non-SOE
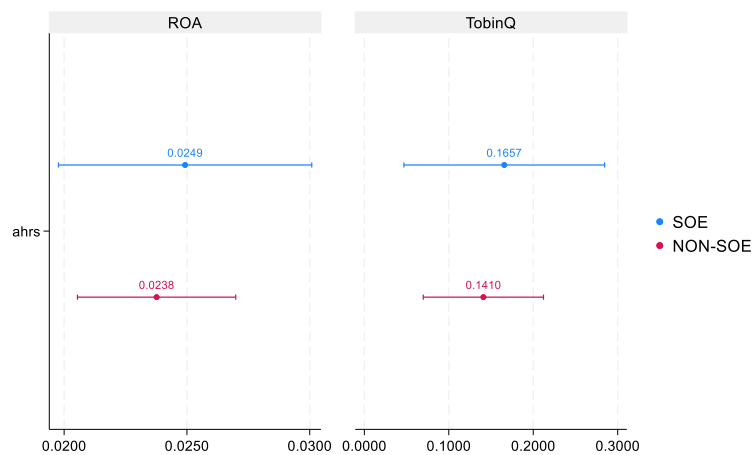
Note. Data sorted out by the author.

Figure E2

RHRS on Firm Performance Moderated by the Ownership, SOE and non-SOE

Note. Data sorted out by the author.

Manufacture and non-Manufacture Groups

The sample is mainly divided into manufacture and non-manufacture industries for group regression. The regression results are as follows.

