

## Article

# State Ownership and Risk-Taking Behavior: An Empirical Approach to Get Better Profitability, Investment, and Trading Strategies for Listed Corporates in Vietnam

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**Abstract:** Corporate risk-taking behavior and investment is a crucial factor in order to seek higher profits and a better trading strategy. Competitive advantage and innovation, while maintaining profitability and state ownership, are considered as crucial resources. Furthermore, it is essential to connect the short-term and long-term business and investment objectives plus stakeholder's expectations to corporate sustainability and development. This connection is especially important in the context of transforming economies and getting better trading strategies. This study estimates the relationship between state ownership, profitability, corporate risk-taking behavior, and investment in Vietnam by using Generalized Method of Moments (GMM) methods. Using the data of 501 listed non-financial corporates during the period 2007–2015 from Ho Chi Minh City and Hanoi Stock Exchanges, we find that profitability is determined as a factor to reduce corporate risk-taking acceptance caused by the chances of entrenchment. Meanwhile, the impact of state ownership on the risk appetite of corporate has a non-linear effect. In particular, state ownership reduces corporate risk-taking behavior and investment but yet increases the risk-taking behavior and investment when the state ownership rate exceeds a threshold. On the one hand, this implies that the low level of state ownership not only prevents risk-taking behavior and investment but also results in more severe agency problems, causing unsustainability due to the imbalance of interests among various stakeholders. On the other hand, a dominant role of state ownership concentration causes a boost in corporate risk-taking decision-making in investment and trading strategy, leveraging the connection of significant external resources to deal with uncertain problems. The study contributes to existing theories of corporate governance in the context of a socialist-oriented market.

**Keywords:** market efficiency; state ownership; risk-taking behavior; investment; Vietnam; GMM; nonlinearity; trading strategy

**JEL Classifications:** G30; G38

## 1. Introduction

Risk-taking behavior and trading strategy play a vital role in the choice of corporate investment activities and are critical to creating the development of a corporate since they provide opportunities for innovation, and improve performance and competitive advantages (Cheng et al. 2020; Li and Liu 2017; Zhai et al. 2015; Shoham and Fiegenbaum 2002). Under uncertain business environments, corporates make different decisions that reflect strategic choices with uncertain consequences to improve their competitive advantage and performance (Hoskisson et al. 2016). For example, choices related to spending on research and development, acquisitions and divestitures, or competition actions. These choices mirror, as an indicator of, corporate risk-taking behavior. Stulz (2015) argued that corporates cannot maximize the shareholders' wealth and their revenue without taking risks. Thus, a corporate achieves efficiency, capital accumulation, and technological innovation through risk-taking activities and investments. However, excessive risk-taking behavior and investment can have a negative impact on corporate performance, since it consumes corporate resources such as capital, labor, and equipment. Excessive risk-taking can create an imbalance among all stakeholders, including the owner (Younas and Zafar 2019). Therefore, an investigation of corporate risk-taking behavior and investment is essential, not only for scholars but also for practitioners in improving corporate governance.

Literature has shown that corporate risk-taking behavior, investment, and trading strategy is associated with structure and corporate governance (Faccio et al. 2016; Su et al. 2016), relying on the risk preferences and investment horizons of different shareholders (Vo 2018). Uddin (2016) believed that the government having ownership in a corporate directly influences its risk-taking decisions on investment and trading strategy, which determine the performance, survival, and growth of the corporate in the competitive market environment. Previous studies recognize that corporate activities are also affected by the unequal treatment between the public and non-public sectors in taking some risks to gain competitive advantages and achieve innovation (Zhou et al. 2016; Song et al. 2016). State-owned enterprises (SOEs), with their political connections, typically receive a multitude of financial and policy incentives that help to increase their performance and competitiveness (Ben-Nasr et al. 2015). Therefore, SOE managers believe that they can also reduce external uncertainties through political relations (Schweizer et al. 2019). However, political connections can derail corporate strategy in various ways (Fan et al. 2007). SOEs generally suffer from excessive interference and a lack of independence needed to conduct business activities (Bhatti and Sarwet 2011; Fan et al. 2007). They have also reoriented the goals and activities of corporates, thereby making them very different from governance principles (Abramov et al. 2017). Besides, SOE managers tend to focus on achieving social objectives and short-term political goals instead of maximizing their performance (Kang and Kim 2012). The above arguments raise an interesting question, that is whether or not corporates with state connections should take more risky investments to maintain their performance.

Moreover, Vietnam is identified as an excellent research sample for the influences of state ownership because it is not only an emerging transitional country but also has a history of a centrally-planned economy with the dominance of state and state-owned firms (Vo 2018). Although, since the 1986 reform, the rate of state property ownership among SOEs in Vietnam has declined significantly, the role of state ownership is still important because it is often considered as the "tactful" tool for the intervention and orientation of the government into the market (Ben-Nasr et al. 2015). Thus, our study provides helpful insights into the relationships among state ownership and corporate risk-taking behavior, investment, and trading strategy, thereby contributing to the management theories and practical implications in the context of Vietnam. There are three important goals for this study. Firstly, most of the existing literature focuses on SOEs' behavior in developed markets, whereas few are conducted for transitional economies (Khaw et al. 2016). Vietnam offers an ideal setting to examine the link between state ownership and risk-taking behavior, investment, and trading strategy for the typical characteristics of a socialist-oriented market and where SOEs have received strong support from the government. Moreover, prior studies on the Vietnamese market focus on investigating the relationship between state ownership and firm performance (e.g., Nguyen et al. 2019;

Phung and Mishra 2015; Quang and Xin 2014; Nguyen et al. 2013) without pointing out whether state ownership promotes or reduces risk-taking behavior and investment by corporates. Therefore, the first goal of this study will fill this research gap.

Secondly, the study highlights the critical role of ownership structure and the duality of state–corporate relations. On the one hand, prior studies suggested a positive association between state ownership and corporate risk-taking behavior and investment (Zhai et al. 2015; Wang et al. 2008). On the other hand, other studies assert that state ownership is negatively associated with risk-taking activities and investments (Vo 2018; Zhou et al. 2016). Since government objectives reflect the interests of the government, discord might be caused between government and other shareholders in deciding corporate risk-taking activities and investments. Thus, the level of government shareholding can have a non-linear effect on corporate risk-taking behavior and investment (Uddin 2016). The next goal of this study will address this ambiguous issue. Thirdly, the study also considers the role of corporate efficiency and growth of revenue, debt, and fixed assets in association with corporate risk-taking acceptance. This study, therefore, adds to the current literature on the analysis of the risk-taking behavior and investment of SOEs in Vietnam, a transitional economy where state-owned corporates remain dominant, and thus enriching studies of state ownership. This contribution is essential in the context of a transition economy, often characterized by weak institutions and uncertainties.

