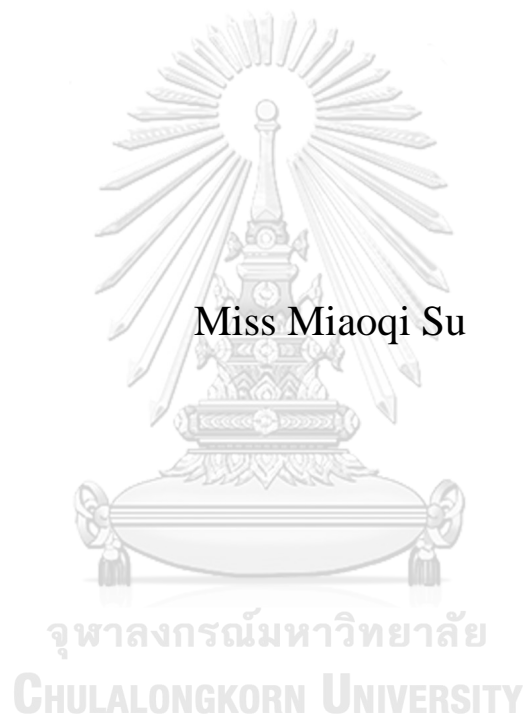


Corporate diversification and stock risk in Thailand: Evidence
from a global shock



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An Independent Study Submitted in Partial Fulfillment of the
Requirements
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Department of Banking and Finance
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การกระจายความเสี่ยงทางธุรกิจและความเสี่ยงหุ้นสามัญในประเทศไทย หลักฐานจากผลกระทบ
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Miaoqi Su : Corporate diversification and stock risk in Thailand: Evidence from a global shock. Advisor: Asst. Prof. Dr. SUPARATANA TANTHANONGSAKKUN, Ph.D.

The objective of this paper is to investigate the impact of corporate diversification on stock risk for 345 companies listed on Stock Exchange of Thailand during the sample period from 4 January 2017 to 30 December 2021 which covers both Covid and pre-Covid period. Furthermore, the differences in effect between Covid and pre-Covid period are also studied.

The result shows that diversifying through only business segments and ignoring global diversification increases stock volatility. Furthermore, it also shows that diversifying through only business segments and ignoring global diversification increases stock volatility during the Covid period compared to pre-Covid period. The result is consistent with findings of Onali and Mascia (2022) who study US companies. However, there is no significant relationship found between only global diversification and stock volatility during the whole sample period as well as the Covid period.

The ability of companies in alleviating the impact of such global shocks that could affect different geographical regions in different time periods might be if they depend only on business segment diversification. The profitability of the companies also affected the most if they only consider diversifying through business segment during pandemic. Similar to the case of US, the coinsurance effect of diversifying by business segments might not benefit investors in Thailand, as it might be done quite easily by investing in stocks of firms operate in different industries.

จุฬาลงกรณ์มหาวิทยาลัย
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1. INTRODUCTION

1.1. Background

The literatures on corporate diversification can be divided into two major topics: the changes in firm value through diversification, and managers' private benefits cause by diversification activities. The literatures discuss the benefits of diversification in general as early as 1970s. Chandler (1977) finds a greater efficiency operationally in multi-segmental firms (Chandler, 1977). On the other hand, there are also literatures focus on the costs related to corporate diversification. Stultz (1990) and Rajan et al., (2000) suggest that inefficient resource allocations and investments result in decreasing firm value. Furthermore, there are papers discuss managers' private benefits caused by diversification activities (Rajan et al., 2000; Stultz, 1990). Jensen (1986) shows that managers of companies that have substantial extra cash flows as well as borrowing capacity, tend to invest in low profit investment or even projects that destroy company value. They aim to control more resources and establish greater power (Jensen, 1986).

The past literature has been unsuccessful in achieving mutual understanding about the relationship between stock risk and corporate diversification (Hund et al., 2010; Mammen et al., 2021; Mansi & Reeb, 2002). Denis et al. (2002) mentioned that different categories of diversification might be crucial in the discussion (Denis et al., 2002). The literature examines firms that adopted both business and global diversification simultaneously, and it further suggests that global and business diversifications are not the same (Denis et al., 2002). As a result, Onali and Mascia (2022) focus their study on companies in USA that adopt in only single category of corporate diversification to disentangled their effects, namely global diversification and business diversification. They have also extended the usual cases by exploiting an economy wide shock, in particular the coronavirus pandemic (Onali & Mascia, 2022). Since investor perceptions, national cultures and market conditions differ between developing and developed countries, in this paper, I further extend their work by studying the topic in an emerging country, Thailand.

While most of the papers focus on companies in the developed countries such as USA, the market and economic conditions are very different for emerging countries such as Thailand. Stock markets in different environment could react differently towards the outbreak. Patel and Sarkar (1998) provide a strong motivation for research to be pointed particularly towards developing countries. Their paper covers the period from 1970 to 1997 with 9 crises involved. The results show that crises in developed market have turned out to be less severe over time, but this did not happen to developing stock markets (Patel & Sarkar, 1998). Furthermore, Bakry et al. (2022) observe that investors interpret risk very differently between developed and emerging markets whenever there are additional confirmed cases, recovery cases, death cases, as well as new measures implemented by the governments (Bakry et al., 2022). This also motivates the need to research on emerging stock market.

The following important differences between developed countries and developing countries such as Thailand during pandemic are explored to show that stock market of Thailand would react differently post-shock.

Firstly, investors in emerging markets are less confident in reported daily confirmed number of cases as well as efficacy of measures implemented by government with frail governance as compared to developed markets (Uddin et al., 2021). Researches also find significant and positive impact of death rate on volatility of stock only in developing countries (Bakry et al., 2022; Harjoto et al., 2021). There is an intensified risk perception of these investors when death rate increases during the outbreak. Furthermore, volatility found to be lowered only in emerging markets when recovery rates increased (Bakry et al., 2022).

Secondly, national culture is different between developing and developed countries. Bakry et al. (2022) compared the median uncertainty avoidance scores and individualism scores of the two types of markets. They find that emerging markets have higher uncertainty avoidance score and lower individualism scores (Bakry et al., 2022). The result aligns with Fernandez et al. (2021). These characteristics possessed by emerging markets are linked to the higher stock volatility (Fernandez-Perez et al., 2021).

Higher uncertainty avoidance also explains why investors in emerging markets are getting more concerned about rising death rates (Ashraf, 2021).

Thirdly, investors perceive risk differently towards government actions during COVID-19 in developing countries. Bakry et al. (2022) show a positive and significant connection between volatility of stock and stringent interventions by government of developing countries, however, yield opposite outcome for developed markets (Bakry et al., 2022). The finding derived from emerging markets reflects them having a greater sensitivity to adverse events happen in the economy. Other reasons suggested by Engelhardt et al., (2021) are the low trustworthiness in governments' actions during the crisis and citizens in the countries following orders of the government in emerging markets (Engelhardt et al., 2021).

Lastly, volatility of both types of markets respond differently to variations in the sub-indices representing the Stringency Index (Bakry et al., 2022). In emerging markets, measures such as international travel restrictions, office and school closures produce a significantly positive relationship with stock volatility. However, none of these shows any positive relationship with stock volatility in the developed market. Neaime, (2016) concludes that the amplified risk sensitivity of emerging markets indicate markets' vulnerabilities during crisis (Neaime, 2016). This could be due to the weak structure as well as the importance of investors herding behaviour in these markets during economic downturn (Demirer et al., 2010).

Thus, I examined relationship between stock risk and corporate diversification by comparing the stock risk of firms that focus only on business or global diversification and ignore global or business diversification to that of firms that adopt both or different or no diversifications during the whole sample period from 2017 to 2021 in Thailand. Denis et al. (2002) examines firms that adopted both business and global diversification simultaneously, and it further suggests that global and business diversifications are not the same, different categories of diversification might be playing a crucial role in why the past literature has failed to reach consensus about the relationship between stock risk and corporate diversification (Denis et al., 2002). Therefore, I focus on companies

adopt only single diversification, similar to Onali and Mascia (2022). I also narrow down to the period from early 2020 when the COVID-19 pandemic outbreak has just started until 31 December 2021. The sample period is extended to 5 years from 2017 to 2021 as COVID-19 has been ongoing for 3 years. Since this was a widely unexpected outbreak which had created chaos on the international market, it is unlikely for firms to react and make changes to their diversification strategies (Kuppuswamy & Villalonga, 2016). As a result, this paper features pandemic shock by adopting a difference-in-differences approach, just like Onali and Mascia (2022) who adapted their methodology from (Albuquerque et al., 2020) .

There are three reasons to conduct the study in Thailand. Firstly, there are literatures studying the relationship between company value and corporate diversification in Thailand and the results are not conclusive. Akben Selçuk (2015) conducts research on nine developing countries including Thailand from 2005 to 2010. The evidence shows that companies operate in single business segment are sold at discount as compared to diversified companies, consistent with diversification premium idea (Akben Selçuk, 2015) . However, Charoenwong et al., (2011) who studies this relationship in Thailand during the Asian Financial Crisis find that, on average, Stock Exchange of Thailand (SET) listed firms experience value destruction for at least 10% through corporate diversification (Charoenwong et al., 2011). Secondly, Panyagometh (2020) demonstrates that market volatility in the SET was substantially higher during COVID-19 (Panyagometh, 2020). The research investigates 46 stocks listed on SET and examines the impact of this pandemic outbreak on them via an event study technique and find out how the price reacts as well as market volatility. The results shows that these stocks have been negatively impacted by the outbreak of this global pandemic, however, stocks in different businesses have shown different price reactions (Panyagometh, 2020). Some of them may have benefitted from the pandemic (Panyagometh, 2020). Lastly, Thailand is one of major emerging market countries in Asia.

1.2. Significance of the problem

This is an important research because determining whether corporate diversifications increase or decrease stock risk after an unanticipated global shock is challenging. Furthermore, different categories of corporate diversification (business-segment or international sales diversification) can result in different economic outcomes. A reduce in demand in a business segment (or a country) could be compensated by a rise in demand in the other business segments (or countries) for both categories of diversification. However, there are also differences in them. Investors may find global diversification more valuable than business diversification because of the high barriers of entries to trade in foreign stock markets. Therefore, it is important to study this relationship as it may help investors in making investment decisions especially with a widespread global shock. The COVID-19 pandemic has caused damage to the middle-class households and the poor alike. It led to widespread job losses. While Thailand has been effective in controlling the COVID-19 cases from April to June, the economic impact has been severe (WorldBank, 2020).

