THE EFFECTS OF MEDIA ON FINANCIAL STABILITY

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List of abbreviations

2SLS	Two Stage Least Square
AEs	Advanced Economies
AMEX	American Express
API	Application Programming Interface
B2C	Business to Customer
CAPM	Capital Asset Pricing Model
CDs	Certificate of Deposit
COVID-19	Coronavirus
CSR	Corporate Social Responsibility
DAX	Dutcher Aktien Index
DCC	Dynamic Conditional Correlations
DD	Distance-to-Default
DJIA	Dow Jones Industrial Average
ECB	European Central Bank
EMDEs	Emerging Market and Developing Economies
EMH	Efficient Market Hypothesis
FDI	Foreign Direct Investment
FTSE100	Financial Times Stock Exchange 100 Index
GDP	Gross Domestic
GMM	Generalized Method of Moments
LVG	Leverage
M&A	Merage and Acquisition
MES	Marginal Expected Shortfall
NASDAQ	National Association of Securities Dealers Automated Quotations Stock Market
NLP	Natural Language Processing
NYSE	New York Stock Exchange
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
PPP	Purchasing Power Parity
SES	Systemic Expected Shortfall
SIFIs	Systemically Important Financial Institutions
S&P500	Standard and Poor's 500 Index
SRISK	A Conditional Capital Shortfall Measure of Systemic Risk.
VAR	Vector Auto Regression
VIX	Chicago Board Options Exchange's CBOE Volatility Index
WHO	World Health Organisation

List of key terms

Banking Liquidity	Market liquidity indicated by banking system, using the proportional bid-ask spread
Banking Stability	Financial stability indicated by banking system, or Z-score
Banking Stock Market Stability	Financial stability indicated by banking stock market, or banking stock price volatility
Financial Market Stability	Financial stability indicated by stock market, or stock price volatility
Media Concentration	The concentration of government-owned media business in a country
Media Coverage COVID-19 Effect	COVID effects from the media, such as the information be covered by the websites, the searching volume of a keyword related to COVID
Media Freedom	The degree of freedom of a media environment for a country
Media Ownership	The ownership type of a media business, a private or government-owned
Modern Media	Modern format media platforms which require Internet to get access, such as online website
Real COVID-19 Effect	COVID effects from itself, such as its infected number, death number and vaccine number
Traditional Media	Traditional format media platforms which do not require Internet to get access, such as TV, Radio and Newspaper

Extended Abstract

My thesis investigates the topic regarding media effects and financial stability, which makes valuable contributions to the current literature and financial industry. Through the study of this thesis, it reveals that the media can indeed manipulate financial stability via controlling different aspects of media, including the type, concept, the post information, the sentiment etc. I believe the findings of thesis would be benefit for not only the policy makers but the individuals who desire to invest in financial market. Specifically, the findings of my thesis would help the policy makers aware of the media power to adjust their monitor level of media industry. At the same time, individual investors may seek opportunities via media platforms and information posted on Twitter. For those who intend to explore links between media and financial world, this thesis would help them establish a better view of current literature and research outcomes related to media and financial aspects.

For indicating different aspects of media effects, this thesis focuses on three research questions, which are presented as separate chapters 1-3. In chapter 1, I focus on the effects of two media formats (traditional and modern media) and three media concepts (media freedom, concentration and ownership) on financial stability. For defining financial stability, I distinguish it into two specific aspects, which are banking stability and financial market stability. Multi types of regression models (OLS, 2SLS and GMM) are applied to analyse the relationship based on data analysis of OECD countries from 2002 to 2016. After the empirical analysis, I find that TV and the Internet both have significant negative effects on financial stability. For other media formats and factors such as Radio, Newspaper, and media freedom, the influence behaves differently depending on the financial environment (banking or financial market).

Chapter 2 is related to social media and financial stability, which investigates how the volume of Tweets and sentiment of Tweets could affect financial stability, established by the banking stock market stability and trading volume. After using a sample including

73 listed banks selected from the NYSE and FTSE 100 index, the primary results indicate that both Tweets volume and Tweets sentiment have significant effects on banking stock market stability and stock trading volume., The novel finding is from the Tweets sentiment, as the number of sentiment Tweets show opposite effects on stock market stability compared with the number of Tweets. Specially, the Tweets volume show a significant positive effect on stock market stability, yet a significant negative effect of sentimental Tweets on stability. The results of this chapter indicate the importance of sentimental information and thus, we should pay attention to information with strong sentiment on a social media platform.

As we know, in 2020, the global pandemic of COVID-19 came across as an unpredictable, unexpected and rare event to the world. The governments around the world announce and carry out strict regulations to control the spread of the COVID-19. For supporting the firms especially during the quarantine, the governments also inject funds into businesses and increase interest rates. Based on that, in Chapter 3, my purpose is to investigate and compare the media coverage and real factor effects of COVID-19 on financial stability from the bank liquidity and bank stability aspects, viewing from three different time waves based on weekly data from six countries with over 30,000 observations from 1st March 2020 to 1st March 2022. The results indicate that both media coverage and real factors of COVID-19 significantly affect bank liquidity and bank stability, and most of the real factors could be harmful to bank liquidity and stability, yet some evidence shows a benefit could exist such as the number of vaccinations. Based on the results, we should continue following the government's suggestions and getting vaccination.

Introduction

The role of information is becoming increasingly essential in an individual's daily life as different media platforms arise and develop in the 20th Century, especially after the Internet boost. Essentially, the use of the media is for delivering and sharing messages among the public. The functions of information sharing include several aspects such as political, economic, entertainment and general communication. For the political aspect, information delivered via media could make the public aware of the government policies and provide a way of seeking help via an official platform. For the economic aspect, information could be a vital part of the financial life in that private investors require a large amount of financial information and any announcements regarding financial activities for predicting or monitoring their investment activities. Moreover, information in the financial world also takes an important part in Corporate Finance, Banking System, Accounting and the Stock Market. For the entertainment and communication aspects, the media, especially social media makes it possible of playing videos, chatting with others and reading the news only with the mobile or any technical devices.