In addition to the introduction, the structure of the paper is as follows: Section 2 presents the literature review. Section 3 states hypotheses and discuss the theory used in our paper, Section 4 describes empirical models and the data collection procedures in our paper, and Section 5 shows the results; Section 6 discusses, and Section 7 gives the conclusions and implications of the study.

## 2. Literature Review

Risk-taking behavior is a combination of several factors, such as agency theory, prospect theory, and resource dependence theory, as well as political connections (Sharma et al. 2020; Díez-Esteban et al. 2017; Uddin 2016). Risk-taking behavior illustrates the manager's risk-bearing with an organization's needs (Nobre et al. 2018). Risk-taking behavior reflects strategic choices with uncertain consequences to improve the competitive advantage and performance of the corporate. Thus, innovative strategies and competitive determinants will impact whether organizations will be risk-averse or risk-assertive (Shoham and Fiegenbaum 2002).

Theoretically, the manager's risk-taking behavior reflects the effect of the level of equity holdings relative to managers' compensation, hence reflecting the agency problem. Typically, equity-based compensation will provide managers the incentive to undertake more risky but value-increasing investment projects and vice versa (Chen and Ma 2011). However, managers may be overconfident about their capabilities, lack understanding of market uncertainties, or try to find luck with risks (Kraus et al. 2011; Vereshchagina and Hopenhayn 2009). As such, it is accepted that risk does not yield a risk premium and does not lead to better performance. Therefore, Gillette et al. (2003) showed that the corporate insiders who are involved in the management of firms have both negative and positive incentives for taking risks due to the divergence of their interests in the firm. Thus, Hoskisson et al. (2016) proposed that the risk-taking behavior of a corporate can be significantly influenced by concentrated ownership and institutional ownership (the owner who holds their stock long term) because those owners have a stronger influence in corporate decision-making.

Friedman (1962) argued that the role of government is to establish a policy and legal framework, enforce rights to reduce monopolies, and prevent misconduct. However, the fact is that the government is also involved in the economy through different forms. For example, it can establish wholly-owned corporates in the early stages of market development and transfer ownership to private owners through full or partial privatization (Uddin 2016). This makes the government a majority or minority shareholder, which allows them to influence the decisions of the corporates, including risk-taking, directly. The empirical results of previous studies of state ownership and risk-taking behavior are also found to be disparate across countries, especially in transition economies (Song et al. 2016; Ben-Nasr et al. 2015). Khan et al. (2019) shed light on the prominent status of state-owners, that

they are more likely to engage in social activities, indicating that they try to harmonize the interests of stakeholders. Thus, corporates with political connections have better performance and sustainability and less risk-taking behavior (Abramov et al. 2017).

The risk avoidance behavior of SOEs becomes stronger in markets with weak corporate governance and poor investor protection environments. Transition markets, such as Vietnam or China, are characterized by the dominance of state ownership in firms, especially in the past (Vo 2018; Luo et al. 2017). Moreover, in the defective business environment, corporates need to take more risks to reap higher profits. This makes the role of internal owners overwhelm the voices and interests of outside minority shareholders. The outside shareholders often succumb to the political pressure of the state, who is also a corporate owner (Durnev et al. 2004). However, SOEs do not need to take more risks because they already have a competitive advantage and better access to financial resources as well as a tax reduction (Vo 2018).

Moreover, instead of pursuing risky projects (uncertain return), state-owners appointed by the government are often asked to focus on socio-political objectives to ensure balance and the stability of society. State owners strive to protect previous achievements and the reputation of the government, such as creating jobs, social services, and public utilities, in political tenure, instead of investing in risky projects that might lead to uncertainty in markets (Boubakri et al. 2013; Fogel et al. 2008). In addition, SOE managers generally face difficulties in corporate governance because of state intervention, a lack of corporate governance skills, and a lack of the necessary independence (Lin et al. 2009). For this reason, they will not bet their political career on risky projects. This is especially true in socialist-oriented economies where the government often focuses on ensuring social stability and creating employment and, as such, avoid risky activities (Abramov et al. 2017; Fogel et al. 2008).

Conversely, some studies suggest that SOEs are willing to risk risky projects because they know that they receive strong support from the government to overcome the risks of the inefficient business environment (Farag and Mallin 2016; Zhai et al. 2015). Uddin (2016) claimed that internal owners involved in managing a business might be more risk-taking acceptant if the growth of corporate value is worth to them. Moreover, corporate state-owners also implement economic goals such as increasing government revenue through corporate income tax and dividends or developing capital markets through leading projects (De la Torre et al. 2007). These goals will be possible in a relatively stable, competitive, and transparent economy where SOE managers have enough independence and information to make their decisions (Uddin 2016; Vo 2018). Under increasing competitive pressure, SOEs also take risks to establish a leading position and contribute more to government revenues. The relationship with the government is itself a political pressure on SOEs, especially firms with the state being the majority shareholders. Therefore, Chong et al. (2018) suggested that state ownership can affect corporate risk-taking, but the non-linear effect of these political connections needs to be considered.

In summary, we realize that there are various findings regarding the influence of state ownership on firms' risk-taking behavior, not only related to aspects of agency problems but also political links and resource dependence. The tension in the nexus between profitability and stability gives rise to agency conflicts of interest. Therefore, this study explains this relationship by analyzing the influence of state ownership on the risk-taking behavior of listed corporates in Vietnam.

### 3. Theories and Hypotheses

Literature has considered that the risk-taking behavior of corporates could be explained through the lens of prospect theory and (Kahneman and Tversky 1979; Wong and Chan 2008). The prospective theory provides an explanation for an individual or organization's decision making under risk through the target. The individuals or organizations refuse to accept more risk when the expected result is higher than the target (i.e., profit). Conversely, they try to fill the gap by accepting more risk when the expected outcome is below the target (Frugier 2016). In other words, prospect theory explains risk-taking behavior through the identification of targeted outcomes, providing clues for trying to identify causal mechanisms that explain the different levels of risk-taking behavior at

organizations. Agency theory also identifies that risk-taking avoidance is caused by conflicts between managers, who are concerned about market and business risks, and shareholders, who diversify their portfolios to earn higher profits (Jensen and Meckling 1976). Basically, the major key to driving a corporate's risk-taking behavior is expected profitability. When a corporate has already expected profitability and managers are compensated based on profitability, they prefer getting a stable income without taking any high-risk decisions. Therefore, the first hypothesis of the study is:

**Hypothesis 1 (H1).** *Profitability has a negative impact on corporate risk-taking behavior.*

Although agency theory refers to the conflict between managers and shareholders, it may also explain the behavior of state owners as inside owners. On the one hand, these authors maintain that outside shareholders prefer higher risk-taking for a higher return. Meanwhile, it is not the same case for inside owners such as managers or founding shareholders as their interests are tied to total wealth portfolios, personal gains and losses, and chances of entrenchment (Uddin 2016). State ownership also leads to the situation in which the de facto owner and SOE staff are state agents. Therefore, agency theory is also relevant to SOEs, e.g., the conflict of interest between shareholders and agents. SOE agents have little incentive to strive for achieving high economic efficiency; they tend to avoid risks to ensure safety for their positions and benefits. Su et al. (2016) argued that corporates with low risk-taking behavior often have more severe agency problems in order to uphold personal benefits.