1.3. Objectives

- To investigate whether firms that focus only on business or global diversification and ignore global or business diversification would have lower or higher risk compared to firms that adopt both or different or no diversifications during the sample period from 2017 to 2021.
- To investigate whether firms that focus only on business or global diversification and ignore global or business diversification would have lower or higher risk after an unanticipated global shock (Covid-19 pandemic outbreak) than pre-Covid period, compared to firms that adopt both or different or no diversifications.

1.4. Research hypotheses

H1: Firms that focus only on business diversification and ignore global diversification would have lower risk compared to firms that adopt both or different or no diversifications during the whole sample period.

Firm risk is expected to be lower for firms that focus only on business diversification and ignore global diversification during the sample period from 2017 to 2021 because business diversification allows firms to make good use of existing resources to grow customer base in their new segments (Mammen et al., 2021). Firms could also avoid the potential political, compliance and currency risks that it may face when diversifying globally. Furthermore, since this is a period involving crisis and has caused a sudden collapse of international trade, firms spread their operations globally or geographically can be potentially damaged by the crisis. For instances, suppliers or customers of companies in nations that are more adversely affected by the COVID-19 epidemic, their stock returns are mostly impacted (Ding et al., 2021). Furthermore, US companies with exposure to China suffered negative return from 2 January to 21 February 2020, but gradually improved after 24 February 2020 (Ramelli & Wagner, 2020).

H2: Firms that focus only on business diversification and ignore global diversification would have lower risk during the Covid period than pre-Covid period, compared to firms that adopt both or different or no diversifications.

Firm risk is expected to be lower for firms that focus only on business diversification and ignore global diversification during COVID-19 pandemic outbreak compared to pre-Covid period because firms can allot resources acquired in new segments to the most productive segments to maximize profit. Panyagometh (2020) studies selected number of stocks listed on SET. The results show that these stocks have been negatively impacted by the outbreak of this global pandemic, however, stocks in different businesses have shown different price reactions. Some of them may have benefitted from the pandemic (Panyagometh, 2020). Furthermore, firm risk might be reduced as profits from global diversification are ignored, since such profit is sensitive towards global shocks (Fillat & Garetto, 2015).

H3: Firms that focus only on global diversification and ignore business diversification would have higher risk compared to firms that adopt both or different or no diversifications during the whole sample period.

Firm risk is expected to be higher for firms that focus only on global diversification and ignore business diversification during the sample period from 2017 to 2021 because the cost of entry is usually large. Firms are likely to exit the market with huge losses. Another possible reason is the complexity in managing international activities since there are cultural differences, regulation differences and business practices differences. This is aligned with Mammen et al. (2021) that international diversification exacerbates stock return volatility (Mammen et al., 2021). Firms should not ignore business diversification as it allows firms to make good use of existing resources to grow customer base in their new segments (Mammen et al., 2021).

H4: Firms that focus only on global diversification and ignore business diversification would have higher risk during the Covid period than pre-Covid period, compared to firms that adopt both or different or no diversifications.

Firm risk is expected to be higher for firms that focus only on global diversification and ignore business diversification during COVID-19 pandemic outbreak compared to pre-Covid period because the profits from diversifying globally are sensitive towards global shocks (Fillat & Garetto, 2015). This is aligned with the perspective that globally diversified firms exhibit higher risk (Fillat & Garetto, 2015).

2. LITERATURE REVIEW

2.1. Relationship between stock risk and corporate diversification

As mentioned in the introduction, there are a few literatures in the past discussed the relationship between stock risk and corporate diversification, but yet to arrive at a distinct conclusion (Hund et al., 2010; Mammen et al., 2021; Mansi & Reeb, 2002). Denis et al. (2002) mentioned that different categories of diversification might be crucial in the discussion (Denis et al., 2002). The literature examines firms that adopted both business and global diversification simultaneously, and it further suggests that global and business diversifications are not the same (Denis et al., 2002). As a result, Onali and Mascia (2022) focus their study on companies that adopt in only single category of corporate diversification to disentangled their effects. They have gone

through a robust and comprehensive stream of literatures that exhibit contrasting empirical and theoretical results on whether global (geographic) and/or business (industrial) diversification mitigates or intensifies stock risk (Onali & Mascia, 2022). This is still an ongoing debate.

There are several literatures study relationship between company value and corporate diversification for the emerging markets. Akben Selcuk (2015) conducts research on nine developing countries including Thailand from 2005 to 2010. The evidence shows that companies operate in single business segment are sold at discount as compared to diversified companies, consistent with diversification premium idea (Akben Selçuk, 2015). However, Charoenwong et al., (2011) who studies this relationship in Thailand during the Asian Financial Crisis find that, on average, Stock Exchange of Thailand (SET) listed firms experience value destruction for at least 10% through corporate diversification (Charoenwong et al., 2011).

For the recent pandemic, Panyagometh (2020) studies the impact of COVID-19 on 46 stocks listed on SET and find out how the price reacts as well as market volatility via an event study technique. The results shows that these stocks have been negatively impacted by the outbreak of this global pandemic, however, stocks in different businesses have shown different price reactions (Panyagometh, 2020). Some of them may have benefitted from the pandemic (Panyagometh, 2020). This literature further demonstrates that market volatility in the SET was substantially higher during COVID-19 (Panyagometh, 2020).

Different from the previous papers, Onali and Mascia (2022) are the first to present global diversification absorbs stock risk when there is a negative shock in economy – COVID-19 (Onali & Mascia, 2022). This pandemic has caused a sudden collapse of international trade. It is possible that the nature of this crisis is potentially damaging to firms that spread their operations globally or geographically. For instances, suppliers or customers of companies in nations that are more adversely affected by the COVID-19 epidemic, their stock returns are mostly impacted (Ding et al., 2021). Furthermore, US companies with exposure to China suffered negative return from 2 January to 21 February 2020, but gradually improved after 24 February 2020 (Ramelli & Wagner,

2020). However, interestingly, Onali and Mascia (2022) find out that companies with only global diversification have a lower level of increase in daily volatility after the outbreak, especially for those with above median Tobin's q and cash holding (Onali & Mascia, 2022). On the contrary, companies adopt only business segment diversification experienced a higher level of increase in daily volatility after the outbreak, especially for those with below median Tobin's q and cash holding (highly vulnerable to negative shocks) (Onali & Mascia, 2022).

2.2. Theory and concept differentiate business and global diversification

Firstly, according to Onali and Mascia (2022), companies with only business segment diversification usually have smaller Tobin's q as well as lower cash holding compared to focused companies (Onali & Mascia, 2022). This conclusion is not applicable for global diversification. Evidently, companies that globally diversified are more likely to keep cash during bad times and have an above median Tobin's q (Benkraiem et al., 2020; Chang & Wang, 2007). This is consistent with Onali and Mascia (2022) that companies adopt only global diversification are more likely to have larger Tobin's q as well as higher cash holding compared to focused companies (Onali & Mascia, 2022). Several literatures conclude that the implication of smaller Tobin's q is greater financial distress (John, 1993; Lindenberg & Ross, 1981; Opler et al., 1999). Similarly, amount of free cash could affect companies' capability in softening the damaging effect from pandemic, the more cash the better ability (Lins et al., 2010). Therefore, it is rationale to think that smaller Tobin's q as well as level of cash holding can potentially increase stock risk in the case of business diversified only companies, and the higher of the two items might decrease stock risk in the case of globally diversified only companies.

Secondly, align with "imperfect capital markets theory", global diversification enables US investors who want to purchase shares from other markets to exploit the low correlation between home country and foreign stock market returns, given the considerable entry barriers imposed on them (Gande et al., 2009). But such benefit does not cover business diversification. This is simply because there are no entry barriers for them on their own stock exchanges. Transaction costs are the same for acquiring shares of a company with only business diversification and a focused company on the US stock

exchange. Since these investors could diversify investment portfolios by purchasing shares from individual companies from various industries, business diversification become unattractive to them (Berger & Ofek, 1995; Dastidar, 2009).

3. SAMPLE AND DATA

I first study the sample period from 2017 to 2021 which covers both Covid and Non-Covid period. This allows us to have a general idea about how corporate diversification affect firm risk in a period involving crisis. Furthermore, we should extend the study period compared to the past literatures since this pandemic has been around for 3 years. It makes the result more relevant because Covid situation is very dynamic and it leads to changing of lifestyle and work pattern as people adapt and live with virus.

Second, I narrow down to COVID-19 period which covers from 2 March 2020 to 30 December 2021, in which 2 March 2020 was the first trading day after first death case was recorded in Thailand (BangkokPost, 2020). The starting point is selected based on first death case because investors in emerging markets are less confident in reported daily confirmed cases and researches also find significant and positive impact of death rate on the volatility of stock only for the developing countries (Bakry et al., 2022; Harjoto et al., 2021). There is an intensified risk perception of these investors when death rate increases during the outbreak. The ending point is the last trading day of 2021 at 30 December because the death rate in Thailand became less than 1% from there on as shown in Figure 1 (Worldometers, 2022) below.