One study carried out by Fang and Peress (2009) mention that the popularity of media emphasises the importance of mass media outlets such as newspaper. In their study, the data record that around 55 million newspaper copies are sold to individuals every weekday in the U.S., which takes approximately 20% proportion of the U.S. population at that time without considering the online subscriptions and multiple readers per copy. Hence, from only the newspaper aspect, the real readership would be much higher than the figure shown.

According to this phenomenon, it indicates that mass media/traditional media plays an important role in disseminating information to a broad audience, especially to individual investors.

We know that media is a relatively broad topic and can be viewed from different aspects. Over the last century, popular media platforms have been changing from the traditional (TV, newspaper, and radio) to modern (social media and online websites). Compared to the past, the Internet are now essential and vital tools for delivering and sharing information as it connects the public and the government from all around the world into one virtual community. Now, there are various kinds of different social media platforms to gain information such as Twitter and Facebook. Twitter can be regarded as a highly influential platform among these. Twitter can be regarded as a more authorised platform for a large amount of official account registration (e.g. CEOs of world-leading companies, members of the government from different countries). Plus, its leading number of active users throughout other platforms. According to its official data record, by the end of 2020, it is recorded over 300 million Twitter users, which makes Twitter a vital and influential media platform. With the posting and basic social functions, Twitter becomes the most popular information-sharing social media platform among others.

When we focus on the modern media effects, the website search or investor attention should also be noticed. The Internet web 2.0 provides a brand-new way for individuals to search for information. Now, we can not only share and post information on social media but also share and gain information via the website such as blogs, Yahoo Finance, BBC

news official website etc. Those websites provide users with chances and convenience to seek the required information. For example, in real life, when an investor desire to make a stock investment decision, it is highly possible to look for information on Yahoo Finance and any news websites regarding stock firms. Apart from the investment purpose, there are many different reasons to use the website searching function. For example, looking for jobs, learning skills, entertaining etc.

By viewing the existing literature, I find that there are studies increasingly investigating the social or modern media effects on various aspects. For example, Kalampokis *et al.* (2013) and Sun *et al.*, (2016) review studies exploring social media effects and its predictive power of it for various applications, which they find that social media information has become a popular source for stock market prediction. Bukovina (2016) reveals that social media is not only able to facilitate communication and information sharing, but also a giant database, which is the 'big data' of social behaviour. With the development of Internet and increasingly online user registration, Nikkinen and Peltomäki (2020) find that web searches will bring the attention of news articles. In addition, they point out that the web search has a deeper impact as it has an immediate effect on stock price and the VIX index based on their study. Cheng and Liu (2018) explore the performance of firms. The results show that when the web search is focused on the public of the firm, it shows a better environmental performance, especially for the state-owned businesses. Although there are many existing studies exploring the online media effects on financial world, the traditional media effects still a mysterious to the financial world. Hence, I intend to investigate not only the online media but more importantly, the traditional media effects on financial world.

We can notice that the power of media is expanding not only for the information system but the financial system. For example, recent news regarding the UK shortage of van drivers especially delivering the fuel after the Brexit at the end of 2021, causes a panic of fuel supply in almost every area of England, which in results of the oil price increase to a peak level through the whole country by 2021. This is the media news power on the economic system. In this regard, media effects could be much significant than our expectations. Hence, we need to think if the media has ability to affect financial world. In addition, if the content and sentiment of news could be manipulated, and what could happen to the financial system? I aim to answer those questions in this thesis based on empirical analysis.

To answer these questions, I separate my thesis into three chapters to focus on three different research questions related to media effects on financial stability through different time periods and sample regions. Chapter 1 is related to the effects of media format (traditional and modern) and media concepts (media ownership, media concentration and media freedom) on financial stability, viewing from the OECD economies throughout the year from 2002 to 2016. This chapter is mainly for analysing and comparing the differences between traditional and modern media effects on financial stability. At the same time, indicating the influence of media ownership, media concentration and media freedom on financial stability. This chapter mainly focuses on the topic of media and is viewed from a whole vision of the topic of media effects. Different from Chapter 1, Chapter 2 is for analysing the effects of social media-Twitter, specifically Twitter sentiment and the number of Tweets on financial stability, which focuses on a more specific topic in the media industry compared with Chapter 1. This chapter also includes stock market data to indicate the media

effects on financial system stability, using a daily time-focus horizon for investigating media impacts based on a specific direction. Chapter 3 explores a more recent and popular topic, which is related to the coronavirus (COVID-19)- a pandemic around the world that hits the development of the economy in many regions. In Chapter 3, the key objective is to analyse the impacts of the attention to the COVID-19 information on financial stability. Different from Chapter 1 and 2, this Chapter is to investigate whether the news and information be noticed would indeed have a significant influence on our economic system, and how it could impact financial stability.