Table E2

Subgroups of Manufacturing industry and non-Manufacturing industry

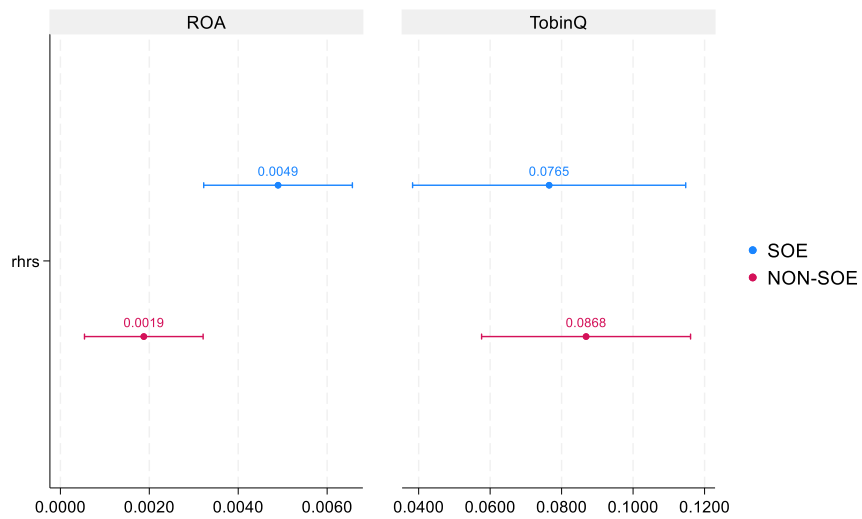| Model Variable	MFG ROA	Non-MFG ROA	MFG TobinQ	Non-MFG TobinQ	MFG ROA	Non-MFG ROA	MFG TobinQ	Non-MFG TobinQ
ahrs	0.0244***	0.0212***	0.155***	0.0340				
	(15.7511)	(6.0854)	(4.3281)	(0.4933)				
rhrs					0.00330***	0.00250*	0.122***	0.0347
					(5.1760)	(2.3204)	(8.3367)	(1.6376)
Size	0.0107***	0.0122***	-0.258***	-0.415***	0.00998***	0.0120***	-0.283***	-0.419***
	(22.3924)	(10.4729)	(-23.3233)	(-18.0347)	(19.9922)	(10.1912)	(-24.7666)	(-18.1048)
Lev	-0.157***	-0.150***	-1.023***	-0.838***	-0.154***	-0.151***	-0.977***	-0.850***
	(-54.9843)	(-21.7326)	(-15.5076)	(-6.1264)	(-53.6325)	(-21.7236)	(-14.8071)	(-6.2068)
ATO	0.0370***	0.0264***	0.0118	0.366***	0.0375***	0.0288***	-0.0536	0.356***
	(27.5452)	(8.6189)	(0.3787)	(6.0533)	(26.5736)	(9.4179)	(-1.6573)	(5.9132)
Cashflow	0.346***	0.273***	3.225***	2.611***	0.350***	0.276***	3.304***	2.625***
	(46.8555)	(15.3676)	(18.8804)	(7.4358)	(46.9353)	(15.4487)	(19.3605)	(7.4782)
REC	0.0576***	0.0820***	0.528***	-0.703***	0.0571***	0.0774***	0.483***	-0.715***
	(11.8369)	(8.4501)	(4.6955)	(-3.6611)	(11.6379)	(7.9483)	(4.2948)	(-3.7365)
INV	0.0279***	0.0573***	0.479***	-0.236	0.0292***	0.0558***	0.529***	-0.259
	(4.9319)	(5.6631)	(3.6664)	(-1.1815)	(5.1293)	(5.4756)	(4.0477)	(-1.2940)
Board	0.00325	-0.00270	-0.0996	0.310*	0.00329	-0.00279	-0.0835	0.326*
	(1.1398)	(-0.3873)	(-1.5101)	(2.2542)	(1.1431)	(-0.3979)	(-1.2673)	(2.3613)
Indep	-0.00413	-0.0242	0.0706	2.006***	-0.00433	-0.0213	0.0652	2.106***
	(-0.4326)	(-0.9930)	(0.3197)	(4.1701)	(-0.4506)	(-0.8654)	(0.2959)	(4.3414)
Top1	0.0422***	0.0728***	-0.510***	-0.936***	0.0418***	0.0717***	-0.503***	-0.949***
	(11.1475)	(7.5236)	(-5.8154)	(-4.8923)	(10.9443)	(7.3719)	(-5.7564)	(-4.9576)
Balance1	0.0121***	0.0126**	-0.160***	-0.236**	0.0123***	0.0130**	-0.162***	-0.231*
	(6.7787)	(2.7475)	(-3.8753)	(-2.6112)	(6.8569)	(2.8355)	(-3.9415)	(-2.5482)
FirmAge	-0.0072***	-0.00206	0.0672*	-0.0769	-0.0077***	-0.00320	0.0709*	-0.0813
	(-5.0413)	(-0.5752)	(2.0251)	(-1.0835)	(-5.3375)	(-0.8887)	(2.1402)	(-1.1472)
N	13681	3222	13681	3222	13681	3222	13681	3222
R^2	0.399	0.285	0.245	0.334	0.389	0.278	0.247	0.334
adj. R^2	0.398	0.280	0.243	0.329	0.388	0.273	0.246	0.330
IndControl	YES	YES	YES	YES	YES	YES	YES	YES
YearControl	YES	YES	YES	YES	YES	YES	YES	YES

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Figure E3

AHRS on firm performance moderated by the industry, MFG and non-MFG
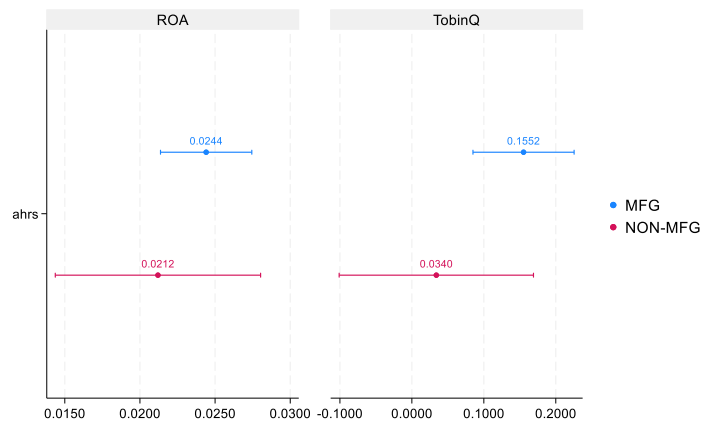
Note. Data sorted out by the author.