Political connections are a useful link to external resources with considerable power and influence. Political connections are defined as informal social connections with officials at the constituent parts of public authorities (Sun et al. 2012). Uddin (2016) suggested that although a corporate's risk reflects the diversity of shareholder benefits, the government is the most politically powerful shareholder, regardless of its level of ownership. Thus, the government's interest reflects the level of risk-taking of corporates (Sharma et al. 2020). Previous research on political connections shows that it often has an impact on corporate operating, although there are some exceptions (Ang et al. 2013). The literature on political connection shows that the advantages of political relations can bring better results (Ling et al. 2016; Boubakri et al. 2013), competitive advantages (Frynas et al. 2006), higher bailout packages from the government (Faccio et al. 2006), or lower capital costs (Boubakri et al. 2012). SOE agents have little incentive to strive for achieving high economic efficiency. Instead, they tend to avoid risks to ensure safety for their positions and benefits. This leads to more severe incentive issues and a more pronounced loss of economic efficiency in SOEs (Young et al. 2014).

Thus, the existence of state ownership is considered to have a significant influence on the corporate's risk-taking behavior, thereby changing its investment and trading strategies to achieve high profitability. Based on the above arguments, it is important to state that the involvement of state ownership in a corporate leads to less risk-taking behavior, as in the below hypothesis:

**Hypothesis 2 (H2).** *State ownership has a negative impact on corporate risk-taking behavior.*

The theory of resource dependence emphasizes that corporates encounter dependencies when they need resources from outside, and influencing and responding to external dependencies is a key task of management (Lux et al. 2010). External links between firms and important sources are a coping mechanism to reduce the risk and uncertainty faced by corporates (Pfeffer and Salancik 1978). Government policy and regulation is a significant force in the external environment (Hillman et al. 1999). However, this interaction depends on the relative strength of the involved parties when internal and external organizations exchange resources and the dependence level of each (Casciaro and Piskorski 2005; Pfeffer and Salancik 1978). Therefore, a corporate will be more dependent on environmental uncertainty and the power of external resources (Santos and Eisenhardt 2005; Pfeffer and Salancik 1978). Díez-Esteban et al. (2017) discovered that this relationship is affected by the nature of the dominant shareholder, which is an important factor in corporate decision-making. This view was confirmed by Uddin (2016), who argued that (i) how the government, as the country's most powerful political institution, works with other insiders in public; and (ii) how the corporate and the

government on the board affect decision making affect the corporate's attitude toward risk-taking, leading to more cautious reactions (accepting or avoiding risks), with changes in operating results.

SOEs receive external resources from political links in the forms of financial support from the government, tax breaks, or better access to information (Faccio 2010; Faccio et al. 2006). Besides, managers of large SOEs believe that they are “too big to fail” or, in other words, protected from bankruptcy due to the consequences of risky investments (Najid and Rahman 2011). Therefore, ownership links with the government transmit a signal to encourage venture investments because of the government advocates and protection of risky investments (Uddin 2016; Zhai et al. 2015). Although the government gives priority to socio-political goals to maximize social stability and employment (helping to ensure the government's political tenure), the government also receives a lot of taxes, dividends, and long-term capital gains if corporates can make successful risk investments. These goals are contradictory in the short term but not in the long run, so the economically stable government can provide more social and employment services to its citizens in a more sustainable way (Uddin 2016).

Thus, the study argues that corporate risk-taking behavior is affected because of the difference in the interests of state ownership and external shareholders, who are more concerned about performance, survival, and growth rather than focusing on both social and political objectives. It depends whether the government is a minority or majority shareholder, deciding whether SOEs managers become more prudent in reducing their risk taking to avoid earnings uncertainty. Conversely, if the government is a majority shareholder with a higher profits target, it puts a pressure on SOEs' managers to make riskier investments. Therefore, the state owners have a reasonable motivation to undertake risky decisions to achieve them. Besides, once successfully implementing risky investments, SOEs can help the government to ensure economic objectives in the long term, such as higher social stability and higher employment in the future. This awareness is important for monitoring ownership structure and restructuring trading strategies in SOEs for better investment and profitability. Thus, this study states the third hypothesis as follows:

**Hypothesis 3 (H3).** *When the level of state ownership is below a threshold, as its ownership rises, the firm takes fewer risks. When the level of state ownership is above a threshold, the firm takes more risks.*

#### 4. Data and Methodology

In this section, we discuss the data and methodology being used in our study. We first discuss the data being used in our study.

##### 4.1. Data

The data consist of 506 corporates listed on the Ho Chi Minh Stock Exchange (HOSE) and Hanoi Stock Exchange (HNX) from 2007 to 2015, with 4171 observations. This period is in an important stage of the equitization process with significant changes in government shares in state-owned corporates. In the period 2007–2011, the number of equitized corporates was 388, while 591 corporates were equitized, merged, and dissolved in the period 2011–2015. It was also marked by an important 929/QD-TTg decision, which was issued by the prime minister on approving the scheme on SOE restructuring in 2011–2015. Moreover, Vietnam was affected by the economic crisis, causing the stock market to be unfavorable and affecting its equitization process as well as the selection of investment and trading strategies in this period. Thus, this sample is useful and reliable for investigating the relationship between state ownership and risk-taking behavior to get better investments and trading strategies. Thus, we select the period in our study. This is a set of unbalanced panel data in which some corporates have more observations than others due to the availability of data, listing time, and our attempt to maximize the number of observations. The annual financial data and the ownership information of corporates are obtained from the FiinPro® Platform, affiliated with Nikkei Inc. and QUICK Corp.