For carrying out this thesis, I believe it will contribute to both academic and industrial aspects. First, the results show that media factors have power to affect financial stability through banking sector and financial market sector. Specifically, both traditional and modern media have significant effects on financial stability, and more importantly they show different impact on different financial environment (i.e. banking or financial market) other than similar effects demonstrated in the literature (e.g. Sundar *et al.*, 2012; Ceron, 2015; Lepori, 2015). Specifically, the traditional media shows a strong power of harming financial stability especially for TV, which has not been revealed from other studies. In the opposite, the modern media indicates a benefit for financial stability, which helps to identify the ability of modern media on financial environment, as previous studies such as Yu *et al.*, (2013) and Jiao *et al.*, (2020) merely indicates its impact on financial market but its sign of effect. Hence, the results contribute to further research and current studies. From the social media side, the results indicate that financial market is sensitive to sentimental information as I find new evidence that media concept is actually an important factor when linking to

financial system. In addition, Twitter sentiment shows its influential power to financial market, and not just to predict the stock market like shown in other studies (e.g. Mao *et al.*, 2011; Souza *et al.*, 2015). Second, I find that information covered by media (i.e. the searching volume of keywords) works as an influential factor during the Covid. Third, my thesis will contribute to the current literature and researchers, who intends to explore the link between media and financial perspective as there is little existing studies which empirically related financial stability. I believe my thesis will provide practical method and useful information to researchers. Finally, my thesis fills the research gap between media type, media concepts and financial stability as there is no empirical studies investigating this. The findings of my thesis would have some important implications and benefit for the government and banking stakeholders, as well as market players for seeking stable financial environment via monitoring and adjusting different media platforms and ownership structure as well as freedom environment. The government and bank owners may monitor the banking stock market and stabilise it via adjusting some news contents, and they can be more rational as aware of media power. Also, They can seek some profit opportunities on Twitter or post themselves regarding stock information. The finding shows that the COVID-19 vaccine has advantages to our financial system but the total death number would be an issue. Therefore, the government can encourage individuals to get vaccination and try to increase the public awareness of vaccine.

The rest of my thesis is structured as follows: Chapter 1 will be followed by this section, in which the topic is how traditional and modern media affect financial stability. In Chapter 1, it includes information regarding traditional media (TV, Newspaper and Radio), modern

media (Internet), media ownership, media concentration and media freedom. The background information and related studies regarding the concepts mentioned above will be introduced in Chapter 1 in detail, and it will indicate how those factors could affect financial stability viewing from banking Z-score and stock volatility. Chapter 2 will discuss the topic of social media effects, which explores Twitter-specific effects on financial stability. This Chapter introduces the importance and popularity of social media, especially Twitter in modern society, as well as the effects of Twitter volume and Tweets sentiment on financial (banking) stability, viewing from bank stock volatility and bank stock exchange volume. Chapter 3 focuses on the topic of the information attention/media coverage of COVD-19 effects on bank liquidity and stability, viewing from different spread stages. In this Chapter, a novel virus COVID-19 will be discussed and analysed from the aspects of its media coverage effects and real effects on financial stability, viewing from the COVID-19 concentration (indicated by Google trends search Index).

Under each chapter, you can find its Introduction, Literature review, Research questions/hypotheses, Methodology, Data Analysis and Conclusion. At the end of this thesis, an overall conclusion is also applied for summarising all three Chapters and the results as well as policy impactions.

Chapter 1

How traditional and modern media affect financial stability

1. Introduction

In modern society, information is not only a simple piece of message to deliver, share and exchange, but a useful tool to analyse for trading and investing in the financial life. From the last century, the importance and practicality of information have already been noticed. The classic theory behind information, which is the EMH (Efficient Market Hypothesis), was firstly introduced by Eugene Fama's (1970) and has been widely accepted and studied in the financial literature for a long time even up to now (e.g. Lim *et al.*, 2008; Szafarz, 2012; Ying *et al.* 2019). Under the EMH theory, it demonstrates that the security market is extremely efficient in reflecting information regarding individual stocks as well as the stock market. In a general word, it means that the stock price will react immediately (increase or decrease) to the news, announcements or any other information related to the stock. For instance, if a company makes an announcement regarding a merge and acquisition, the stock price will either increase or decrease according to that announcement. As the EMH describes a phenomenon that the stock price will act immediately according to any news and information that arises, neither the technical analysis (to predict future stock prices) nor

fundamental analysis (analysis of financial information to help investors select "undervalued" stocks) would enable an investor to achieve returns greater than those that could be obtained by holding a randomly selected portfolio of individual stocks.

According to the description regarding EMH above, it reveals that information plays a fundamental role in the efficiency of the financial world (specifically the stock markets). It will have a direct effect on stock price. A question may arise here regarding the effectiveness of the EMH. If it is possible for the information to be manipulated? There is plenty of daily information we receive. For the financial aspects, information is used to make investments, control potential risks and the government may establish policies based on market information. However, that information publicly received may be covered by the truth or manipulated by agents. Hence, in this regard, how the information will be delivered and handled would be important. In the financial world, both the financial and macroeconomic as well as microeconomic areas are based on using available information to operate, monitor and make investments. Both investors and businesses try to use the information to earn profits (e.g. purchasing and selling stocks), manage risk (e.g. assessing market share and opportunities) and establish or adjust policies. Specifically, the information allows a more sophisticated market analysis as well as better monitoring and evaluation of events which are significant not only for the agents' financial decisions but most importantly, for the stability of the financial system. As the EMH indicates, information will affect stock price/stock market, and there is no doubt that the stability of the stock market is related to the whole financial system stability. A typical stock market crash is the well-known 2007-08 financial crisis, which infects globally. The DJIA (Dow Jones Industrial Average) falls

around 750 points in intraday trading and the whole market crashes as the bank bailout fail. Regarding the discussion above, it is believed that the information would be a vital factor in the stability of the whole financial system.