Figure E4

RHRS on Firm Performance Moderated by the Industry, MFG and non-MFG
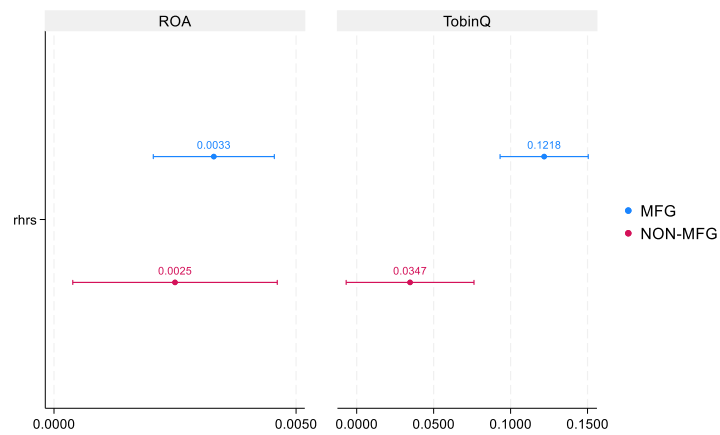
Note. Data sorted out by the author.

Appendix F

Mediation Effect Regression Results for Sub-HR Slack

The above analysis has tested the mediation effect of overall HR slacks (AHRS and RHRS) on the firm performances (ROA and Tobin's Q) via financial constraints (WW). In this section, the independent variables are selected as sub-AHRS and sub-RHRS. It will test the individual impact of HR slacks with every educational level and every job type on firm performance by the mediator, WW.

Step Regression: Sobel Test

First, the Sobel test for sub-AHRS has been performed, and the results are organized as follows. Most Sobel statistics exceed the threshold of 1.96 at the 1% level except for the two paths, ahrsedu4->WW->Tobin's Q and ahrsjob1->WW->Tobin's Q.

Table F1

Sobel Statistics for Mediation Effect (Sub-AHRS)

Effect	Direct Effect: a	Direct Effect: Std. err for a	Indirect Effect: b	Indirect Effect: Std.err for b	Sobel Statistic
ahrsedu1->WW->ROA	-0.0142***	0.00083	-0.4231***	0.0130	15.2166
ahrsedu1->WW->Tobin's Q	-0.0142***	0.00083	-1.3198***	0.3053	4.1935
ahrsedu2->WW->ROA	-0.0197***	0.00093	-0.3842***	0.0118	17.7818
ahrsedu2->WW->Tobin's Q	-0.0197***	0.00093	-0.9647***	0.2774	3.4318
ahrsedu3->WW->ROA	-0.0156***	0.00079	-0.3931***	0.0123	16.7616
ahrsedu3->WW->Tobin's Q	-0.0156***	0.00079	-0.8864***	0.2773	3.1557
ahrsedu4->WW->ROA	-0.0134***	0.00096	-0.3919***	0.0163	12.0350
ahrsedu4->WW->Tobin's Q	-0.0134***	0.00096	0.3555	0.3652	-0.9710
ahrsjob1->WW->ROA	-0.0155***	0.00073	-0.3994***	0.0119	17.8901
ahrsjob1->WW->Tobin's Q	-0.0155***	0.00073	-0.4089	0.2718	1.5007
ahrsjob2->WW->ROA	-0.0190***	0.00085	-0.3755***	0.0119	18.2775
ahrsjob2->WW->Tobin's Q	-0.0190***	0.00085	-0.4581*	0.2708	1.6864
ahrsjob3->WW->ROA	-0.0116***	0.00064	-0.3937***	0.0114	15.9529
ahrsjob3->WW->Tobin's Q	-0.0116***	0.00064	-0.8059***	0.2667	2.9795
ahrsjob4->WW->ROA	-0.0107***	0.00064	-0.4013***	0.0113	15.1087
ahrsjob4->WW->Tobin's Q	-0.0107***	0.00064	-0.9236***	0.2626	3.4418

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Second, the Sobel test for sub-RHRS has been performed, and the results are organized as follows. Sobel statistics exceed the threshold of 1.96 at the 1% level for those paths, rhrsedu3->WW->ROA (/Tobin's Q), rhrsjob1->WW->ROA (/Tobin's Q), rhrsjob2->WW->ROA (/Tobin's Q), rhrsjob3->WW->ROA (/Tobin's Q).