#### 4.2. Variables

*Risk* is a dependent variable that measures risk-taking behavior such that:

$$Risk_{ROA} = \frac{ROA_{i,t}}{\sigma ROA_i} \text{ and } Risk_{ROE} = \frac{ROE_{i,t}}{\sigma ROE_i}$$

where  $ROA_{i,t}$  and  $ROE_{i,t}$  are the returns on assets and equity of corporate  $i$  at time  $t$ , and  $\sigma ROA_i$  and  $\sigma ROE_i$  are the standard deviations of ROA and ROE for firm  $i$  in the sample, respectively. We hypothesize that a more volatile performance is more relevant to the risk and risk-taking activities by corporates.  $Risk_{ROA}$  and  $Risk_{ROE}$  are indicators that are the inverse of corporate risk-taking behavior. Higher values for these indices means less risky behavior from corporates and vice versa. These measures are common proxies for corporate risk-taking in the extant literature and also have been used in many studies (Faccio et al. 2016; Vo 2018).

$Profitability_{i,t-1}$  are variables which measure the corporate's performance in earning profits from their assets or equity, represented by  $ROA_{i,t-1}$  and  $ROE_{i,t-1}$ . Basically, the higher these indicators are, the more profitable the corporate is. The difference between ROA and ROE tends to reflect the debt burden. ROA shows the profit earned per unit of assets, and it, more importantly, reflects the ability of the corporate in using its resources to earn profits. Meanwhile, ROE reflects how effectively the corporate uses shareholder capital (Lin et al. 2019; Mun and Jang 2015).

$Gov_{i,t}$  represents state ownership, which is measured by the percentage of state holdings of corporate  $i$  at the end of year  $t$ . It can be understood that the state ownership level can be measured by shareholding by state agencies and SOEs. SOEs can be parent SOEs or non-parent SOEs (Hope 2013). Many listed corporates are originally spun off from their unlisted parent SOEs and floated on the stock market. For some listed corporates, their parent SOEs remain the major shareholder and control their resources in subsidiary firms.

$Control\ variables_{i,t}$  is a set of variables that clearly explain corporate risk-taking behavior, including size ( $Size_{i,t}$ ), which is the logarithm of the total assets at the end of the year; fixed assets ( $Fixed_{i,t}$ ), which is the ratio of fixed assets to total assets; the level of mature debt ( $Debt_{i,t}$ ), which is the short-term debt to total assets ratio; and growth ( $Growth_{i,t}$ ), which is the difference in revenue between  $t$  and  $t - 1$  year of corporate  $i$ . These variables have been used in previous studies on corporate risk management (Thanh et al. 2019; Khuong et al. 2019; Nguyen et al. 2019; Mishra 2011).

#### 4.3. Models

We extend the models of Faccio et al. (2016), Vo (2018), and others to develop the following new prior models to study the relationship between state ownership and corporate risk-taking behavior:

$$Risk_{i,t} = \alpha_1 + \alpha_2 Profitability_{i,t-1} + \alpha_3 Gov_{i,t} + \alpha_4 Size_{i,t} + \alpha_5 Fixed_{i,t} + \alpha_6 Debt_{i,t} + \alpha_7 Growth_{i,t} + \varepsilon_{i,t}, \quad (1)$$

$$Risk_{i,t} = \beta_1 + \beta_2 Profitability_{i,t-1} + \beta_3 Gov_{i,t} + \beta_4 Gov^2_{i,t} + \beta_5 Size_{i,t} + \beta_6 Fixed_{i,t} + \beta_7 Debt_{i,t} + \beta_8 Growth_{i,t} + \varepsilon_{i,t} \quad (2)$$

In the model in Equation (2),  $Gov_{i,t}$  represents state ownership, which is measured by the percentage of state holdings of corporate  $i$  at the end of year  $t$ . We note that if  $\beta_3$  is significantly positive and  $\beta_4$  is significantly negative, then there is an inverted U-shaped relationship. On the other hand, if  $\beta_3$  is significantly negative and  $\beta_4$  is significantly positive, there is a U-shaped relationship between corporate risk-taking and state ownership. Taking the first derivative of both sides concerning  $Gov$ , we get:  $Gov' = \beta_3 + 2\beta_4 Gov$ . Finding the maximum value of  $Gov$  requires  $Gov' = 0$ . Solving this equation, we find the threshold value of  $Gov$  ( $\varsigma$ ) as follows:

$$\varsigma = \frac{\beta_3}{-2\beta_4} \quad (3)$$

Based on the thresholds of  $Gov$  ( $\varsigma$ ), this study separates the level of state ownership into two regimes: higher and lower than the threshold. Then, we check the robustness of the study's findings by re-developing two equations:

$$Risk_{it} = \begin{cases} \beta_{11} + \beta_{12}Profitability_{it-1} + \beta_{13}Gov_{it} + \beta_{14}Size_{it} + \beta_{15}Fixed_{it} + \beta_{16}Debt_{it} \\ + \beta_{17}Growth_{it} + (\varsigma_i + \varepsilon_{it}), \text{ if } Gov < \varsigma, \\ \beta_{21} + \beta_{22}Profitability_{it-1} + \beta_{23}Gov_{it} + \beta_{24}Size_{it} + \beta_{25}Fixed_{it} + \beta_{26}Debt_{it} \\ + \beta_{27}Growth_{it} + (\varsigma_i + \varepsilon_{it}), \text{ if } Gov \geq \varsigma. \end{cases} \quad (4)$$

By applying the GMM method, our findings will be confirmed as robustness if  $Gov < (\varsigma)$  is negatively statistically significant for risk-taking behavior, and  $Gov \geq (\varsigma)$  is positively statistically significant for risk-taking behavior and vice versa.

#### 4.4. Methodology

It can be seen that both the models in Equations (1) and (2) are dynamic models with the participation of variable ROA in periods  $t$  and  $t - 1$  as independent and dependent variables. Regression methods for panel data such as ordinary least squares (OLS), the fixed effects model (FEM), or the random-effects model (REM) may produce biased and inconsistent results because of the correlation between  $\varepsilon_{i,t}$  and  $ROA_{i,t-1}$ , i.e., an endogenous problem. To solve this, we considered the difference Generalized Method of Moments (diff-GMM) method proposed by Arellano and Bond (1991), in which the models in Equations (1) and (2) are transformed into first-order difference models, and the lag of them is used as instrumental variables. This transformation eliminates the unobserved effects and allows the creation of orthogonal conditions between  $\varepsilon_{i,t}$  and explanatory variables, thereby solving the endogenous problem. However, Arellano and Bover (1995) suggested that the variance of the estimates in diff-GMM may increase asymptotically and create considerable bias. Blundell et al. (2001) found that estimation in first differences had a large bias and low precision due to the inertial degree of consideration, even with a large number of individuals (N).