Today in the 21st century, we gain various kinds of daily information via multiple ways. As the Internet has rapid developed over the last century, information platform can be simply divided into two categories, which are the traditional media platform (e.g. newspapers, radio broadcasts, television) and the Internet-based/modern media platform (e.g. websites and social media). The key difference between traditional and modern media platforms is the requirement of the Internet access. Before a decade, the popular media platform to gather information should rely more on the traditional way (such as TV, Newspaper and Radio). However, with the rapid development of the Internet and its popularity in our life especially after 2010, more individuals and agencies prefer to collect information via the Internet (such as Websites and social media). With the popularity of the Internet access, we are able to receive messages much more frequent compared to the past. Hence, it is important to distinguish it when handling with loads of different information. For traditional media, the message delivered is much convinced as those can be seen as 'official' information. For the modern media, especially the social media such as Twitter and Facebook, the message we receive may include much fake and false information, as everyone not only the official account can post a message via social media. Hence, when we receive messages from these platforms, we may trust some messages that are actually fake and result in the wrong decision when we use the information to make investment action. Even for the traditional media, it could still be manipulated. In many areas, media can be

partly or even totally controlled by the local government, rich families and financial institutions which own a large number of shares of the media industry. Therefore, the information we received may provide a biased version of the truth no matter what kinds of media platforms, and information affects the stock market, which could lead to harmful results for the financial stability system in the end. For not only investors but depositors as well as market players, who all need to trade using available information. The development of media and the relevant information that is produced are regarded as being increasingly influential in the financial world. Thus, access to the relevant information is very important for those market traders. For most individual investors, the online websites such as Google is one of the key information sources for collecting financial information. As Joseph *et al.* (2011) mention, individual investors usually search for information via Google when they desire to make stock investments. In this regard, the first thing that needs to investigate is if the media has power to influence financial system, specifically financial stability and then to discover how (in what way) media could affect financial stability.

As discussed above, now information has been spread fast, and the likelihood of accepting biased information also increased. From this regard, whether information could affect the financial market and system becomes an unsolved question. In a more specific way, whether information could be manipulated by the government or large media companies even private information agencies? If they do so, how does it affect our financial system and whole financial stability? As we know, the financial market especially the security market depends extremely on the information. In this regard, how it will affect our financial environment? Should we regard information as a vital part of the financial area?

How information can have an impact on financial activities via media tools, and our financial stability system? These kinds of questions still unclear and need to be investigated now.

As this chapter aims to investigate the relationship between media and financial stability. Media category should be the first factor to specify in that information is required to be delivered and share, different media platforms may affect the information contents and credibility differently. For traditional media platforms such as TV and newspaper. There is a great chance that information is delivered by an authorised agent, including the government-controlled official TV channel (e.g. BBC News) and newspaper (The Times). The information contents via these official platforms are more likely convincing and less-biased. However, for modern media platforms such as website, Twitter, and Facebook. There is a higher chance that the information is fake and biased as most of the users are personal accounts and not authorised by any official agency or the government. Hence, a problem may arise that the unauthorised news could be spread quickly and the information related to the financial aspects is possible to impact the stock market price and thus the stock market stability as a server consequence. The discussion above is only a one-sided view of the traditional and modern media. From another side, the government-controlled media yet could also have a negative impact on the information delivered. As higher government control means that the government has the rights to decide when and how the information be posted, and even the content could also be modified. Hence, from this view of point, traditional official media platforms may also deliver biased news. However, it may not be harmful to financial stability compared with modern media platforms, as the government is

aimed to expand and stimulate its economic condition. On the modern side, as everyone sharing and posting personal views and in-time news via the Internet, there is also a chance to read and see the most reliable news. The issue is that it may be sunk by millions of posts each day. All in all, no matter fake or non-fake news, the information delivered by platforms is able to affect the financial world and financial system. From this point of view, this research believes that both traditional and modern media platforms may have impacts on financial stability and thus it is necessary to identify any differences exist between the traditional and modern media effects.

Besides its type, it is also essential to specify media concepts. According to literatures (e.g. Liu and McConnell 2013; Houston *et al.* 2014; Ambrey *et al*., 2016; Starke *et al*., 2016 and Sjøvaag and Ohlsson, 2019), this chapter believes three media concepts as important, which are media ownership, media concentration and media freedom. Media ownership is simply the ownership type (i.e. government-owned or private owned) of one media agency or company, and it is under the assumption that ownership can have an impact on the contents and practices of the published news (Sjøvaag and Ohlsson, 2019). The explanation behind this is quite similar to the explanation of traditional and modern media platforms. The government-owned media is able to manipulate the information content so that affects the financial world, and vice versa. Media concentration can be seen as the concentration of media ownership, which is regarded as a high concentration with a large proportion of state-owned media platforms and vice versa. In the real world, if a country with high media concentration, it is possible that information is controlled by the government. Hence, it can be realised to stable the financial stability of the government. Media freedom (also as

freedom of the press) is the principle that expression through different kinds of media platforms, including printed, digital, online, and offline media, should be considered a right to be exercised freely (Ambrey *et al*., 2016; Starke *et al*., 2016). Theoretically, a country with a high concentration should have low freedom. Media freedom also affects financial stability via information platforms. The reason is also similar to traditional and modern media. A high-freedom environment is just like social media platforms such as Twitter. Information is able to be shared, posted and spread fast, and at the same time, the stock price will be reacted to information shared so that leads to impacts on financial stability. From the discussion of the media type and media concepts, this chapter hereby believes that it is essential to include them in the analysis of media effects on financial stability.

The main objective of this chapter is to explore how the media affects financial stability. For the importance of financial stability, it usually means the sounding situation of the whole financial system or the absence of system-wide episodes where the financial system fails to function, and it is also related to the resilience of the banking system to stress (the World Bank, 2018). literatures also indicate (e.g. Anginer *et al.*, 2018; Noman *et al.*, 2018) that financial stability is vital for a sounding economic environment and the financial system (financial markets and banking systems). In a stable financial environment, the system will absorb the shocks primarily via self-corrective mechanisms, preventing adverse events from having a disruptive effect on the real economy or on other financial systems. In addition, financial stability is paramount for economic growth, as most transactions in the real economy are made through the financial system. Besides, financial stability is important not only it reflects a sounding financial system, but it also reinforces trust in the financial

system and prevents some unhealthy economic situations. Under an instability situation, the financial market may experience bankruptcy, credit crisis and economic crush. Hence, monitoring financial stability and understanding the influential factors to financial stability is beneficial for the whole financial system.