Outcome of Cases (Recovery or Death) in Thailand

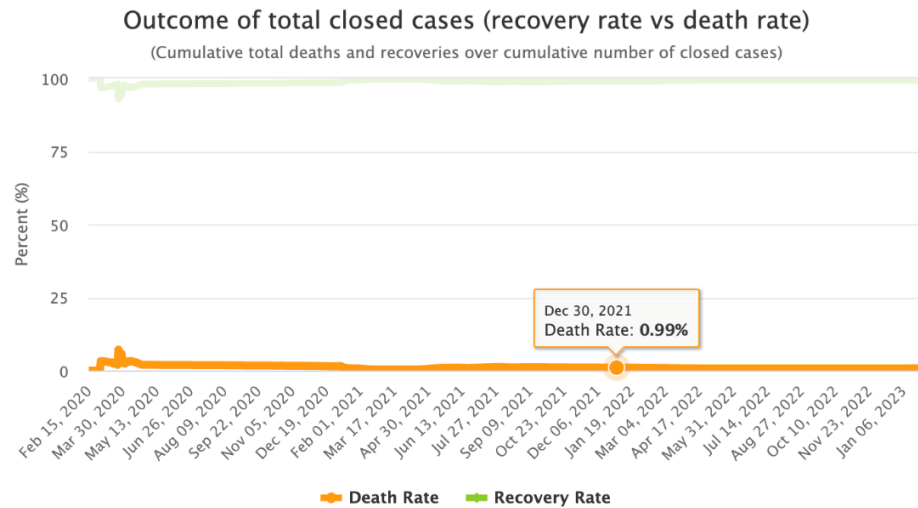


Figure 1: Outcome of Cases (Recovery or Death) in Thailand

First, all common stocks traded on the Stock Exchange of Thailand (SET) from 2017 to 2021 are considered except for firms from financial services industry (Colla et al., 2013; Onali & Mascia, 2022; Thomas, 2002), and firms without proper revenue breakdown or has been delisted. Daily stock price data are extracted from DataStream. Second, I use standard deviation of logarithmic daily returns over the quarter to derive quarterly stock volatility (Albuquerque et al., 2020). Logarithmic daily returns is calculated using formula $\ln(P_t/P_{t-1})$ where P refers to the closing price. Third, the final dataset are combined with the latest available accounting data in DataStream quarterly.

There are total 473 non-financial companies found in DataStream that were listed on SET throughout the required sample period from 2017 to 2021. Furthermore, 95 companies were dropped due to no proper revenue breakdown either in terms of business segment or geographical segment, and 33 companies were dropped due to missing data. As a result, final sample size is 345 companies.

The process of defining the companies' diversification types was done on a yearly basis for 5 years through reading company's annual report, form 56-1, financial statements and company data available in SETSMART, The Securities and Exchange Commission

(SEC), Thailand or company website from 2017 to 2021. The types of diversification adopted by companies are recorded each year to capture any changes in the way they diversify from year to year. Companies are defined as only globally-diversified if it has international sales (Abdi & Aulakh, 2018), and without reporting multiple segments revenue. Using international sales to identify global diversification firms is typical in literature (Wiersema & Bowen, 2011). According to Hund et al. (2010), companies are defined as only business-diversified if it reports revenue in multiple business segments, and without international sales (Hund et al., 2010). Reporting revenue in multiple business segments refer to companies operate in more than one industrial sectors (Hund et al., 2010). The classification of each industrial sectors is in Appendix 1 defined by the SET (StockExchangeofThailand, 2021).

Furthermore, government responses to COVID-19 outbreak including fiscal policies and other control measures have brought positive effects to the stock market in 28 countries (Liu et al., 2022). COVID-19 Government response index is used as a proxy to represent the variable FISCAL. This index records how the governments' response has changed over 23 indicators and becoming stronger or weaker over the course of the outbreak. The 23 indicators include policies such as Economic policies, Health system policies and Vaccine policies etc (UniversityOfOxford, 2022a). COVID-19 Government response index for Thailand is extracted from Oxford Covid-19 Government Response Tracker on a daily basis from 1 January 2020 to 30 December 2021 as shown in Figure 2 (UniversityOfOxford, 2022b). The period when index is greater than 50.00 is taken as FISCAL = 1, otherwise = 0.

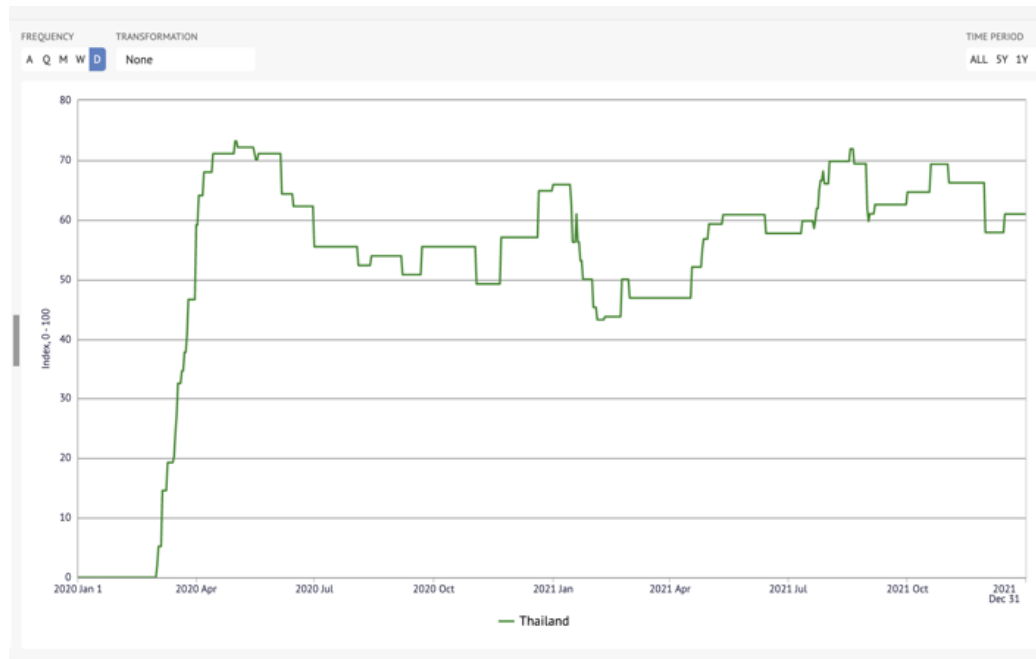


Figure 2: Oxford Covid-19 Government Response Tracker

4. METHODOLOGY

The main analysis adopts the difference-in-differences method. While Onali and Mascia (2022) run their regression using daily stock volatility, I use standard deviation of logarithmic daily returns over the quarter (Albuquerque et al., 2020). Logarithmic daily returns is calculated using formula $\ln(P_t/P_{t-1})$ where P refers to the closing price. Quarterly stock volatility is used instead of daily frequency because the sample period includes both the time before and during Covid outbreak (January 2017 to December 2021) while Onali and Mascia (2022) only studied the initial outbreak of the pandemic (January 2020 to March 2020).

According to Onali and Mascia (2022), control variables including Book-to-Market, Cash Holdings, Leverage, ROE and Size, dummy variables including COVID, FISCAL, Only Business and Only Global are used to run the regressions below and assess the effect of diversification (Onali & Mascia, 2022). Standard errors are grouped at both firm (i) and quarterly (t) level (Albuquerque et al., 2020).

Business Diversification and Risk:

To investigate whether firms that focus only on business diversification and ignore global diversification would have lower risk compared to firms that adopt both or different or no diversifications during the sample period from 2017 to 2021.

$$\begin{aligned} QuarterlyVol_{it} = & \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\ Holdings_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \\ & \beta_5 Size_{it} + \beta_6 Only\ Business_i + v_t + e_{it} \end{aligned} \quad (1)$$

Where i = each firm and t = the quarters

The coefficient of the term Only Business (β_6) is expected to be negative and significant. Firm risk is expected to be lower for firms that focus only on business diversification and ignore global diversification during the sample period from 2017 to 2021 because business diversification allows firms to make good use of existing resources to grow customer base in their new segments (Mammen et al., 2021). Firms could also avoid the potential political, compliance and currency risks that it may face when diversifying globally. Furthermore, since this is a period involving crisis and has caused a sudden collapse of international trade, firms spread their operations globally or geographically can be potentially damaged by the crisis. For instances, suppliers or customers of companies in nations that are more adversely affected by the COVID-19 epidemic, their stock returns are mostly impacted (Ding et al., 2021). Furthermore, US companies with exposure to China suffered negative return from 2 January to 21 February 2020, but gradually improved after 24 February 2020 (Ramelli & Wagner, 2020).

To examine Only Business diversification during Covid:

$$\begin{aligned} QuarterlyVol_{it} = & \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\ Holdings_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \\ & \beta_5 Size_{it} + \beta_6 Only\ Business_i + \beta_7 COVID_t * Only\ Business_i + \beta_8 FISCAL_t * Only\ Business_i + v_t \\ & + e_{it} \end{aligned} \quad (2)$$

Where i = each firm and t = the quarters

The coefficient of the term COVID*Only Business (β_7) is expected to be negative and significant. Firm risk is expected to be lower for firms that focus only on business diversification and ignore global diversification during COVID-19 pandemic outbreak compared to pre-Covid period because firms can allot resources acquired in new segments to the most productive segments to maximize profit. Panyagometh (2020) studies selected number of stocks listed on SET. The results shows that these stocks have been negatively impacted by the outbreak of this global pandemic, however, stocks in different businesses have shown different price reactions. Some of them may have benefitted from the pandemic (Panyagometh, 2020). Furthermore, firm risk might be reduced as profits from global diversification are ignored, since such profit is sensitive towards global shocks (Fillat & Garetto, 2015).

Global Diversification and Risk:

To investigate whether firms that focus only on global diversification and ignore business diversification would have higher risk compared to firms that adopt both or different or no diversifications during the sample period from 2017 to 2021.

$$QuarterlyVol_{it} = \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\text{ Holdings}_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \beta_5 Size_{it} + \beta_6 Only\text{ Global}_i + v_t + e_{it} \quad (3)$$

Where i = each firm and t = the quarters

The coefficient of the term Only Global (β_6) is expected to be negative and significant. Firm risk is expected to be higher for firms that focus only on global diversification and ignore business diversification during the sample period from 2017 to 2021 because the cost of entry is usually large. Firms are likely to exit the market with huge losses. Another possible reason is the complexity in managing international activities since there are cultural differences, regulation differences and business practices differences. This is aligned with Mammen et al. (2021) that international diversification exacerbates stock return volatility (Mammen et al., 2021). Firms should not ignore business diversification as it allows firms to make good use of existing resources to grow customer base in their new segments (Mammen et al., 2021).

To examine Only Global diversification during Covid:

$$QuarterlyVol_{it} = \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\ Holdings_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \beta_5 Size_{it} + \beta_6 Only\ Global_i + \beta_7 COVID_t * Only\ Global_i + \beta_8 FISCAL_t * Only\ Global_i + v_t + e_{it} \quad (4)$$

Where i = each firm and t = the quarters

The coefficient of the term COVID*Only Global (β_7) is expected to be positive and significant. Firm risk is expected to be higher for firms that focus only on global diversification and ignore business diversification during COVID-19 pandemic outbreak compared to pre-Covid period because the profits from diversifying globally are sensitive towards global shocks (Fillat & Garetto, 2015). This is aligned with the perspective that globally diversified firms exhibit higher risk (Fillat & Garetto, 2015).