Therefore, they proposed that the system Generalized Method of Moments method (sys-GMM), which displayed the lowest bias and highest precision for used series, is moderately or highly consistent. Moreover, the GMM method with two steps has a higher efficiency than that with one step due to the application of a suboptimal weighting matrix, which then produced the bias of uncorrected standard errors when the instrument count was high. Therefore, Roodman (2009) suggested a principle that the number of instrumental variables must be less or equal to the number of groups (N) as a reasonable condition. Both estimation methods are considered appropriate only when two conditions are met: (1) The suitability of the instrument variables is determined through the Hansen or Sargan tests. Specifically, the higher the  $p$ -value of the Sargan and Hansen statistics is, the more likely that the null hypothesis is accepted. (2) There is no second-order autocorrelation phenomenon in the error terms through the AR (2) test.

## 5. Results and Findings

### 5.1. Descriptive Statistics

Table 1 presents the descriptive statistics of the variables in this study.

**Table 1.** Definition and description of variables.

Code	Definition	Obs	Mean	Median	Min	Max
$Risk_{Roa}$	Risk-taking behavior based on $Roa$	4171	2.169	1.832	−2.772	12.794
$Risk_{Roe}$	Risk-taking behavior based on $Roe$	4171	2.307	1.888	−2.917	18.066
$Roa$	Return/total assets	4171	0.069	0.054	−0.646	0.784
$Roe$	Return/equity	4171	0.132	0.133	−7.836	0.982



Gov	Percentage of state holdings by the state	4171	0.273	0.280	0.000	0.967
Size	Logarithm of total assets	4171	26.676	26.584	21.370	31.906
Fixed	Fixed assets/total assets	4171	0.282	0.230	0.000	0.978
Debt	Short-term debt/total debt	4171	0.624	0.785	0.000	1.000
Growth	$Revenue_t/Revenue_{t-1}$	4171	0.136	0.118	-4.643	7.070

(Source: HOSE and HNX).

Table 1 shows the summary statistics of all the variables. It presents the descriptive statistics of the entire sample of 4171 corporate-year observations. The mean (median) risk-taking behavior ( $Risk_{ROA}$ ) of the sample corporates is 2.169 (1.832), lower than that for  $Risk_{ROE}$  at 2.307 (1.888). The mean (median) state ownership ( $Gov$ ) is only 2.73% (2.80%), notably lower than the Vo (2018) observations. The difference is mainly caused by the sample size; Vo (2018) used an average of 2000 observations in the Ho Chi Minh Stock Exchange (HoSE), while our study uses data of listed corporates in the Ho Chi Minh Stock Exchange (HoSE) and Hanoi Stock Exchange (HNX), with 4171 observations.

### 5.2. Correlation Matrix

Table 2 presents the correlation matrix of the variables. It can be seen that the coefficients between state ownership and the two variables of risk-taking are significantly positive, indicating that higher state ownership is associated with a lower level of corporate risk-taking behavior. Moreover, the table also shows a negative correlation between the variables of risk-taking and the firm size, fixed assets, and level of debt, and a positive correlation with growth.

**Table 2.** Definition and description of variables.

	$Risk_{ROA}$	$Risk_{ROE}$	$ROA$	$ROE$	$Gov$	$Size$	$Fixed$	$Debt$	$Growth$
$Risk_{ROA}$	1.00								
$Risk_{ROE}$	0.86 ***	1.00							
$ROA$	0.61 ***	0.53 ***	1.00						
$ROE$	0.44 ***	0.42 ***	0.68 ***	1.00					
$Gov$	0.17 ***	0.18 ***	0.11 ***	0.11 ***	1.00				
$Size$	-0.07 ***	-0.08 ***	-0.07 ***	0.02	0.06 ***	1.00			
$Fixed$	-0.07 ***	-0.04 **	-0.03	-0.02	0.12 ***	0.09 ***	1.00		
$Debt$	-0.13 ***	-0.11 ***	-0.19 ***	-0.08 ***	-0.16 ***	0.04 **	-0.28 ***	1.00	
$Growth$	0.14 ***	0.13 ***	0.18 ***	0.20 ***	-0.05 ***	0.03 *	0.01	-0.04 *	1.00

Note: (\*), (\*\*), and (\*\*\*) are 10%, 5%, and 1%, respectively.

### 5.3. Relationship between State Ownership and Corporate Risk-Taking Behavior

Empirical results of the models in Equations (1) and (2) are presented in Tables 3 and 4, respectively. It can be seen that the conditions of the GMM methods are satisfied. The p-value from the Hansen and Sargan tests is large, implying that the GMM regression results are reliable and that the chosen instrumental variables in the models are appropriate. The p-value of the AR (2) test for the first-order difference of error terms also shows that there is no correlation between the error terms and the explanatory variables at all levels.

**Table 3.** State ownership and corporate risk-taking behavior.

Variable	$RISK_{ROA}$		$RISK_{ROE}$	
	2-Steps Diff-GMM	2-Steps Sys-GMM	2-Steps Diff-GMM	2-Steps Sys-GMM
Lag of profitability	4.819 ** [2.08]	11.339 *** [4.50]	1.633 * [1.70]	4.883 *** [4.44]
Gov	3.283 * [1.73]	7.485 *** [4.62]	4.058 ** [2.07]	9.348 *** [4.57]
Size	-1.016 **	0.261	-1.385 ***	0.013

	[-2.28]	[0.70]	[-3.30]	[0.03]
Fixed	-4.987 ***	-3.696 **	-5.479 ***	-4.560 ***
	[-3.85]	[-2.55]	[-4.16]	[-2.82]
Debt	-1.576 ***	-2.292 ***	-1.754 ***	-2.368 ***
	[-3.05]	[-3.50]	[-3.04]	[-2.75]
Growth	1.609 ***	1.514 ***	1.637 ***	1.657 ***
	[6.17]	[4.54]	[6.29]	[4.34]
AR (1) test				
(p-value)	0.000	0.000	0.000	0.000
AR (2) test				
(p-value)	0.858	0.812	0.754	0.282
Sargan test				
(p-value)	0.898	0.543	0.908	0.368
Hansen test				
(p-value)	0.838	0.871	0.974	0.642
Num. IV	40	43	40	43
Groups	501	501	501	501

Note: (\*), (\*\*), and (\*\*\*) are 10%, 5%, and 1%, respectively. z-statistic in [ ].