When defining financial stability, it cannot be defined from a single aspect as it includes a whole complex financial system according to Anginer *et al.* (2018), viewing from macro and micro-economic aspects, as well as stock market and banking stability aspects. Hence, I intend to analyse financial stability from two main aspects, which are the financial market and the banking side. For the stability in the financial market/security market, Baur and Schulze (2009) reveal a definition of financial market based on stock markets and they define that financial market stability is connected with a constant impact of shocks in normal and extreme market situations among the stock market. The results of their study revel that the stability of financial market is an essential part of whole financial system stability. On the other hand, banking stability is also essential to maintain because when the banking system starts to imbalance (instability), banks are reluctant to finance profitable projects, asset prices deviate excessively from their intrinsic values, and payments may not arrive on time. The importance of banking functions are also mentioned by Wagner (2007). The well-known global financial crisis of the 2007-2008 is also a typical example of the failure of banking stability and exposes the issue of the banking system's fragility. Based on the common acknowledgement, the banking system is one of the most important parts of the whole financial system. The 2007-2008 financial crisis highlights the importance of monitoring the performance and regulations of both financial market and banking system.

After the financial crisis, it has been witnessed that the government set up massive interventions to control and monitor banking behaviour, especially in mergers and bank bail-outs. Major banking instability can lead to bankrupts and then may lead to severe consequences to the whole economy (e.g. hyperinflation and stock market crash) due to the contagion effects among banks. It is believed for a long period that an relationship exists between banking stability and financial stability (Repullo, 2004; IJtsma *et al.* 2017) as the banking industry serves as a major conduit through which instability may be transmitted to other sectors of the economy by disrupting the interbank lending market and payments mechanism, by reducing credit availability, and by freezing deposits. In addition, bank failures also directly increase market concentrations and therefore, impact the whole financial system.

Apart from that, bank also plays an essential role in financial intermediation as it facilitates efficient capital allocation and maturity transformation (Ingves, 2015). As we know, one of the banks' central roles in the financial system is the creation of high liquid debt claims. However, this can lead to excessive risk-taking behaviour, which, if not appropriately accounted for, can increase vulnerability to financial stocks such as the 2007-2008 financial crisis. Moreover, these negative impacts are indiscriminate, affecting a wide variety of sectors including even the labour market and spreading distress across borders. Besides, for the importance of the banking system, it can be noticed from the new Basel III framework, which aims at enhancing greater financial system stability (also reducing the probability of financial crisis) based on the regulatory targeting banking system especially after the 2007-2008 financial crisis. Studies also revel the importance of banking system in

financial stability. Acharya and Ryan (2016) point out that banks' development of debt and risk overhangs in the economy has effects on the stability of the financial system, especially when these debt and overhangs issue happens on the asset side of a bank, which will lead to a liquidity problem on the liability side, and the problem would result in a sever outcome of the financial environment in the end. They give an indication of two common points generally agreed upon in the banking system field. First, the bank is essential to the whole financial system stability as it is the primary backstop provider of liquidity in the economy and issuers of federally guaranteed deposits. Second, stability is enhanced by restraining banks' undisciplined investment financed by readily available credit in the economy. From the view of Acharya and Ryan (2016), there is no doubt that bank has connections with financial stability. For the importance of stock market and banking system in financial system, I hereby will specifically explore the media effects on stock market and banking stability.

For demonstrating the media effects of traditional and modern platforms, Goodrich and De Mooji (2014) indicate that both traditional and online media have significant influence, and no obvious differences among these two media platforms when analysing purchasing ability on customer behaviour. In this regard, a question arises: Do both traditional and modern media have similar significantly effects when referring to financial stability? Yu *et al.* (2013) suggest that traditional media have a strong interaction effect on stock performance, and the volume of traditional media complements reduces the uncertainty associated with the stock prices. In this regard, I believe that traditional media as an information intermediate, it may link to stock price volatility as results indicated by Yu *et*

al. (2013). For modern media side, Shin *et al.* (2015) show that consumption of news from websites is associated with higher trust. Hoffmann and Lutz (2015) illustrate that the Internet access could be expected to increase stakeholders' engagement in corporate affairs and facilitate good governance. Starke *et al.* (2016) and Enikolopov *et al.* (2018) suggest that the Internet-based media can discipline corruption. Hence, I believe that online media gives opportunities to the public to gain additional information and increase public trust. However, will this possible positive effect also exist in financial system? I aim to answer it in this chapter. For the effects of media concepts, I aim to find out if media ownership, media concentration and media freedom could harm or benefit financial system, as there are several studies reveal their relationship to corruption and independency issues (Houston *et al.*, 2011; Okwuchukwu, 2014; Starke *et al*., 2016; Mala and Hao, 2018).

From all discussions above, I believe that media may have the power to strongly affect financial stability. For giving a better and deep analysis of the relationship between media factors and financial stability, I specify my objectives into the followings: (i) find out two different media types (traditional and modern) effects on the financial market and banking stability; (ii) explore three media concepts (media ownership, concentration and freedom) effects on financial market and banking stability; (iii) are these media effects all show statistical and economic significance to the financial market and banking stability, respective; (iv) are these media effects harm or benefit for financial market and banking stability; (v) fill the literature gap between media and financial stability.