Table F2

Sobel Statistics for Mediation Effect (Sub-RHRS)

Effect	Direct Effect: a	Direct Effect: Std. err for a	Indirect Effect: b	Indirect Effect: Std.err for b	Sobel Statistic
rhrsedu1->WW->ROA	-0.000023	0.00012	-0.4323***	0.0123	0.1959
rhrsedu1->WW->Tobin's Q	-0.000023	0.00012	-1.3084***	0.2843	0.1957
rhrsedu2->WW->ROA	-0.000275	0.00032	-0.4067***	0.0112	0.8722
rhrsedu2->WW->Tobin's Q	-0.000275	0.00032	-1.0203***	0.2608	0.8515
rhrsedu3->WW->ROA	-0.0011***	0.00031	-0.4098***	0.0116	3.6148
rhrsedu3->WW->Tobin's Q	-0.0011***	0.00031	-0.9843***	0.2607	2.6181
rhrsedu4->WW->ROA	-0.0001	0.00016	-0.4118***	0.0147	0.8980
rhrsedu4->WW->Tobin's Q	-0.0001	0.00016	-0.1171	0.3334	0.3271
rhrsjob1->WW->ROA	-0.0005***	0.00011	-0.4177***	0.0112	4.4605
rhrsjob1->WW->Tobin's Q	-0.0005***	0.00011	-0.5159**	0.2548	1.8457
rhrsjob2->WW->ROA	-0.0030***	0.00039	-0.4010***	0.0112	7.5307
rhrsjob2->WW->Tobin's Q	-0.0030***	0.00039	-0.7532***	0.2556	2.7522
rhrsjob3->WW->ROA	-0.0005***	0.00013	-0.4082***	0.0109	3.9967
rhrsjob3->WW->Tobin's Q	-0.0005***	0.00013	-0.8896***	0.2534	2.6440
rhrsjob4->WW->ROA	0.0002	0.00027	-0.4099***	0.0108	-0.6092
rhrsjob4->WW->Tobin's Q	0.0002	0.00027	-0.8956***	0.2494	-0.6007

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

Bootstrap Test for AHRS

When the independent variables are AHRS with educational levels, the Bootstrap

test results of mediation effect are shown in the below table.

Table F3

Bootstrap Test of Mediation Effect (sub-AHRS_Edu)

AHRS edu1	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval
ROA	Direct Effect	0.0047***	0.0013	3.5800	0.0000	0.0021	0.0072
	Indirect Effect: WW	0.0060***	0.0005	11.5200	0.0000	0.0050	0.0070
	Total Effect	0.0107***	0.0014	7.8600	0.0000	0.0080	0.0133
Tobin's Q	Direct Effect	0.0489*	0.0274	1.7900	0.0740	-0.0047	0.1026
	Indirect Effect: WW	0.0188***	0.0050	3.7200	0.0000	0.0089	0.0287
	Total Effect	0.0677***	0.0270	2.5100	0.0120	0.0148	0.1206

AHRS Edu2	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval
ROA	Direct Effect	0.0096***	0.0015	6.4400	0.0000	0.0067	0.0126
	Indirect Effect: WW	0.0076***	0.0006	13.6000	0.0000	0.0065	0.0086
	Total Effect	0.0172***	0.0015	11.1800	0.0000	0.0142	0.0202
Tobin's Q	Direct Effect	0.1163***	0.0348	3.3500	0.0010	0.0482	0.1844
	Indirect Effect: WW	0.0190***	0.0062	3.0500	0.0020	0.0068	0.0312
	Total Effect	0.1353***	0.0339	3.9900	0.0000	0.0688	0.2018

AHRS Edu3	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval
ROA	Direct Effect	0.0065***	0.0013	5.0400	0.0000	0.0040	0.0090
	Indirect Effect: WW	0.0061***	0.0005	12.4400	0.0000	0.0052	0.0071
	Total Effect	0.0126***	0.0013	9.7400	0.0000	0.0101	0.0152
Tobin's Q	Direct Effect	0.0950***	0.0268	3.5400	0.0000	0.0424	0.1476
	Indirect Effect: WW	0.0138***	0.0048	2.8800	0.0040	0.0044	0.0232
	Total Effect	0.1089***	0.0265	4.1000	0.0000	0.0569	0.1609

AHRS Edu4	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval
ROA	Direct Effect	0.0088***	0.0015	5.8800	0.0000	0.0059	0.0117
	Indirect Effect: WW	0.0053***	0.0006	8.8300	0.0000	0.0041	0.0064
	Total Effect	0.0141***	0.0015	9.1900	0.0000	0.0111	0.0171
Tobin's Q	Direct Effect	0.0872***	0.0299	2.9200	0.0040	0.0287	0.1457
	Indirect Effect: WW	-0.0048	0.0053	-0.8900	0.3720	-0.0152	0.0057
	Total Effect	0.0824***	0.0295	2.7900	0.0050	0.0246	0.1402

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

When the independent variables are AHRS with job types, the Bootstrap test results

of mediation effect are shown in the below table.