The empirical results provide some interesting contributions. Firstly, the *Gov* and *Risk* exhibit a positive correlation and are statistically significant at 1%, 5%, and 10% with the GMM methods. As a higher value of *RISK* implies lower risk-taking behavior, this indicates that high state ownership (proxied by *Gov*) is associated with less risk-taking activity. This finding is consistent with previous studies, which also suggest that increased state ownership reduces corporate risk appetite (Vo 2018; Khaw et al. 2016; Boubakri et al. 2013). Uddin (2016) mentioned that the government also has political and social interests, such as in controlling the employment rate, ensuring social stability, and pursuing political and economic benefits related to increasing government income from dividends and corporate taxes. Thus, if economic objectives and even political targets are the priority in the long-term, the government may actively support SOEs; hence, there will be an increase in risky behavior by SOEs. However, agency problems may arise in this situation as the government has to deal with other shareholders to develop a governance mechanism that is deemed appropriate to the interests of different groups of shareholders (Sur et al. 2013). This is an uneasy situation; hence, whether or not the state ownership increases risky behavior is unclear, as major shareholders' interests ultimately determine corporate risk-taking behavior. Based on these arguments, this study examines the non-linear relationship between state ownership and risk-taking, presented in Table 4 as follows.

**Table 4.** Non-linear relationship between state ownership and corporate risk-taking behavior.

Variable	<i>RISK<sub>ROA</sub></i>		<i>RISK<sub>ROE</sub></i>	
	2-Steps Diff-GMM	2-Steps Sys-GMM	2-Steps Diff-GMM	2-Steps Sys-GMM
Lag of	4.757 **	9.148 ***	2.171 **	3.461 ***
profitability	[1.87]	[3.44]	[2.32]	[2.86]
Gov	11.253 **	19.934 ***	12.018 **	24.520 ***
	[2.03]	[2.94]	[2.34]	[3.61]
Gov <sup>2</sup>	-14.064 **	-20.476 **	-13.842 **	-26.680 ***
	[-1.96]	[-2.15]	[-2.03]	[-2.71]
Size	-0.753	0.228	-0.567	0.123
	[-1.59]	[0.55]	[-1.61]	[0.29]
Fixed	-4.848 ***	-4.529 ***	-3.748 ***	-3.893 ***
	[-3.55]	[-2.91]	[-3.32]	[-2.65]
Debt	-2.052 ***	-2.679 ***	-2.315 ***	-2.979 ***
	[-3.58]	[-3.75]	[-3.83]	[-3.44]
Growth	1.418 ***	1.382 ***	1.325 ***	1.210 ***
	[5.87]	[4.39]	[5.32]	[3.45]

AR (1) test (p-value)	0.000	0.000	0.000	0.000
AR (2) test (p-value)	0.625	0.585	0.793	0.799
Sargan test (p-value)	0.874	0.938	0.845	0.872
Hansen test (p-value)	0.799	0.902	0.965	0.946
Num. IV	40	62	40	62
Groups	501	501	501	501
Gov ( $\varsigma$ )	0.400	0.487	0.434	0.456

Note: (\*), (\*\*), and (\*\*\*) are 10%, 5%, and 1%, respectively. z-statistic in [ ].

The results from the GMM methods show a clearer non-linear relationship between state ownership and corporate risk-taking. In particular, the coefficient of  $Gov$ ,  $\beta_3$  is positive, whereas the coefficients of  $Gov^2$ ,  $\beta_4$  are negative and significant at the 5% and 10% levels, respectively. The thresholds ( $\varsigma$ ) for state ownership obtained from Equation (3) range from 40% to 48%. This result implies that for SOEs with minor government holdings, the principal-principal conflicts between minority shareholders and controlling shareholders is more serious due to the pressure from minority shareholders, who have political and economic interests, and majority shareholders, who require a higher yield and profitability. Therefore, SOE managers tend to be more prudent in risk-taking to avoid earnings uncertainty (Uddin 2016; Boubakri et al. 2013). On the contrary, if the government plays the role of the majority shareholder, it may encourage SOEs to take on risky projects for the economy, which may only be done by SOEs due to their importance and financial capability. Additionally, these SOEs generally receive greater government support in accessing finance and resources to cope with uncertain risks from the market (Zhai et al. 2015; Farag and Mallin 2016).

Tables 3 and 4 also provide results that can shed light on the risk-taking behavior of Vietnamese corporates. Firstly, profitability is found to have a significant reversal of impact on risky behavior in all equations. They illustrate that managers refuse to accept more risky behavior if the target profitability increases. Another explanation is that managers are rewarded based on the profits of the company's operations; they prefer a stable income with low-risk decisions. This study also provides reliable estimates of the impact of short-term debt rates and the degree of the use of fixed assets that promotes the corporate's risk appetite, with 1% statistical significance. Businesses may be more risk-taking in the search for more profitable projects for debt repayments, primarily short-term debts. Similarly, an increase in fixed assets requires businesses to look for more projects to improve the earnings of their assets, leading to higher risk appetite. Secondly, the level of corporate performance in the previous period is negatively related to the level of risk tolerance in this period. Greater efficiency is associated with higher cash flow, hence less risk-taking in this period. Finally, it is expected that firm size has a relationship with risk acceptance, but the empirical results are not precise and consistent. These findings are relevant for shareholders in monitoring their corporates to avoid agency problems and improve corporate performance.

#### 5.4. Robustness Test

In this section, this study examines the robustness of empirical results, according to Equation (4). Based on the thresholds of  $Gov$  ( $\varsigma$ ) presented in Table 4, this study separates the level of state ownership into two regimes: higher and lower than the threshold. According to the literature review, this study assumes that a high level of state ownership increases corporate risk-taking behavior. In other words,  $Gov$  ( $\varsigma$ ) has a negative relationship with the  $Z$ -score and vice versa. Using GMM methods, we found consistent results, which are presented in Table 5.