For investigating the relationships, I follow the methods provided by Djankov *et al.* (2003) and Houston *et al.* (2011), using the three media concepts index and traditional and modern media ratio extracted from TV, Radio, Newspaper, and the Internet access to indicate all media factors. Following financial stability studies (e.g. Leroy and Lucotte 2017; Berger *et al.* 2018), I use stock price volatility and bank Z-score to indicate stock market and banking stability, and apply OLS, GMM and 2SLS to indicate the media effects and check endogeneity issues. In addition, I also apply 7 different dependent variables to test the results for a robustness purpose. After empirically analysing the relationship between media and financial stability, the finding indicates that media indeed affects financial stability, which is consistent with Houston *et al.* (2011) and Yu *et al.* (2013). Specifically, the TV and the Internet both significantly negatively affect financial stability for both financial market types (i.e. banking or financial market). For other media formats and factors such as Radio, Newspaper, and media freedom, the influence behaves differently depending on the financial environments (e.g. radio has negative effects on banking stability but positive effects on financial market stability; newspaper positively affects banking stability but negatively affect financial market stability).

For the media concepts, the results show that media freedom, ownership and concentration also significantly affect financial stability, which agrees with Houston *et al.* (2011) and Enikolopov *et al.* (2018). For media ownership, it reveals that a stated-owned ownership would harm financial stability viewing from both banking and financial market, which is also consistent with the hypothesis. As for media freedom, for banking stability, a higher free environment would benefit bank stability as Ambrey (2016) indicated that a free

environment would expose corruption. However, in the financial market, a higher freedom environment seems not to benefit from its stability. Similar to media freedom, for the financial market, the finding indicates that it requires a higher concentrated state-owned media platform (i.e. government need to control more market share and power). However, for the banking side, the higher the concentrated state-owned media platform, the higher chance of bank corruption and so that more easily lead to bank instability.

For the meaning and contribution behind this chapter, first and foremost, it is to fill a research gap between the traditional media, modern media factors and financial stability. Recent studies focus on financial stability mostly indicates and concentrate on the relationship between financial aspects (e.g. bank concentration and bank competition) and financial stability (Jokipii and Monnini, 2013; Creel *et al.*, 2015; Holmström, 2015; Ingves, 2015). There are little studies to explore the information/media aspect effects on financial stability. As mentioned above, information is regarded as increasingly important compared to the past, and its influence on the financial market side cannot be ignored, I hereby carry out this chapter and fill the research gap based on an empirical analysis.

Secondly, I believe the results would be benefit for the government, the policy makers and investors and it would add new information and ideas to the existing literature. Specifically, the results indicate a powerful media tool it is. It confirms that we can manipulate the financial stability via the media, and traditional and modern media are actually perform differently other than show similar effects mentioned in existing studies (Sundar *et al.*, 2012; Ceron, 2015; Lepori, 2015). The results indicate that traditional media

shows more negative effects but the modern media shows more positive effects on banking stability. However, from an economical view, these effects are not easy to hit banking stability during a short-time period as the original figures of these factors are quite high except the Newspaper ratio. However, if we view from a long-term horizon, these factors all need to be considered. The results of this chapter also contribute to the literature of investigating effects of media ownership, concentration and freedom. I find interesting outcomes that the effects of media concepts show differently among differently financial environment. For the financial market, these factors show consistent results to the existing studies (i.e. media ownership and concentration harm financial market but media freedom enhance it; both effects are statistical significant). However, for a banking system, media freedom shows a negative impact yet media concentration behaves a beneficial factor. My findings contribute to the current studies and specify the financial environment, which confirm the same media factor could show different impact when the financial environment changes and reveal the possible reasons behind this. Thirdly, the method used in chapter 1 would provide a whole new direction and approach to the readers who intend to explore these two areas in the future. I also collect and create the ownership and concentration index for modern media based on the methodology provided by Djankov *et al.* (2003), which provide a new way of indicating the modern media ownership and concentration data.

The rest of chapter 1 is organised as follows: section 2 will discuss some previous literature focusing on the related topics of media effect and financial stability. section 3 will introduce the main hypotheses based on the current literature and section 4 will discuss the methodology used in this chapter, including the data collection method, variable

descriptions, and econometric modelling. section 5 will focus on the basic data analysis, including the statistical summary and correlation analysis. The main regression results will also be discussed in section 5. Section 6 will summarise all the results and give a conclusion of the main findings, as well as imply potential policy implications based on this research.

2. Related literature

2.1 Traditional media and modern media

Traditional media, old media or legacy media are the mass media institutions that are available to the public prior to the development of the Internet; particularly printing media, film studios, music studios, TV and radio broadcasting (Goodrich and De Mooji, 2014). Traditional media is the most basic media tool that we are familiar with for gathering information over the past decades before the popular acceptance of the Internet. For the word 'traditional,' we can easily link it to some classical offline media platforms such as TV, radio and newspaper. According to Lu and Hindman (2011), they indicate that the most common and popular traditional media tool is the TV. This can also be identified from the data, which the TV ratio (household with TV) is the highest one among three classical media platforms (i.e. TV, Newspapers and Radio). However, with the increasingly development and acceptance of the Internet around the world from 20th Century, new types of media platforms arise (Lu and Hindman, 2011; Nielsen and Schroder, 2014). People start to seek information via the Internet. We begin to browse the website to gather financial information, use financial apps and do online investments via PC and smartphone. All these above are

based on the access of the Internet. In this chapter, it considers these media formats as the Internet-based media or modern media.

For both traditional and modern media, they have surprisingly not been the subject of extensive research in the financial world. Not much research has examined the relationship between media and financial-related topics. For the existing literature regarding traditional and modern media, Yu *et al.* (2013) investigates the effects of traditional media (including newspapers, TV, broadcasting companies and business magazines) and social media on short-term firm stock market performances. Their finding suggests that both traditional and social media have a strong interaction effect on stock performance, and the volume of modern and traditional media complements each other to reduce the uncertainty associated with stock prices. These two studies indicate that the traditional and modern media link to the stock market. In addition, Xie and Jiang (2019) explore the relationship between traditional news and the prediction of Chinses stock market. After collecting over 2,000,000 news for an 8-year time period, their results indicate that news indeed impacts the stock market, and the news quality and audience number could impact the financial source. Another study carried out by Jiao *et al.* (2020) study the coverage of traditional news and social media effects on the stock market, and their results also reveal an impactive relationship between these two factors.