Table F4

Bootstrap Test of Mediation Effect (Sub-AHRS_Job)

AHRS Job1	Effect	Coeff.	Bootstrap std. err	z	p	95% conf. interval	
ROA	Direct Effect	0.0079***	0.0014	5.6400	0.0000	0.0052	0.0106
	Indirect Effect: WW	0.0062***	0.0005	12.5100	0.0000	0.0052	0.0072
	Total Effect	0.0141***	0.0015	9.5800	0.0000	0.0112	0.0170
Tobin's Q	Direct Effect	0.0870***	0.0268	3.2500	0.0010	0.0345	0.1395
	Indirect Effect: WW	0.0063	0.0047	1.3300	0.1820	-0.0030	0.0156
	Total Effect	0.0934***	0.0261	3.5800	0.0000	0.0422	0.1445

AHRS Job2	Effect	Coeff.	Bootstrap std. err	z	p	95% conf. interval	
ROA	Direct Effect	0.0144***	0.0014	10.0400	0.0000	0.0116	0.0172
	Indirect Effect: WW	0.0071***	0.0005	13.8500	0.0000	0.0061	0.0081
	Total Effect	0.0215***	0.0015	14.5100	0.0000	0.0186	0.0244
Tobin's Q	Direct Effect	0.1941***	0.0311	6.2400	0.0000	0.1331	0.2551
	Indirect Effect: WW	0.0087	0.0056	1.5400	0.1230	-0.0024	0.0197
	Total Effect	0.2028***	0.0306	6.6300	0.0000	0.1429	0.2627

AHRS Job3	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval
ROA	Direct Effect	0.0071***	0.0011	6.5000	0.0000	0.0049	0.0092
	Indirect Effect: WW	0.0046***	0.0004	11.9600	0.0000	0.0038	0.0053
	Total Effect	0.0116***	0.0011	10.4300	0.0000	0.0094	0.0138
Tobin's Q	Direct Effect	0.0974*	0.0218	4.4800	0.0000	0.0548	0.1401
	Indirect Effect: WW	0.0093***	0.0036	2.6200	0.0090	0.0024	0.0163
	Total Effect	0.1067*	0.0214	5.0000	0.0000	0.0649	0.1486

AHRS Job4	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval
ROA	Direct Effect	0.0040***	0.0011	3.7400	0.0000	0.0019	0.0061
	Indirect Effect: WW	0.0043***	0.0004	11.3900	0.0000	0.0035	0.0050
	Total Effect	0.0083***	0.0011	7.5800	0.0000	0.0061	0.0104
Tobin's Q	Direct Effect	0.0350*	0.0212	1.6500	0.0980	-0.0065	0.0766
	Indirect Effect: WW	0.0098***	0.0033	2.9500	0.0030	0.0033	0.0164
	Total Effect	0.0449**	0.0210	2.1400	0.0330	0.0037	0.0860

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Bootstrap Test for RHRS

When the independent variables are RHRS with educational levels, the Bootstrap test results of mediation effect are shown in the below table.

Table F5

Bootstrap Test of Mediation Effect (sub-RHRS_Edu)

RHRS edu1	Effect	Coeff.	Bootstrap std. err	z		p	95% conf. interval	
ROA	Direct Effect	-0.0006***	0.0002	-3.4700		0.0010	-0.0009	-0.0002
	Indirect Effect: WW	0.0000	0.0001	0.1900		0.8520	-0.0001	0.0001
	Total Effect	-0.0006***	0.0002	-3.3200		0.0010	-0.0009	-0.0002
Tobin's Q	Direct Effect	-0.0431***	0.0034	-12.7200		0.0000	-0.0497	-0.0365
	Indirect Effect: WW	0.0000	0.0002	0.1900		0.8510	-0.0003	0.0003
	Total Effect	0.0431***	0.0034	-12.7100		0.0000	-0.0497	-0.0364