Only include date fixed effect and exclude firm fixed effect because the control variables are time-invariant (Onali & Mascia, 2022).

- Date fixed effects (v_t): allow events that are unrelated to COVID-19 outbreak to occur during the study period.

Table 1: Summary of variables

Name	Type	Definition	Frequency
COVID	Dummy Variable	COVID equals to 1 from 2 March 2020 to 30 December 2021, and 0 otherwise	Not Applicable
FISCAL	Dummy Variable	FISCAL equals to 1 in periods when Government Response Index > 50.00, and 0 in periods when Government Response Index = < 50.00	Not Applicable
Only Business (time-invariant)	Dummy Variable	Only Business equals to 1 for companies engage only in business segment diversification (reports multiple segment revenue), but not globally diversified (without international sales), and 0 otherwise.	Not Applicable
Only Global (time-invariant)	Dummy Variable	Only Global equals to 1 for companies engage only in global diversification (with international sales), but not diversified into multiple business segments (does not report revenue for multiple segments), and 0 otherwise.	Not Applicable
Quarterly Volatility	Dependent Variable	Standard deviation of logarithmic daily returns ($\ln(P_t/P_{t-1})$) over the quarter, where P refers to the closing price.	Quarterly
Book-to-Market	Control Variable	Ratio of the book value of assets to the market value of assets (book value of assets minus book value of equity plus the market value of equity)	Quarterly
Cash Holdings	Control Variable	Ratio of cash to total assets	Quarterly
Leverage	Control Variable	Total long-term, short-term debt, then divide the sum by total assets	Quarterly

ROE	Control Variable	Return on Average Common Equity	Quarterly
Size	Control Variable	Natural logarithm of total assets	Quarterly

5. RESULTS AND DISCUSSIONS

5.1 Data Overview

After reading firms' annual report from 2017 to 2021 year by year, the classification of their corporate diversification type is done according to the criteria shown in Figure 3. When revenues are reported for multiple business segments without export activities and no business operations found overseas, this company would be grouped under "only business" diversification (Type A). When all revenues are derived from a single business segment, and either export activities or at least one business operation is found overseas with proper revenue reporting, this company would be grouped under "only global" diversification (Type B). When all revenues are derived from a single business segment without export activities and no business operations found overseas, this company would be grouped under "no diversification" (Type C). When revenues are reported for multiple business segments, and either export activities or at least one business operation is found overseas with proper revenue reporting, this company would be grouped under "diversify both business and global" (Type D). Moreover, the classification of each business segment is according to Appendix 1 defined by the SET.



Figure 3: Classification of Corporate Diversification

After the classification is done, an overview can be reported as follow. As shown in Figure 4, 37% of the 345 companies diversify through global diversification while only 18% of them diversify through business segments. On the other hand, 29% of the companies adopt no diversification at all, while 16% of them diversify through both global and business segments.

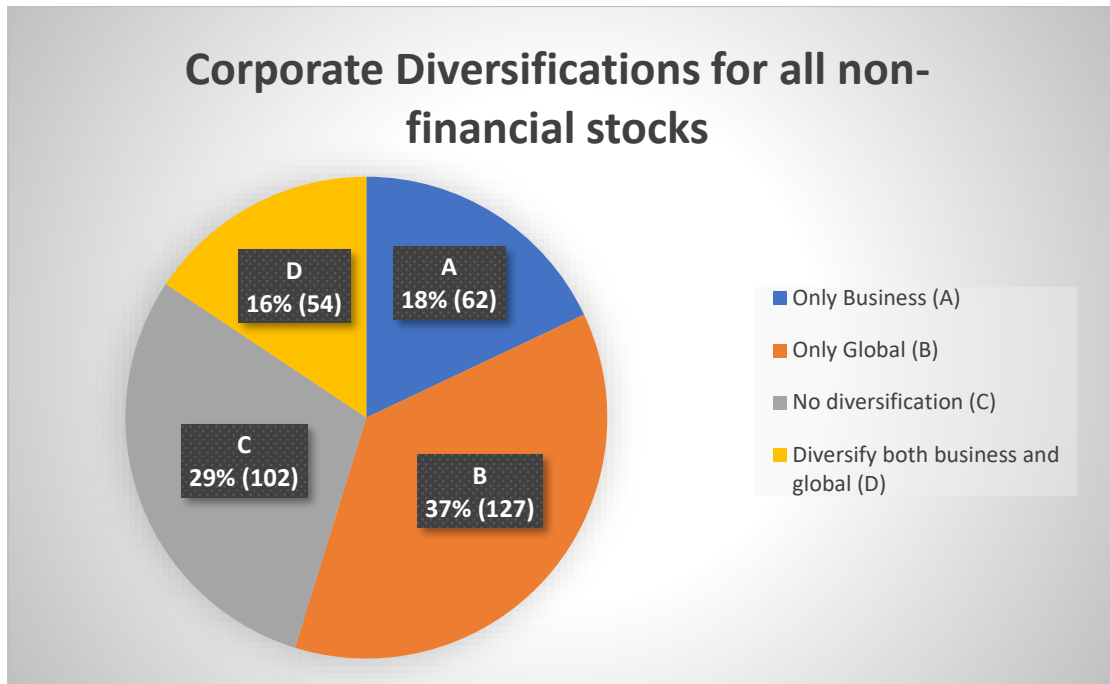


Figure 4: Corporate Diversifications for all non-financial stocks

As seen in Figure 5, top 3 business segments that companies operate in are property development, energy and utilities, and food and beverages. However, top 3 business segments for companies adopt only business diversification as shown in Figure 6 are property development, construction services, and energy and utilities. This could be because companies take into consideration the existing resources and expertise they have when deciding which business segment to diversify into. For instance, property development companies could have existing knowledge and network to do construction services and provide utilities.