**Table 5.** Relationship between state ownership and corporate risk-taking behavior

Variable	<i>RISK<sub>ROA</sub></i>		<i>RISK<sub>ROA</sub></i>		<i>RISK<sub>ROE</sub></i>		<i>RISK<sub>ROE</sub></i>	
	2-Steps Diff-GMM	2-Steps Diff-GMM	2-Steps Sys-GMM	2-Steps Sys-GMM	2-Steps Diff-GMM	2-Steps Diff-GMM	2-Steps Sys-GMM	2-Steps Sys-GMM
Lag of profitability	5.314 ** [2.15]	5.619 ** [2.23]	10.032 *** [3.58]	10.412 *** [3.25]	2.039 ** [2.11]	2.026 ** [2.10]	3.876 *** [2.80]	3.512 *** [2.65]
Gov	7.434 ** [2.01]	2.753 * [1.71]	13.661 *** [3.00]	8.570 *** [4.40]	9.792 *** [2.65]	3.667 ** [2.30]	16.515 *** [3.11]	8.188 *** [4.65]
Gov ≥ ( $\varsigma$ )	−4.861 * [−1.87]		−6.367 * [−1.75]		−6.089 ** [−2.21]		−8.282 ** [−1.93]	
Gov < ( $\varsigma$ )		4.153 * [1.66]		9.138 ** [2.13]		6.043 ** [2.19]		9.391 ** [2.29]
Size	−0.686 [−1.47]	−0.515 [−1.31]	0.412 [1.02]	0.606 [1.29]	−0.565 [−1.57]	−0.569 [−1.63]	0.155 [0.37]	0.188 [0.46]
Fixed	−4.371 *** [−3.42]	−3.884 *** [−3.32]	−3.745 ** [−2.50]	−3.789 ** [−2.37]	−3.329 *** [−3.13]	−3.297 *** [−3.08]	−3.408 *** [−2.23]	−2.940 *** [−2.11]
Debt	−1.813 *** [−3.30]	−1.779 *** [−3.30]	−2.559 *** [−3.48]	−2.996 *** [−2.96]	−2.165 *** [−3.60]	−2.189 *** [−3.60]	−2.698 *** [−3.12]	−2.826 *** [−3.22]
Growth	1.385 *** [5.89]	1.417 *** [6.14]	1.291 *** [4.18]	1.152 *** [2.87]	1.316 *** [5.37]	1.321 *** [5.35]	1.193 *** [3.41]	1.187 *** [3.49]
AR (1) test ( <i>p</i> -value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR (2) test ( <i>p</i> -value)	0.712	0.739	0.587	0.375	0.939	0.945	0.686	0.896
Sargan test ( <i>p</i> -value)	0.848	0.927	0.926	0.897	0.846	0.886	0.807	0.873
Hansen test ( <i>p</i> -value)	0.780	0.933	0.893	0.856	0.981	0.989	0.862	0.962
Num. IV	41	52	42	26	60	61	54	62
Groups	501	501	501	501	501	501	501	501
Gov ( $\varsigma$ )	0.400	0.400	0.487	0.487	0.434	0.434	0.456	0.456

Note: (\*), (\*\*), and (\*\*\*) are 10%, 5%, and 1%, respectively and z-statistic in [].

The results from robust tests show that state ownership tends to reduce corporate risk-taking appetite. However, when state ownership exceeds the threshold ( $\zeta$  is approximately 40%), it tends to increase risk-taking behavior (significant at 5% and 10%) and vice versa. These results are consistent for both *Risk<sub>KROA</sub>* and *Risk<sub>KROE</sub>*, confirming that state ownership has a significant impact on the level of corporate risk tolerance. In addition, for other factors such as *Fixed*, *Debt*, and *Growth* is consistently found statistical significance in empirical models.

## 6. Discussion

As discussed in the literature review, a decrease in risk-taking acceptance yields a serious agency problem that interferes with political connections. The serious agency problem forces internal managers to take less risky behavior to seize opportunities for entrenchment and benefits, which is met by outside shareholder costs (Uddin 2016). State connection forces SOEs to ensure stability for social goals rather than seeking risky projects to get higher profitability (Boubakri et al. 2013). Additionally, SOEs with state ownership have advantages in accessing information, financial resources, and state support through their political connections (Vo 2018). Indeed, our results show that SOEs have little incentive to engage in any risk-taking activity to gain a competitive position. Another reason is that SOE managers, who are generally appointed by the state, often face difficulties in corporate governance because of excessive control from the state and a lack of business management skills (Lin et al. 2009). They, therefore, hesitate to engage in any risky activity.

On the other hand, according to the theory of resource dependence, links to external sources are a coping mechanism to reduce risk and uncertainty (Pfeffer and Salancik 1978). Government policy and regulation are major forces in the external resources (Hillman et al. 1999), and they change the decision-making on any risk-taking behavior for corporates. In our case, the high state ownership in the SOEs reflects the role of SOEs in the market and economy as strategic corporates. Thus, these entities have available resources from the government to promote risky activities to achieve profitable investments and get better trading strategies under uncertainties (Zhai et al. 2015; Farag and Mallin 2016), a condition that can discourage other common enterprises.

Our empirical findings contribute to the literature on the ownership structure's operating and monitoring to avoid agency issues and get better investment and trading strategies. The agency problem has existed and is continuously controversial in transition economies where the state has significant shares in enterprises, and investor protection is often weaker than in developed countries (Vo 2018). Chen et al. (2013) use transaction costs and agency theory to propose that ownership structure provides an important mechanism to realize the necessary resources for innovation and competition in the context of emerging markets, thereby affecting the risk appetite of the corporates. Although risk-taking behavior is important for achieving a better trade and investment strategy (Faccio et al. 2011), state ownership relationships reduce the firm's craving for risk through conservatives, social goals, and government support. On the other hand, Su et al. (2016) suggest that a strong incentive for corporates to minimize their risk-taking activities is to protect the dominant shareholders' benefits. Similarly, Nguyen et al. (2019) show that lower than 25% or higher than 75% state ownership will yield positive effects on corporate performance in Vietnam, while it is negatively impacted by the level of state ownership between 25% and 75%. Our results, once again, support the importance of ownership restructuring as an important mechanism to enhance accountability and create incentives for corporate governance.

## 7. Conclusions

The sustainability of corporates differs because their ability to respond to uncertain economic conditions is different. Due to the uncertainty of the economic situation, corporates taking high risks may have higher agency costs, resulting in a negative impact on their sustainable development, investment, and trading strategy. The deviation in corporate profitability is a crucial representation of risk-taking behavior in order to seek profit, carry on their investment, and alter their trading strategy, while state ownership is considered as a competitive advantage, connecting the long-term

business objectives and stakeholder expectations that relate to corporate sustainability, investment, and trading strategy, especially in the context of transforming economies. On the one hand, through the political connection, state ownership ensures corporate objectives which serve as the foundation for ensuring sustainable and steady development. On the other hand, it also creates an agency problem that can lead to an imbalance of interests of stakeholders, seriously affecting the sustainability, investment, and trading strategy of the firms. The influence of a state relationship can promote risky behaviors of firms, thereby shifting the costs of the stakeholder's sustainability into risky investments for the benefits of majority shareholders. Thus, the relationship between risk-taking behavior and state ownership is an exciting topic, especially in transition economies such as Vietnam. On the other hand, Vietnam is undergoing a robust privatization process with a shift in ownership structure from the state to the private sector, which is expected to boost economic growth as well as market development. The state still owns strategic and important corporates to maintain its dominant role in the socialist-oriented market. Therefore, insights into the role of state ownership help to promote radical reforms and policies to facilitate the development of corporates and the economy.