RHRS Edu2	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval	
ROA	Direct Effect	-0.0013***	0.0005	-2.5700	0.0100		-0.0022	-0.0003
	Indirect Effect: WW	0.0001	0.0001	0.7500	0.4510		-0.0002	0.0004
	Total Effect	-0.0012**	0.0005	-2.3000	0.0220		-0.0021	-0.0002
Tobin's Q	Direct Effect	-0.0764***	0.0095	-8.0600	0.0000		-0.0950	-0.0578
	Indirect Effect: WW	0.0003	0.0004	0.6800	0.4990		-0.0005	0.0011
	Total Effect	-0.0761***	0.0095	-8.0400	0.0000		-0.0947	-0.0576

RHRS Edu4	Effect	Coeff.	Bootstrap std. err	z	p	95% conf. interval	
ROA	Direct Effect	0.0004	0.0003	1.4500	0.1470	-0.0001	0.0010
	Indirect Effect: WW	0.0001	0.0001	0.7600	0.4460	-0.0001	0.0002
	Total Effect	0.0005*	0.0003	1.6600	0.0960	-0.0001	0.0011
Tobin's Q	Direct Effect	0.0427***	0.0064	6.6800	0.0000	0.0302	0.0552
	Indirect Effect: WW	0.0000	0.0001	0.1900	0.8460	-0.0002	0.0002
	Total Effect	0.0427***	0.0064	6.6800	0.0000	0.0302	0.0553

Note. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

When the independent variables are RHRS with job types, the Bootstrap test results

of mediation effect are shown in the below table.

Table F6

Bootstrap Test of Mediation Effect (Sub-RHRS_Job)

RHRS Job1	Effect	Coeff.	Bootstrap std. err	z	p	95% conf. interval	
ROA	Direct Effect	-0.0001	0.0002	-0.6600	0.5110	-0.0005	0.0003
	Indirect Effect: WW	0.0002***	0.0001	3.8400	0.0000	0.0001	0.0003
	Total Effect	0.0001	0.0002	0.3400	0.7360	-0.0003	0.0005
Tobin's Q	Direct Effect	0.0363***	0.0043	8.5400	0.0000	0.0280	0.0447
	Indirect Effect: WW	0.0003	0.0002	1.4200	0.1560	-0.0001	0.0006
	Total Effect	0.0366***	0.0043	8.5900	0.0000	0.0282	0.0449

RHRS Job2	Effect	Coeff.	Bootstrap std. err	z	p	95% conf. interval	
ROA	Direct Effect	0.0040***	0.0006	7.2800	0.0000	0.0029	0.0051
	Indirect Effect: WW	0.0012***	0.0002	7.1500	0.0000	0.0009	0.0015
	Total Effect	0.0052***	0.0006	9.2400	0.0000	0.0041	0.0063
Tobin's Q	Direct Effect	0.0612***	0.0127	4.8300	0.0000	0.0364	0.0861
	Indirect Effect: WW	0.0023**	0.0009	2.4300	0.0150	0.0004	0.0041
	Total Effect	0.0635***	0.0127	5.0200	0.0000	0.0387	0.0883

RHRS Job3	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval	
ROA	Direct Effect	0.0005**	0.0002	2.4800	0.0130	0.0001	0.0008	
	Indirect Effect: WW	0.0002***	0.0001	4.0400	0.0000	0.0001	0.0003	
	Total Effect	0.0007**	0.0002	3.4500	0.0010	0.0003	0.0010	
Tobin's Q	Direct Effect	0.0181***	0.0047	3.8500	0.0000	0.0089	0.0273	
	Indirect Effect: WW	0.0005**	0.0002	2.3900	0.0170	0.0001	0.0008	
	Total Effect	0.0185***	0.0047	3.9400	0.0000	0.0093	0.0278	

RHRS Job4	Effect	Coeff.	Bootstrap std. err	z	p		95% conf. interval	
ROA	Direct Effect	-0.0010**	0.0005	-2.2500	0.0240	-0.0019	-0.0001	
	Indirect Effect: WW	-0.0001	0.0001	-0.5300	0.5980	-0.0003	0.0002	
	Total Effect	-0.0011**	0.0005	-2.2900	0.0220	-0.0020	-0.0002	
Tobin's Q	Direct Effect	-0.0127	0.0081	-1.5700	0.1170	-0.0286	0.0032	
	Indirect Effect: WW	-0.0001	0.0003	-0.4900	0.6250	-0.0007	0.0004	
	Total Effect	-0.0129	0.0081	-1.5900	0.1130	-0.0287	0.0030	

Note. Data sorted out by the author.