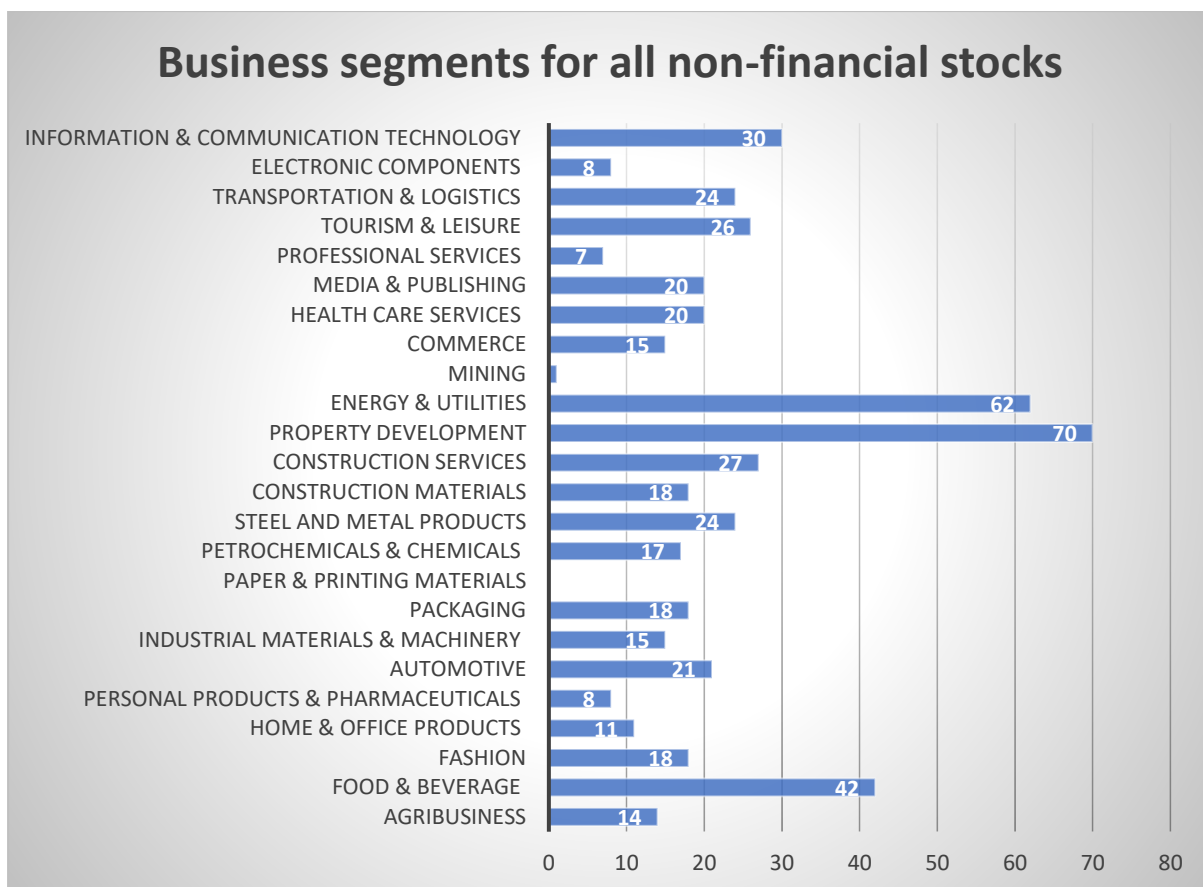


Figure 5: Business segments for all non-financial stocks

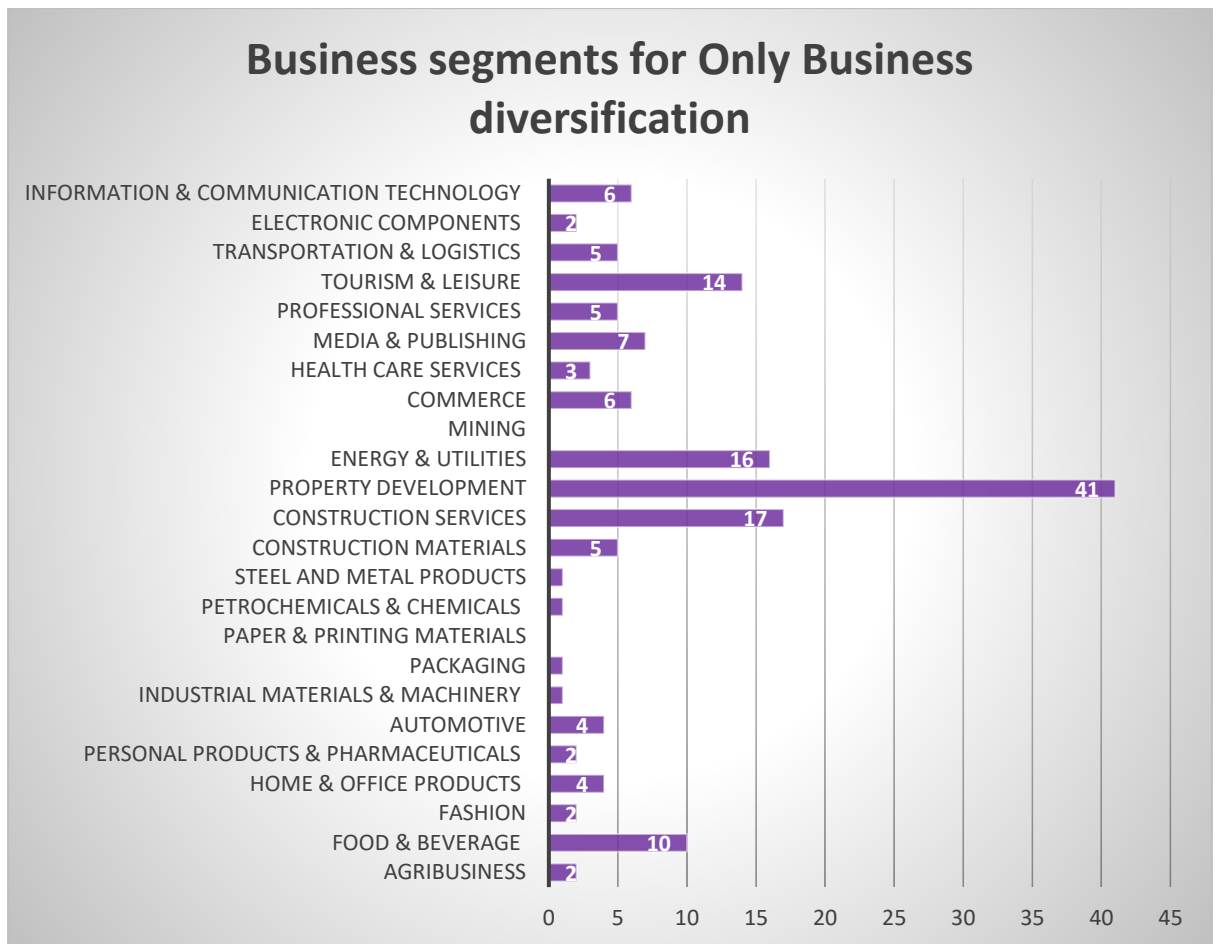


Figure 6: Business segments for Only Business diversification

As for Figure 7 and 8, besides those fall under “Others”, countries that these SET listed non-financial companies most frequently diversify into are United States and China. Same goes to those companies that only do global diversification. United States and China are considered having the most serious outbreak of Covid virus compared to other countries around the world.

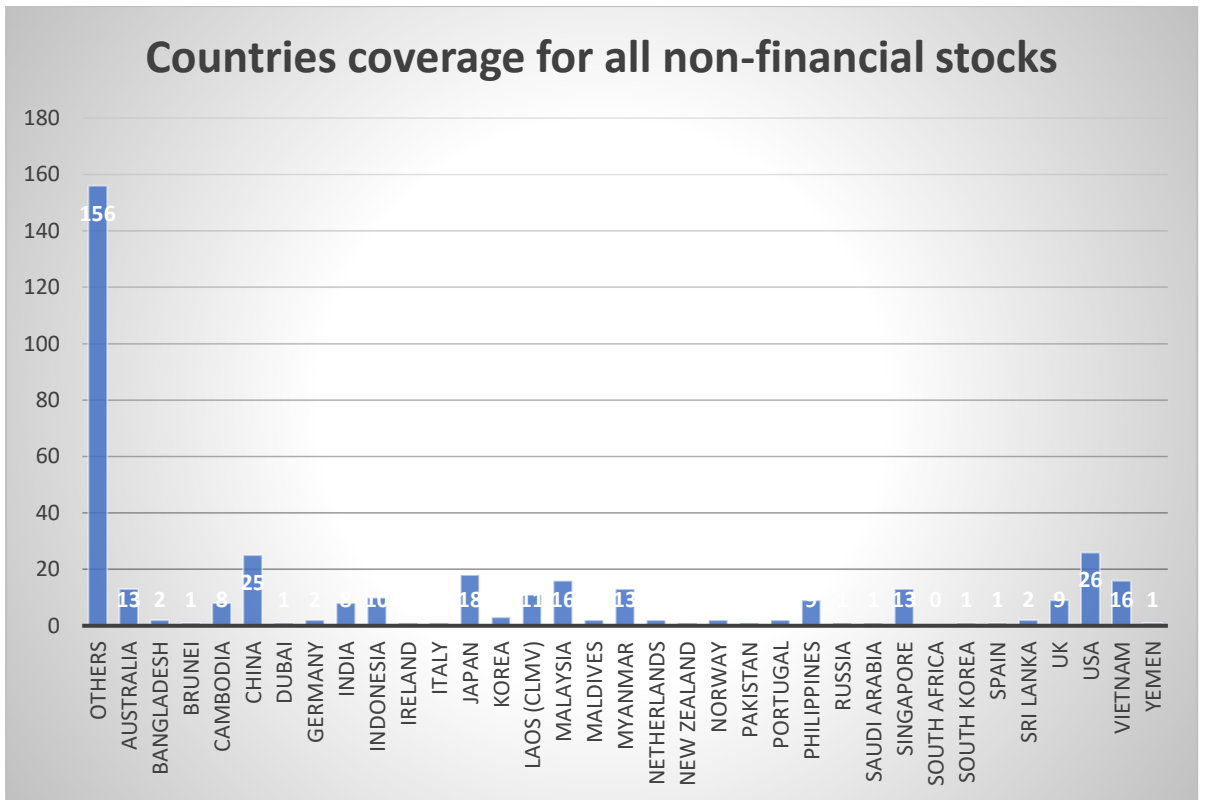


Figure 7: Countries coverage for all non-financial stocks

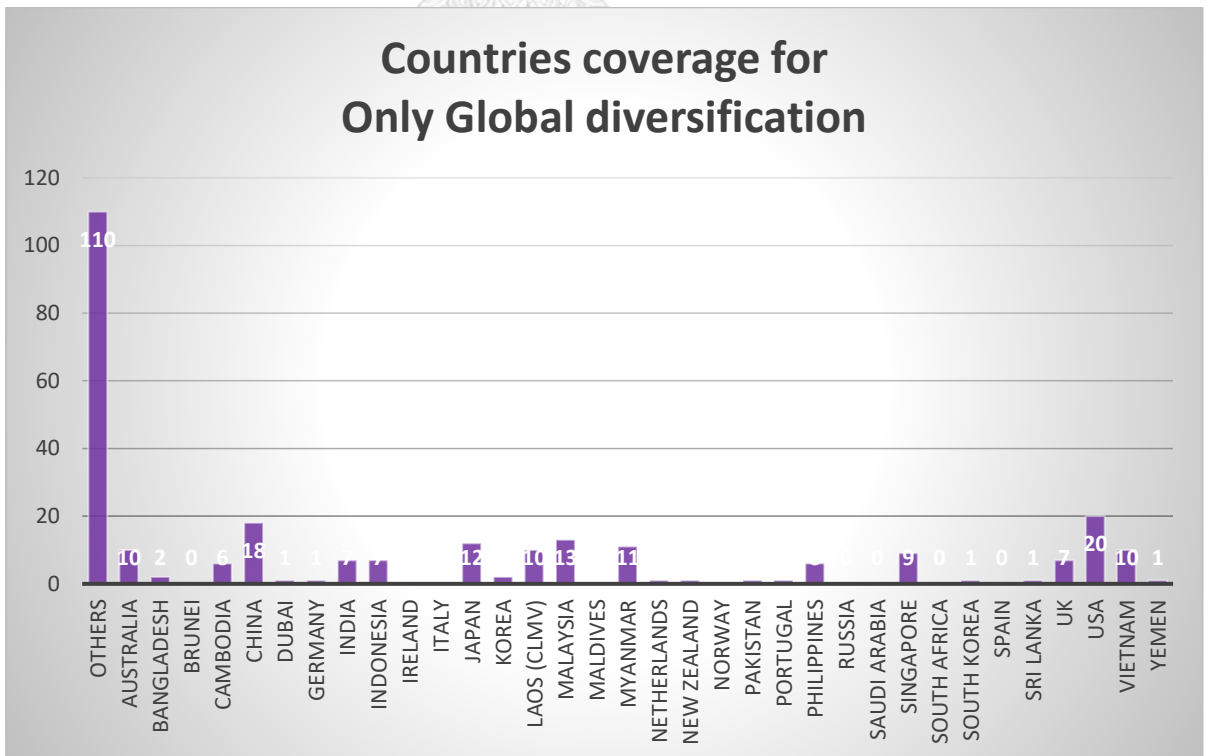


Figure 8: Countries coverage for Only Global diversification

5.2 Summary statistics of variables

This table presents the summary statistics of the dependent and control variables employed in this analysis. There are 10 panels in total. Panel A to E shows the statistics summary of these variables for non-financial companies listed on SET, companies diversify only through business, non-financial companies listed on SET excluding those diversify only through business, companies diversify only through global and non-financial companies listed on SET excluding those diversify only globally respectively during the whole sample period from 4 January 2017 to 30 December 2021. Panel F to J shows the statistics summary of these variables for non-financial companies listed on SET, companies diversify only through business, non-financial companies listed on SET excluding those diversify only through business, companies diversify only through global and non-financial companies listed on SET excluding those diversify only globally respectively during the Covid period from 2 March 2020 to 30 December 2021.