For the previous studies which sought to explore the effects of traditional media, there are some reveal the relationship from financial market side. Specifically, Birz *et al.* (2011) measure news related to macroeconomy to estimate its effect on stock returns since

newspaper stories provide an interpretation of the statistical releases. The findings indicate that news about GDP and unemployment does affect stock returns. Another study carried out by Ammann *et al.* (2014) investigating newspaper effect, analyse whether newspaper content can predict aggregate future stock returns. They summarise newspaper content in a systematic way by constructing word-count indices for a large number of words. Word-count indices are instantly available and potentially valuable financial indicators. Their finding is that newspaper articles have provided information valuable for predicting future DAX returns in and out of the sample. They find evidence that the predictive power of newspaper content has increased over time, particularly since 2000. The results suggest that a cluster analysis approach increases the predictive power of newspaper articles substantially. In addition, Birz (2017) employs a classification of headlines from newspapers and wire services to examine whether stale macroeconomic news affects stock prices. Unlike individual stocks, the cost of obtaining information about major economic releases is relatively low. Thus, stock prices should adjust to economic news announcements prior to their coverage in newspapers. Birz (2017) finds a statistically and economically significant relationship between stale news stories on unemployment and next week's S&P 500 returns. This effect is then completely reversed during the following week. These findings show that investors are affected by salient information and support the hypothesis that investors overreact to stale macroeconomic news reported in newspapers. A more recent study by Peress and Schmidt (2020) shows the impact of noise traders' limited attention on financial markets. Specifically, they exploit episodes of sensational news that distract noise

traders. They find that on "distraction days," trading activity, liquidity, and volatility decrease, and prices reverse less among stocks owned predominantly by noise traders.

There are also studies indicating the traditional media effects but adding the sentimental elements. Lepori (2015) employs a novel discrete mood proxy to investigate the response of the U.S. stock market to exogenous daily variations in investor mood. Drawing upon the psychology and communication literature, which documents that the end of popular TV series causes negative emotional reactions in large numbers of television viewers, the author employs major TV series finales (between 1967 and 2012) as mood-altering events. The results show that an increase in the fraction of Americans watching a TV show finale on a given day is immediately followed by a decrease in U.S. stock returns. This effect is stronger in small-cap and high-volatility stocks, whose pricing is more sensitive to sentiment, and is consistent with the hypothesis that negative mood reduces the demand for risky assets. Moreover, Strauß *et al.* (2016) investigate news with sentimental factors (emotions) in Dutch newspaper articles and their effects on, and responses to, opening prices of 21 stocks listed on the Amsterdam Exchange index from 2002 to 2013. With regard to the financial context, they employ a selection of the Dutch Linguistic Inquiry and Word Count dictionary to automatically content analyse emotional tone in news articles. Neither positive nor negative emotions in news articles show consistent effects on the opening prices of stocks the following day. Granger causality tests suggest, however, that newspapers rather reflect movements in the stock market the following days by using more negative emotional words after an increase in the change of the opening prices.

When bringing the Internet to the media platform, such as web search and social media, studies by Bollen *et al.* (2011); Mao *et al.* (2012) both indicate its importance in the stock market. In addition, several studies also investigate its impacts on political side. For instance, Enikolopov *et al.* (2018) show that online media (blog) posts which exposed corruption in Russian state-controlled companies, have a negative causal impact on their market returns. Furthermore, they indicate that the posts are ultimately associated with higher management turnover and fewer minority shareholder conflicts. In conclusion, their results suggest that the Internet-based media can discipline corruption even in a country with limited political competition and heavily censored traditional media. Starke *et al.* (2016) also believe the global rise of the Internet access and e-government also increases the likelihood for corrupt public officials to be exposed. They indicate that the Internet access and governmental online service delivery significantly reduce corruption at the country level.

Furthermore, Ceron (2015) investigate the relationship between the Internet usage and political trust via performing a cross-sectional analysis of Eurobarometer survey data related to 27 countries and a supervised sentiment analysis of online political information broadcast during the Italian debate on the reform of public funding of parties. The results show that consumption of news from information/news websites is positively associated with higher trust. In addition, according to Shin *et al.* (2015), researchers argue that online media such as the Internet are critical platforms not just for organisations to disseminate information but also for them to interact with stakeholders through feedback or dialogic. In fact, the interactivity of online media, which allows organisation–public interactions, conversations,

and user engagement, has been found to be associated with various positive outcomes, including increasing consumers' trust, enhancing product knowledge, and higher positive attitude toward online advertising and purchasing, as well as maximising organisations' profit (Sundar *et al*., 2012; Shin *et al.,* 2015). Moreover, Hoffmann and Lutz (2015) illustrate that online media provides new opportunities for citizens and stakeholders to be informed, identify common interests, express, and share opinions and demands, organise, and coordinate interventions. Therefore, the Internet could be expected to increase stakeholders' engagement in corporate affairs and facilitate good governance. They analyse studies from the field of business participation and find a strong bias among consumer engagement and marketing issues.

Different from the studies mentioned above, a study by Chong *et al.* (2018) investigates the relationship between social media effects and bank loan contracting, which they find that banks provide a more favourable price for their loan contracts to those who receive positive feedback from social media. Based on that, this study provides evidence that social media reduces the cost of bank loans by decreasing information asymmetry between borrowers and lenders in the capital markets. There is also one study compare both traditional and modern media effects, Jiao *et al.* (2020) study the effects of traditional news media and modern social media on stock volatility and turnover, which they find that coverage by traditional news media predicts decreases in subsequent volatility and turnover, but coverage by social media predicts increases in volatility and turnover. The results are consistent with a model so-called "echo chambers," where social networks repeat news, but some investors interpret repeated signals as genuinely new information.