* p<0.1 ** p<0.05 *** p<0.01.

A Summary for Mediation Effect

To summarize the above tests, the results are sorted out as follows. First, the mediation effect on the relationship between AHRS and firm performance (ROA and Tobin's Q) are concluded.

Table F7

A Summary of AHRS-WW-ROA/Tobin's Q Mediation Effect

Dependent Variable	Independent Variable	Mediation Effect			Sobel Statistics	Bootstrap Test
		Direct	Indirect (WW)	Total		
ROA	AHRS	***	***	***	***	Yes
Tobin's Q	AHRS	***	**	***	***	Yes
ROA	AHRS_edu1	***	***	***	***	Yes
Tobin's Q	AHRS_edu1	*	***	***	***	DE Not
ROA	AHRS_edu2	***	***	***	***	Yes
Tobin's Q	AHRS_edu2	***	***	***	***	Yes
ROA	AHRS_edu3	***	***	***	***	Yes
Tobin's Q	AHRS_edu3	***	***	***	***	Yes
ROA	AHRS_edu4	***	***	***	***	Yes
Tobin's Q	AHRS_edu4	***	Not	***	Not	IE Not
ROA	AHRS_job1	***	***	***	***	Yes
Tobin's Q	AHRS_job1	***	Not	***	Not	IE Not
ROA	AHRS_job2	***	***	***	***	Yes
Tobin's Q	AHRS_job2	***	Not	***	***	IE Not
ROA	AHRS_job3	***	***	***	***	Yes
Tobin's Q	AHRS_job3	***	***	***	***	Yes
ROA	AHRS_job4	***	***	***	***	Yes
Tobin's Q	AHRS_job4	*	***	**	***	DE Not

Note. DE: Direct Effect, IE: Indirect Effect, TE: Total Effect. Not: Not Significant. Data sorted out by the author.

* $p<0.1$ ** $p<0.05$ *** $p<0.01$.

Second, the mediation effect on the relationship between RHRS and firm performance (ROA and Tobin's Q) are concluded.

Table F8

A Summary of RHRS-WW-ROA/Tobin's Q Mediation Effect

Dependent Variable	Independent Variable	Mediation Effect			Sobel Statistics	Bootstrap Test
		Direct	Indirect (WW)	Total		
ROA	RHRS	***	**	***	***	Yes
Tobin's Q	RHRS	***	***	***	***	Yes
ROA	RHRS_edu1	***	Not	***	Not	IE Not
Tobin's Q	RHRS_edu1	***	Not	***	Not	IE Not
ROA	RHRS_edu2	**	Not	**	Not	IE Not
Tobin's Q	RHRS_edu2	***	Not	***	Not	IE Not
ROA	RHRS_edu3	**	***	***	***	Yes
Tobin'sQ	RHRS_edu3	***	**	***	***	Yes
ROA	RHRS_edu4	Not	Not	*	Not	DE & IE Not
Tobin's Q	RHRS_edu4	***	Not	***	Not	IE Not
ROA	RHRS_job1	Not	***	Not	***	DE & TE Not
Tobin's Q	RHRS_job1	***	Not	***	***	IE Not
ROA	RHRS_job2	***	***	***	***	Yes
Tobin'sQ	RHRS_job2	***	**	***	***	Yes
ROA	RHRS_job3	**	***	***	***	Yes
Tobin's Q	RHRS_job3	***	**	***	***	Yes
ROA	RHRS_job4	**	Not	***	Not	IE Not
Tobin's Q	RHRS_job4	Not	Not	Not	Not	IE & DE & TE Not

Note. DE: Direct Effect, IE: Indirect Effect, TE: Total Effect. Not: Not Significant. Data sorted out by

the author.

* p<0.1 ** p<0.05 *** p<0.01.