Table 2: Summary statistics of variables

Panel A:		SET non-financial stocks 2017 -2021			
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	6,900	0.0224	0.0131	0.0011	0.2110
BTM	6,900	0.9720	0.7950	0.0074	10.7874
CASH	6,900	0.0710	0.0785	0.0001	0.7585
LEVERAGE	6,900	0.2524	0.2029	0.0000	0.8696
ROE	6,900	0.0653	0.1598	-1.4501	1.1128
SIZE	6,900	22.7033	1.5494	18.6698	28.7553

Panel B:		Only Business 2017 -2021			
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	1,240	0.0237	0.0143	0.0011	0.1058
BTM	1,240	1.1074	0.8059	0.0498	6.1695
CASH	1,240	0.0672	0.0727	0.0011	0.6972
LEVERAGE	1,240	0.2514	0.1967	0.0000	0.8696
ROE	1,240	0.0304	0.1511	-1.4501	0.3923
SIZE	1,240	22.6456	1.6286	18.6697	28.7553

Table 2: Summary statistics of variables (cont.)

Panel C: SET non-financial stocks exclude Only Business 2017 -2021					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	5,660	0.0221	0.0128	0.0021	0.2110
BTM	5,660	0.9423	0.7896	0.0074	10.7874
CASH	5,660	0.0718	0.0797	0.0001	0.7585
LEVERAGE	5,660	0.2526	0.2043	0.0000	0.7978
ROE	5,660	0.0729	0.1607	-1.4280	1.1128
SIZE	5,660	22.7160	1.5313	19.5697	27.4815

Panel D: Only Global 2017 -2021					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	2,540	0.0224	0.0122	0.0021	0.0996
BTM	2,540	1.0195	0.8377	0.0270	10.0587
CASH	2,540	0.0813	0.0847	0.0002	0.7585
LEVERAGE	2,540	0.2233	0.2049	0.0000	0.7978
ROE	2,540	0.0744	0.1484	-1.1629	1.1128
SIZE	2,540	22.5953	1.4810	19.5697	27.3926

Panel E: SET non-financial stocks exclude Only Global 2017 -2021					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	4,360	0.0223	0.0136	0.0011	0.2110
BTM	4,360	0.9442	0.7678	0.0074	10.7874
CASH	4,360	0.0650	0.0741	0.0001	0.6972
LEVERAGE	4,360	0.2694	0.1999	0.0000	0.8696
ROE	4,360	0.0600	0.1659	-1.4501	0.8111
SIZE	4,360	22.7663	1.5847	18.6697	28.7553

Panel F: SET non-financial stocks COVID PERIOD					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	2,760	0.0279	0.0151	0.0015	0.2110
BTM	2,760	1.1277	0.9444	0.0074	10.7874
CASH	2,760	0.0745	0.0823	0.0001	0.7585
LEVERAGE	2,760	0.2704	0.2067	0.0000	0.8696
ROE	2,760	0.0518	0.1765	-1.4501	1.1128
SIZE	2,760	22.7676	1.5730	18.8695	28.7553

Table 2: Summary statistics of variables (cont.)

Panel G: Only Business COVID PERIOD					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	496	0.0298	0.0156	0.0015	0.1058
BTM	496	1.3008	0.9627	0.0760	6.1695
CASH	496	0.0735	0.0825	0.0011	0.6972
LEVERAGE	496	0.2794	0.2056	0.0000	0.8696
ROE	496	0.0058	0.1554	-1.4501	0.3073
SIZE	496	22.7138	1.6671	18.8695	28.7553

Panel H: SET non-financial stocks exclude Only Business COVID PERIOD					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	2,264	0.0275	0.0149	0.0025	0.2110
BTM	2,264	1.0898	0.9363	0.0074	10.7874
CASH	2,264	0.0747	0.0822	0.0001	0.7585
LEVERAGE	2,264	0.2684	0.2070	0.0000	0.7978
ROE	2,264	0.0618	0.1792	-1.4280	1.1128
SIZE	2,264	22.7794	1.5518	19.7189	27.4815

Panel I: Only Global COVID PERIOD					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	1,016	0.0279	0.0138	0.0025	0.0996
BTM	1,016	1.1672	0.9705	0.0699	10.0587
CASH	1,016	0.0849	0.0890	0.0002	0.7585
LEVERAGE	1,016	0.2347	0.2077	0.0000	0.7978
ROE	1,016	0.0702	0.1668	-1.0999	1.1128
SIZE	1,016	22.6423	1.4976	19.7189	27.3926

Panel J: SET non-financial stocks exclude Only Global COVID PERIOD					
Variable	Obs	Mean	Std. dev.	Min	Max
QuarterlyVol	1,744	0.0279	0.0158	0.0015	0.2110
BTM	1,744	1.1048	0.9284	0.0074	10.7874
CASH	1,744	0.0684	0.0774	0.0001	0.6972
LEVERAGE	1,744	0.2912	0.2033	0.0000	0.8696
ROE	1,744	0.0410	0.1810	-1.4501	0.6893
SIZE	1,744	22.8405	1.6113	18.8695	28.7553

Table 3: Mean difference T-test of variables

This table presents t-tests aimed at verifying whether the variable means, by group, are statistically different.

Whole sample period							
	(A) Only Business = 1	(B) Only Global = 1	t-test (A-B)	(C) Only Business = 0	(D) Only Global = 0	t-test (A-C)	t-test (B-D)
QuarterlyVol	0.0237	0.0224	-0.0013***	0.0221	0.0223	-0.0017***	-0.0001
BTM	1.1074	1.0195	-0.0878***	0.9423	0.9442	-0.1651***	-0.0753***
CASH	0.0672	0.0813	0.0141***	0.0718	0.0650	0.0047**	-0.0163***
LEVERAGE	0.2514	0.2233	-0.0281***	0.2526	0.2694	0.0012	0.0461***
ROE	0.0304	0.0744	0.0440***	0.0729	0.0600	0.0425***	-0.0145***
SIZE	22.6456	22.5953	-0.0503	22.7160	22.7663	0.0704	0.1709***

Covid Period							
	(A) Covid*Only Business = 1	(B) Covid*Only Global = 1	t-test (A-B)	(C) Covid*Only Business = 0	(D) Covid*Only Global = 0	t-test (A-C)	t-test (B-D)
QuarterlyVol	0.0298	0.0279	-0.0018**	0.0218	0.0214	-0.0080***	-0.0065***
BTM	1.3008	1.1672	-0.1336**	0.9465	0.9382	-0.3543***	-0.2289***
CASH	0.0735	0.0849	0.0114**	0.0708	0.0686	-0.0027	-0.0163***
LEVERAGE	0.2794	0.2347	-0.0447***	0.2503	0.2555	-0.0291***	0.0208***
ROE	0.0058	0.0702	0.0644***	0.0699	0.0645	0.0641***	-0.0057
SIZE	22.7138	22.6423	-0.0715	22.7025	22.7139	-0.0113	0.0715

*** p<0.01, ** p<0.05, * p<0.1

We can first compare companies between the two periods. As shown in Table 2, the average volatility is higher during the Covid period compared to the whole sample period regardless of the diversification companies adopt. In which, the average volatility of companies diversify through only business segment is observed to have the highest average volatility compared to all the other groups of companies in both periods. This group of companies also have its average volatility increase in greatest magnitude after the global shock.

For the control variables, average BTM during the whole sample period are mostly below 1 or only slightly above 1 which means that companies are likely to be overvalue or at its fair value. In contrast, average BTM during the Covid period are above 1 regardless of the diversification companies adopt, which means the companies are undervalued following a global shock. Average leverage and cash are observed to be higher during the Covid period compared to the whole sample period regardless of the diversification companies adopt. This shows that most of the companies borrow more

and conserve more cash holdings during the difficult period. While average size is quite consistent in all the panels, average ROE differs. Average ROE is observed to be lower during the Covid period compared to the whole sample period except for Only Global diversification. Furthermore, average ROE of companies diversify through only business segment decrease in greatest magnitude compared to all the other group of companies after the global shock. This shows that profitability of the companies affected negatively if they only consider diversifying through business segment during pandemic but improved slightly if they only consider diversifying globally.

Within the whole sample period, we can see that the average cash of companies that diversify through only business segments are lower than other companies, while the average cash of companies that diversify only globally are higher than other companies. As mentioned by Duchin (2010), diversifying into different business segments results in lower cash for companies (Duchin, 2010). This inverse relationship between business diversification and firm liquidity is observed from the t-tests for Cash variable in Table 3 (whole sample period) too. In contrast, the findings that shows higher average cash for companies that diversify globally compared to the others are inconsistent with Benkraiem et al. (2020) which suggests that globally diversified companies are less likely to save cash (Benkraiem et al., 2020). Similarly, average ROE of companies that diversify through only business segments are lower than other companies, while the average ROE of companies that diversify only globally are higher than other companies. This is also consistent with the results of the t-tests for ROE variable in Table 3 (whole sample period).

Within the Covid period, the average volatility of companies that diversify through only business segments are higher than other companies, while the average volatility of companies that diversify only globally are also higher than other companies. This shows that either only business or only global diversification results in higher firm risks during pandemic, in particular only business diversification exhibits a higher degree of average risks increased in firms. Furthermore, the average cash of companies that diversify only globally are also higher than other companies. This is aligned with Benkraiem et al. (2020) that global diversification is positively related with the tendency of companies

to save cash out of their cash flows during bad economic situation (Benkraiem et al., 2020). Cash holding can affect companies' ability to soften the negative effect from shocks, the more cash the better ability (Lins et al., 2010). These findings match the results of the t-tests for in Table 3 (covid period). On the other hand, the average leverage of companies that diversify through only business segments are higher than other companies, while the average leverage of companies that diversify only globally are also lower than other companies. Both are observed from the t-tests for leverage variable in Table 3 (covid period) too. While this positive relationship between business diversification and firm leverage during the Covid period is understandable as companies need more cash flow to keep operations ongoing since large parts of the economy are expected to be slowed or even shut down. However, the negative relationship between global diversification and firm leverage during the Covid period could be due to the fact that global diversification is deemed to be risky especially after a global shock which results in harder access to loans.

5.3 Main results

The main results are discussed based on the figures reported in Table 4. It is to investigate how corporate diversification might affect risk of the firms.