This study sheds light on the relationship between state ownership and the risk-taking behavior of corporates in Vietnam. Employing the GMM method on data of 501 listed corporates from 2007 to 2015, this study found substantial evidence for the negative impacts of state ownership on the risk-taking behavior of corporates. Firstly, the study provides evidence that state ownership reduces corporate risk-taking behavior. This result shows that state-owned corporates are controlled to ensure stability instead of taking risks for higher profits. This may be because SOEs already have competitive advantages and resources available; therefore, managers have no incentive to take the risk and choose a trading strategy having less risk. Moreover, according to the theory of the agency problem, SOE managers are often appointed by the state, and they are more interested in social-political objectives than activities that promote profits, get better investment opportunities, and obtain a better trading strategy for the corporate. It, therefore, improves the corporate image to the public and provides a competitive advantage in uncertain economic conditions. Secondly, the results show that political connections are a double-edged sword, as SOEs with stronger political connections may be more risk-taking and make investments and take trading strategies having higher risk but getting higher profit. The study also shows that state ownership has a U-shaped nonlinear relationship with the corporate's risk-taking and investment behavior. When the state is the majority shareholder, the SOE managers are under higher pressure for achieving economic objectives. This causes serious agency problems because higher economic pressure translates the interests of stakeholders into more risky investments and trading strategies for the majority shareholder's goals. The study highlights the need to develop an effective monitoring mechanism as well as corporate governance for SOEs. This is clear and relevant in the context of the transition economy when the state is promoting the equitization process. It leads to policy recommendations on the level of state ownership, which should include involvement in strategic or non-strategic corporates. Finally, the study also finds that an increase in corporate efficiency and growth of revenue would reduce corporate risk-taking behavior and investment activity, while an increase in debt and fixed assets would put pressure on corporates to implement more risk-taking behavior and investment. The results contribute to existing theories of corporate governance in the context of the socialist-oriented markets.

This is in line with the context of Vietnam with the presence of the weak and uncertain environment and the significant role of the government in accessing financial and business resources (Luo et al. 2017). In addition, state ownership may lead to a dependence of corporates on state support instead of actively innovating and making excellent investments to increase competitiveness. It might be suitable for SOEs in the early stages of development, but it may cause inequality in competition, leading to the crowding out of the private enterprises in the long-term (Van Thang and Freeman 2009). However, the extensive results show that the role of state ownership depends on the level of ownership; it can have a U-shape relationship with corporate risk-taking investment. Accordingly, if state ownership is the majority, the government can require SOEs to

undertake important and risky projects for economic goals. Vo (2018) noted that risk-taking is of importance for the development of a corporate since it allows businesses to gain competitive advantage and innovation.

Therefore, this study provides some practical implications. First, the government should clearly define strategic and non-strategic businesses and restrict their investment and trading strategies. State ownership in non-strategic businesses not only limits incentives for finding corporate profits, investment, and trading strategies but also causes serious agency problems. As a result, privatization is an important strategy to promote the development of corporates in transition economies, especially small and medium private firms. Second, this study also supports the role of the government in holding strategic businesses. With support from the government, SOE managers can promote corporate activities to gain a dominant position in the socialist-oriented economy without hesitation about risky situations and investment. This not only offers a competitive advantage to strategic businesses but also facilitates innovation among businesses, thereby boosting sustainable development and getting better investment and trading strategies.

This study also has some limitations. Although the main relationship between state ownership and risk-taking has been demonstrated, there are still potential factors that influence this relationship, such as monitoring roles, the business environment, and economic crisis. Therefore, future studies should expand the analytical framework for a comprehensive view. Furthermore, although the validity and reliability of the data have been determined, the number and time of data should be improved in subsequent studies to ensure robustness and avoid possible bias. Finally, this paper studies the profitability and risk-taking behavior in investment and trading strategies for state-owned enterprises. An extension of our paper could study other behaviors, other investments, and other trading strategies. This could include an extension of Tobin (1958), Pratt (1964), Kogan and Wallach (1964), Slovic (1964), Wong and Li (1999), Li and Wong (1999), Wong (2006, 2007), Wong and Ma (2007), Qiao et al. (2013), Guo and Wong (2019), and many others to study other types of risk-loving behavior; of Wong and Chan (2008), Lean et al. (2010), Qiao et al. (2012), Clark et al. (2015), and others to study a mixture of both risk-averse and risk-loving behavior; of Egozcue et al. (2015), Guo et al. (2017b), and Guo and Wong (2019) to study regret-aversion behavior; of Guo et al. (2020) to include the behavior of disappointment; of Munkh-Ulzii et al. (2018) to study herding behavior; and of Guo et al. (2017a), Chan et al. (2019), and Wong and Qiao (2020) to use other types of utility functions to study the behavior of risk loving. Scholars could also extend Lean et al. (2007), Chiang et al. (2008), Qiao and Wong (2015), Tsang et al. (2016), Guo et al. (2017b), and others to examine the existence of any arbitrage opportunity; extend Abid et al. (2014), Wong et al. (2008, 2018), Li et al. (2018), and others to study other investment behaviors; and extend Wong et al. (2001, 2003), Lam et al. (2007), Lam et al. (2010, 2012), Kung and Wong (2009a, 2009b), Egozcue and Wong (2010), Egozcue et al. (2011), Lean et al. (2012), Chan et al. (2012, 2014), Fabozzi et al. (2013), Hoang et al. (2015a, 2015b), Lozza et al. (2018), Lu et al. (2018), Hoang et al. (2019), and Guo et al. (2020) to study different trading strategies. In addition, academics and practitioners could extend Liao and Wong (2008), Liao et al. (2012, 2014), Moslehpour et al. (2017), Moslehpour et al. (2018a, 2018b) to study marketing behavior; extend Moslehpour et al. (2018a) to study management behavior; extend Mou et al. (2018) and Pham et al. (2018) to study corporate behavior; and extend Thompson and Wong (1991, 1996), Fung et al. (2011), Wong and Chan (2006), Xu et al. (2017), and Ly et al. (2019a, 2019b) to study the handling of risk. There is much other work studying behavior, investment, and trading strategy. Readers may refer to Chang et al. (2018) and Woo et al. (2020) for more information.

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