Table 4: Difference-in-differences regressions on QuarterlyVol

Panel A	(1) QuarterlyVol	(2) QuarterlyVol	(3) QuarterlyVol	(4) QuarterlyVol
COVIDOnlyBusiness		0.000707* (0.000406)		
FISCALOnlyBusiness		-0.000432 (0.000451)		
COVIDOnlyGlobal				-0.0000245 (0.000296)
FISCALOnlyGlobal				0.000207 (0.000864)
OnlyBusiness	0.000973*** (0.000227)	0.000820** (0.000330)		
OnlyGlobal			0.000141 (0.000283)	0.0000893 (0.000186)
BTM	0.00157*** (0.000390)	0.00157*** (0.000390)	0.00159*** (0.000386)	0.00159*** (0.000387)
CASH	0.00717*** (0.00168)	0.00716*** (0.00169)	0.00703*** (0.00174)	0.00703*** (0.00173)

LEVERAGE	0.00855*** (0.000931)	0.00854*** (0.000933)	0.00853*** (0.000935)	0.00853*** (0.000935)
ROE	-0.00907*** (0.00151)	-0.00906*** (0.00151)	-0.00930*** (0.00150)	-0.00931*** (0.00152)
SIZE	-0.00145*** (0.000225)	-0.00145*** (0.000225)	-0.00145*** (0.000225)	-0.00145*** (0.000226)
Constant	0.0515*** (0.00514)	0.0515*** (0.00514)	0.0515*** (0.00517)	0.0515*** (0.00517)
Observations	6,900	6,900	6,900	6,900
R-squared	0.079	0.079	0.078	0.078
Date (Quarter) FE	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Business Diversification and Risk (H1 and H2):

Firstly, the results reported in Columns (1) suggest that there is statistical evidence that diversifying through only business segments and ignoring global diversification increases stock volatility during the whole sample period as the coefficients of the term Only Business is 0.000973, which is positive and significant. Similarly, mean difference t-test in Table 3 in terms of volatility during the whole sample period for Only business diversification versus others produce the same positive relationship and it is statistically significant. However, the result is inconsistent with our first hypothesis that expects to have lower firm risk for firms that focus only on business diversification and ignore global diversification during the whole sample period.

Secondly, the results reported in Columns (2) suggest that there is statistical evidence that diversifying through only business segments and ignoring global diversification increases stock volatility during the Covid period compared to pre-Covid period as coefficient of the term COVID * Only Business is 0.000707, which is positive and significant. Similarly, mean difference t-test in Table 3 in terms of volatility during the Covid period for Only business diversification versus others produce the same statistically significant positive relationship. The result is inconsistent with our second hypothesis that expects to have lower firm risk for firms that focus only on business diversification and ignore global diversification during the Covid period compared to pre-Covid period. However, the result is consistent with the main reference paper Onali

and Mascia (2022) who study US companies. The coefficient of the term COVID * Only Business in their paper is also positive and significant (Onali & Mascia, 2022). They find that diversifying through only business segments and ignoring global diversification increases stock volatility during the Covid period (Onali & Mascia, 2022).

Global Diversification and Risk (H3 and H4):

Thirdly, the results reported in Columns (3) suggest that there is no statistical evidence that diversifying only by country and ignoring business segment diversification increases stock volatility as the coefficient of the term Only Global is insignificant. Similarly, mean difference t-test in Table 3 for volatility during the whole sample period for Only Global diversification versus others is also statistically insignificant. The result is inconsistent with our third hypothesis that expects to have higher firm risk for firms that focus only on global diversification and ignore business segment diversification during the whole sample period. Therefore, H3 is rejected.

Lastly, the results reported in Columns (4) also suggest that there is no statistical evidence that diversifying only by country and ignoring business segment diversification increases stock volatility during the Covid period compared to pre-Covid period as coefficient of the term COVID * Only Global is statistically insignificant. This result is inconsistent with our fourth hypothesis that expects to have higher firm risk for firms that focus only on global diversification and ignore business diversification during the Covid period compared to pre-Covid period. Therefore, H4 is rejected. In contrast, the coefficient of the term COVID * Only Global in Onali and Mascia (2022) who study US companies is negative and significant (Onali & Mascia, 2022). They find that diversifying only globally and ignoring business segment diversification decreases stock volatility during the Covid period (Onali & Mascia, 2022).

Moreover, the coefficient of control variable cash is positive and significant. This is aligned with the summary statistics reported in Table 3 section 5.2 where the average cash of companies that diversify only globally are higher than other companies.

5.4 Robustness test

This section does further analysis to explore more about the differences between diversification groups (according to the classification in Figure 3) which might affect stock volatility in different periods.

Whole sample period 2017 to 2021:

I use the following equation to investigate whether firms that focus only on business diversification and ignore global diversification (Type A) would have lower or higher risk during the whole sample period from 2017 to 2021, compared to: (5) firms that adopt only global diversification and ignore business diversification (Type B), where *Only Business* = 1 for Type A firms, *Only Business* = 0 for Type B firms. Type C and D firms are excluded; (6) firms that adopt no diversification (Type C), where *Only Business* = 1 for Type A firms, *Only Business* = 0 for Type C firms. Type B and D firms are excluded; (7) firms that adopt both business and global diversification (Type D), where *Only Business* = 1 for Type A firms, *Only Business* = 0 for Type D firms. Type B and C firms are excluded.

$$QuarterlyVol_{it} = \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\ Holdings_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \beta_5 Size_{it} + \beta_6 Only\ Business_{it} + v_t + e_{it} \quad (5) \text{ to } (7)$$

Next, I use the following equation to investigate whether firms that focus only on global diversification and ignore business diversification (Type B) would have lower or higher risk during the whole sample period from 2017 to 2021, compared to: (8) firms that adopt no diversification (Type C), where *Only Global* = 1 for Type B firms, *Only Global* = 0 for Type C firms. Type A and D firms are excluded; (9) firms that adopt both business and global diversification (Type D), where *Only Global* = 1 for Type B firms, *Only Global* = 0 for Type D firms. Type A and C firms are excluded.

$$QuarterlyVol_{it} = \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\ Holdings_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \beta_5 Size_{it} + \beta_6 Only\ Global_{it} + v_t + e_{it} \quad (8) \text{ to } (9)$$

Table 5: Whole sample period 2017 to 2021 Comparison Study

VARIABLES	(5) A vs B QuarterlyVol	(6) A vs C QuarterlyVol	(7) A vs D QuarterlyVol	(8) B vs C QuarterlyVol	(9) B vs D QuarterlyVol
OnlyBusiness	0.000744** (0.000314)	0.000643** (0.000296)	0.00116** (0.000413)		
OnlyGlobal				0.000491 (0.000444)	0.00127*** (0.000295)
BTM	0.00103*** (0.000278)	0.00205*** (0.000503)	0.00207*** (0.000579)	0.00133*** (0.000377)	0.00188*** (0.000368)
CASH	0.00664*** (0.00225)	0.00526* (0.00282)	0.0134*** (0.00247)	0.00464** (0.00220)	0.00733*** (0.00238)
LEVERAGE	0.00938*** (0.00118)	0.00390*** (0.00116)	0.00407*** (0.00107)	0.0106*** (0.00113)	0.0134*** (0.00140)
ROE	-0.00870*** (0.00180)	-0.0136*** (0.00219)	-0.0133*** (0.00206)	-0.00775*** (0.00187)	-0.00163 (0.00139)
SIZE	-0.00147*** (0.000207)	-0.00165*** (0.000281)	-0.00123*** (0.000311)	-0.00150*** (0.000213)	-0.00120*** (0.000213)
Constant	0.0526*** (0.00465)	0.0572*** (0.00635)	0.0467*** (0.00749)	0.0523*** (0.00476)	0.0430*** (0.00519)
Observations	3,780	3,280	2,320	4,580	3,620
R-squared	0.075	0.109	0.106	0.072	0.075
Date (Quarter) FE	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	NO

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From Table 5, the results reported in Columns (5), (6) and (7) suggest that there is statistical evidence that diversifying through only business segments results in higher stock volatility comparing to diversifying through only global diversification, or no diversification, or diversifying through both business and global diversification during the whole sample period, as the coefficients of the term Only Business is 0.000744, 0.000643 and 0.00116 for the 3 Models respectively, which is positive and significant. This aligns with the result produced in Model 1 in Table 4 which shows that diversifying through only business segments and ignoring global diversification increases stock volatility during the whole sample period. Similarly, mean difference t-test in Table 3 in terms of volatility during the whole sample period for Only business diversification versus Only Global diversification, and Only business diversification

versus others. They produce the same positive relationship and are statistically significant.

While the result reported in Column (8) shows no statistical evidence that diversifying through only global results in higher stock volatility comparing to no diversification during the whole sample period, the result in Column (9) suggests a strong statistical evidence that diversifying through only global results in higher stock volatility comparing to diversifying through both business and global diversification during the whole sample period as the coefficients of the term Only Global is 0.00127, which is positive and significant. Similar to Column (7) which compares diversifying through only business segments to diversifying through both diversifications, this shows that investors could choose firms that diversifying through both diversifications (Type D) to minimise the exposure to stock risk.

Covid period:

I use the following equation to investigate whether firms that focus only on business diversification and ignore global diversification (Type A) would have lower or higher risk during the Covid period than pre-Covid period, compared to: (10) firms that adopt only global diversification and ignore business diversification (Type B), where *Only Business* = 1 for Type A firms, *Only Business* = 0 for Type B firms. Type C and D firms are excluded; (11) firms that adopt no diversification (Type C), where *Only Business* = 1 for Type A firms, *Only Business* = 0 for Type C firms. Type B and D firms are excluded; (12) firms that adopt both business and global diversification (Type D), where *Only Business* = 1 for Type A firms, *Only Business* = 0 for Type D firms. Type B and C firms are excluded.

$$\begin{aligned} QuarterlyVol_{it} = & \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\ Holdings_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \beta_5 Size_{it} + \beta_6 Only\ Business_i + \beta_7 COVID_t * Only\ Business_i + \beta_8 FISCAL_t * Only \\ & Business_i + v_t + e_{it} \end{aligned} \quad (10) \text{ to } (12)$$

Next, I use the following equation to investigate whether firms that focus only on global diversification and ignore business diversification (Type B) would have lower or higher

risk during the Covid period than pre-Covid period, compared to: (8) firms that adopt no diversification (Type C), where *Only Global* = 1 for Type B firms, *Only Global* = 0 for Type C firms. Type A and D firms are excluded; (9) firms that adopt both business and global diversification (Type D), where *Only Global* = 1 for Type B firms, *Only Global* = 0 for Type D firms. Type A and C firms are excluded.

$$\begin{aligned} QuarterlyVol_{it} = & \beta_0 + \beta_1 Book\text{-}to\text{-}Market_{it} + \beta_2 Cash\ Holdings_{it} + \beta_3 Leverage_{it} + \beta_4 ROE_{it} + \beta_5 Size_{it} + \beta_6 Only\ Global_i + \beta_7 COVID_t * Only\ Global_i + \beta_8 FISCAL_t * Only \\ & Global_i + v_t + e_{it} \end{aligned} \quad (13) \text{ to } (14)$$

Table 6: Covid period Comparison Study

VARIABLES	(10) A vs B Quarterly Vol	(11) A vs C Quarterly Vol	(12) A vs D Quarterly Vol	(13) B vs C Quarterly Vol	(14) B vs D Quarterly Vol
COVIDOnlyBusiness	0.000618 (0.000486)	0.000786 (0.000586)	0.000767 (0.00107)		
FISCALOnlyBusiness	-0.000464 (0.000759)	-0.000809 (0.000901)	0.000303 (0.00112)		
COVIDOnlyGlobal				0.000315 (0.000658)	-0.000135 (0.000683)
FISCALOnlyGlobal				-0.000341 (0.00141)	0.000887 (0.000676)
OnlyGlobal				0.000468 (0.000311)	0.00106*** (0.000309)
OnlyBusiness	0.000637* (0.000347)	0.000572 (0.000411)	0.000763 (0.000513)		
BTM	0.00103*** (0.000279)	0.00204*** (0.000501)	0.00206*** (0.000577)	0.00133*** (0.000377)	0.00188*** (0.000368)
CASH	0.00663*** (0.00226)	0.00527* (0.00285)	0.0132*** (0.00248)	0.00464** (0.00219)	0.00732*** (0.00238)
LEVERAGE	0.00938*** (0.00119)	0.00390*** (0.00116)	0.00400*** (0.00106)	0.0106*** (0.00113)	0.0134*** (0.00139)
ROE	-0.00869*** (0.00180)	-0.0136*** (0.00218)	-0.0133*** (0.00208)	-0.00775*** (0.00189)	-0.00167 (0.00138)
SIZE	-0.00147*** (0.000207)	-0.00165*** (0.000281)	-0.00123*** (0.000310)	-0.00150*** (0.000213)	-0.00120*** (0.000213)
Constant	0.0526*** (0.00465)	0.0572*** (0.00635)	0.0467*** (0.00751)	0.0523*** (0.00475)	0.0429*** (0.00520)
Observations	3,780	3,280	2,320	4,580	3,620
R-squared	0.075	0.109	0.106	0.072	0.076
Date (Quarter) FE	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	NO

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From Table 6, the results reported in Columns (10), (11) and (12) suggest that there is no statistical evidence that diversifying through only business segments results in higher stock volatility comparing to diversifying through only global diversification, no diversification or diversifying through both business and global diversification during the Covid period than pre-Covid period, as coefficient of the term COVID * Only Business is statistically insignificant. This is inconsistent with the result produced in Model 2 in Table 4 which shows that there is statistical evidence that diversifying through only business segments and ignoring global diversification increases stock volatility during the Covid period compared to pre-Covid period.

Similarly, the results reported in Columns (13) and (14) suggest that there is no statistical evidence that diversifying only by country result in higher stock volatility comparing to no diversification or diversifying through both business and global diversification during the Covid period than pre-Covid period, as coefficient of the term COVID * Only Global is statistically insignificant. This aligns with the result produced in Model 4 in Table 4 which also shows no statistical evidence that diversifying by country and ignoring business segment diversification increases stock volatility during the Covid period compared to pre-Covid period.

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6. CONCLUSION

The results reported show that diversifying through only business segments and ignoring global diversification increases stock volatility. Furthermore, it also shows that diversifying through only business segments and ignoring global diversification increases stock volatility during the Covid period compared to pre-Covid period. On the other hand, there is no statistical evidence that diversifying only by country and ignoring business segment diversification increases stock volatility or increases stock volatility during the Covid period compared to pre-Covid period.

This concludes that, depend only on business segment diversification might lower the ability of companies in alleviating the impact of such global shocks that could affect different geographical regions in different time periods. As mentioned previously in section 5.2, average ROE of companies diversify through only business segment decrease in greatest magnitude compared to all the other group of companies after the global shock in Table 2. Similarly, mean difference t-test in Table 3 for ROE during the Covid period for Only business diversification versus others produce statistically significant results too, and it exhibits a higher degree of ROE decreased in firms during the Covid period compared to the whole sample period. This shows that profitability of the companies affected the most if they only consider diversifying through business segment during pandemic. Similar to the case of US, the coinsurance effect of diversifying by business segments might not benefit investors in Thailand, as it might be done quite easily by investing in stocks of firms operate in different industries (Berger & Ofek, 1995; Dastidar, 2009). Investors should choose firms that diversifying through both diversifications (Type D) to minimise the exposure to stock risk.

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Appendix 1

1. Agribusiness
 - Produce and distribute agricultural products, livestock as well as aquaculture feed
 - Fishery, plantation, forestry, raise livestock and butchery
 - Distribute core agricultural goods which is also usable in the other industries
 - Do not include fertilizers or pesticides manufacturers, because those are under the chemicals business

2. Food & Beverage
 - Produce food derived from agricultural goods to turn it into prepared or ready-to-eat food. For example, cooked food, preserved products and meat processing
 - Restaurant operators.
 - Produce and distribute food and beverages, food seasoning and pet foods

3. Fashion
 - Produce/design/distribute footwear, apparel, bags or leather goods
 - Cut/process jewellery and accessories
 - Manufacture thread, fabric, or skins (raw materials for this sector)

4. Home & Office Products
 - Produce/distribute household or office products, such as cloth, toys, sports equipment, kitchenware, furniture, office stationery.
 - Manufacture or distribute home or office electric products, such as audio equipment, televisions, light bulbs or photocopiers.

5. Personal Products & Pharmaceuticals
 - Produce/distribute
 - personal products: beauty products, fragrances or sanitizers etc.
 - pharmaceutical products: medical devices or biotechnology-based products.

6. Banking
 - Banking in accordance with the Commercial Banking Act or other related laws, including similar businesses created under special laws.

7. Securities and Finance
 - Financing, leasing, consumer financing, credit cards, factoring, securities, asset management business
 - hire-purchasing (exclude those provide services or selling products to customers directly)

8. Insurance
 - business activities as defined in the Non-Life and Life Insurance Acts, including similar businesses created under special laws.

9. Automotive
 - Produce automobiles
 - Manufacture, assemble or distribute auto parts
 - Offer car care services.
 - Distribute brand new or used cars and manage car trading.
10. Industrial Materials & Machinery
 - Produce/distribute
 - all types of tools or machines
 - basic equipment or parts for electrical appliances, such as electric insulators, wires, motors or light bulbs
 - raw materials used in many industries (excludes those producing tools or equipment that can be used only in a specific sector)
11. Packaging
 - Manufacture/distribute containers or container parts, including products or materials used to produce containers, which are not part of other sectors.
12. Paper & Printing Materials
 - Produce/distribute
 - paper, tissues, or other paper product
 - printing ink (excludes printing houses as those are classified under Media & Publishing sector)
13. Petrochemicals & Chemicals
 - Produce/distribute
 - products used in petrochemical industries: moulded plastic products or plastic powder/granules
 - chemicals: fertilizers, pesticides, commodity chemicals or specialty chemicals
 - excluding specific moulded plastic products for equipment or parts of any specific products
14. Steel and Metal Products
 - Produce/process/distribute
 - steel products or steel fabrication
 - metal products which have steel as a main part
15. Construction Materials
 - Produce/distribute materials (exclude steel/iron) used in refurbishment or construction, including sanitary ware
16. Construction Services
 - Construct residences or other related units including interior, such as condominiums, industrial estates, shopping malls, roads or bridges
 - Offer advisory or other related services including related designs or engineering, for construction projects

17. Property Development
 - Develop property for sales or rentals, including related management, such as housing, buildings or land.
 - Act as agents or middle man for sale or lease of the property
18. Property Fund & Real Estate Investment Trusts (REITs)
 - Mutual funds or trusts that mainly invest in properties or generate income from rental fees, interests, or profits from sale of property.
19. Energy & Utilities
 - Produce/explore/drill/refine/distribute many forms of natural energy
 - Provide utilities
20. Mining
 - Explore/extract/refine/distribute minerals including both metal or non-metal but excluding fuel minerals
21. Commerce
 - Retail or wholesale including both companies with physical shops services or those without physical shops and provide it online
 - Sale of consumers end products from many different sectors.
 - Exclude financial services, IT services, or other classified specialized services
22. Health Care Services
 - Health care services, dentistry, health/physical therapy or beauty surgery.
23. Media & Publishing
 - Produce/distribute
 - entertainment media: drama/movies/entertainment shows, music including entertainment service providers, such as movie theatres, or theatres
 - radio or television broadcasting services
 - advertising media, advertising agencies
 - printed media: publishers or printing houses, including publishers of newspapers, magazines, or other similar printed media
24. Professional Services
 - Specialized services which are not classified under other sectors, such as business consultation, education, waste treatment disposal or others etc.
25. Tourism & Leisure
 - Hotels or temporary accommodation, including tourism services provider such as travel agent
 - Leisure facilities, such as entertainment venues, fitness centres/stadiums or zoos.

26. Transportation & Logistics

- Transportation-related services: land/railway/air/sea transportation, or logistics
- Warehouses or other related services.

27. Electronic Components

- Manufacture electronic parts of general electronic equipment or electrical appliances, such as PCB, semiconductors and IC, excluding components for computer

28. Information & Communication Technology

- Technology service related, information or communication management, such as IT system planners, telecommunication/internet/satellite/cable service provider, including internet designers or developers
- Servicing or producing computer systems, CPU or servers
- Manufacture/distribute equipment for this technology, such as computer components, software, or hardware for telecommunication



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