Based on the literature above, it is clear that both traditional and the Internet-based media may have power to affect financial and political world, which could have influence on stock price, financial market and government corruption even bank loans (Bollen *et al.*, 2011; Mao *et al.*, 2012; Hoffmann and Lutz, 2015; Chong *et al.*, 2018; Jiao *et al.* 2020). However, if the traditional and the Internet-based media have and have similar effects on our financial stability system, it still need to be investigated.

2.2 Media ownership, media concentration and media freedom

For the media area, there are some important concepts regarding it besides the format (traditional and modern), which includes media freedom, media concentration and media ownership. Media ownership is under the assumption that ownership can have an impact on the contents and practices of journalism. Ownership of news media can take many forms such as state ownership, family ownership, party ownership, trust ownership, public and corporate ownership (Sjøvaag and Ohlsson, 2019). Media concentration refers to the concentration degree of ownership. For example, a high government concentration indicates the local government controls most of the market share in the media industry or most of the owners of the media industry come from the local government. Media freedom (also known as the freedom of the press) is the principle that expression through different kinds of media should be considered a right to be exercised freely (Ambrey *et al*., 2016; Starke *et al*., 2016).

According to the literature related to at least one of the three media concepts, it is believed that media concepts have impacts on media content, and thus it may affect political

and economic issues. First, many studies demonstrate that media ownership has notable effects on news content (Dunaway 2013; Abdenour 2018; Archer and Clinton 2018; Hedding 2019). Specifically, these studies investigate the media ownership effects based on the different events and focused samples, yet the results are similar (i.e. ownership affects news context). For a relative recent study carried out by Hedding (2019), investigates the 'Sinclair effects' (Sinclair is one of the largest broadcast groups of the U.S. television station) on news content and compares the news of national politics from Sinclair stations with government-owned stations. Results indicate evidence of 'Sinclair Effects' on news quality and contents. It is shown that Sinclair-owned stations display more cable news-style elements and it produces more stories with dramatic elements. This finding is also consistent with Abdenour (2018) and Archer and Clinton (2018). Dunaway (2013) also studies ownership effect but from the aspect of news outlets' ownership on different tones (i.e. positive, negative and neutral) in campaign news coverage. It indicates that negative bias is sometimes shown in political news, and it reveals that media ownership could affect the possibility of tones in news. Based on its results, Dunaway (2013) suggests that the media ownership of corporate, chain and non-local would all have consequences for news tone, which reveals that compared to privately-owned, publicly-owned traded corporations produce fewer substantive political stories, less local news overall, and more negative coverage of elections (Dunaway 2013). Archer and Clinton (2018) believe that the press is an important chain for delivering information and informing citizens, and media industries need to keep attracting an audience for its maintenance. To explore its supply-side effects, Archer and Clinton (2018) investigate the influences of media ownership on media

behaviour by analysing the media content before and after the purchase of the Wall Street Journal in August 2007. They use every front-page story and editorial for a 27-month period and compare differences in political coverage between the New York Times and Wall Street Journal before (publicly-owned) and after the purchase (privately-owned), which they find that the amount of political content in the opinion pages of both journals remains the same, but the political coverage of Wall Street Journal in front-page increases markedly relative to the New York Times. After comparing with USA Today and the Washington Post, similar phenomena happen again. From the results, Archer and Clinton (2018) believe that the ownership structure may hinder the journalists' ability of being a watchdog role in democracies. For the effects on democracy, Simiyu (2014) carries out research in Kenya indicating that almost every journalist surveyed agreed that independence of the media is important to democratic life, more than half of journalists said media ownership had a direct editorial influence on their work.

Studies mentioned above (Dunaway, 2013; Archer and Clinton, 2018) confirm that ownership of the media industry impacts the news content and even the democracy (Simiyu, 2014; Archer and Clinton, 2018). Another study carried out by Abdenour (2018) finds that stations owned by publicly traded corporations are more likely to produce investigative stories, which are expensive to produce but often provide important information to citizens about potential abuses of power. Abdenour (2018) explores the relationship between the 'investigative' fact (i.e. if the investigative quality and quantity can reach the true 'investigative' by its definition) and media ownership of local television stations. This study

finally shows that stations in competitive markets and owned by public traded businesses have a higher possibility of producing high-quality and quantity investigative programs.

From all the literature mentioned above, the key factors of media ownership effects could be summarised as follows: (i) media ownership has an influence on news content and news coverage (Dunaway, 2013; Simiyu, 2014; Abdenour, 2018; Archer and Clinton, 2018; Hedding, 2019); (ii) media ownership could affect the political and democracy event and public's opinion (Dunaway, 2013; Simiyu, 2014; Archer and Clinton, 2018); (iii) the type of ownership could affect the quantity and quality of TV program (Abdenour, 2018). From the discussion above, as the ownership type of media has been testified that it could impact news content, it is highly possible that media ownership could affect financial news content and coverage. In this regard, it may be an indirect but significant effect on the financial system.

Similar to media ownership, the level of media concentration also has the power to control news content and quality. For the link between media concentration and content diversity, there is a general consensus that shared by media owners and regulators (i.e. a high level of media concentration) may hinder to media pluralism (Leandros, 2010). The high degree of ownership concentration or it can be regarded as an oligopoly is believed to manipulate the supply of news and information, and thus influence an individual's opinion (Klimkiewicz, 2010). Mala and Hao (2018) provide evidence that the concentration of media ownership or so-called media concentration could affect the practice of professional values in day-to-day news-reporting activities through interventional practice in the newsroom.

They mention that both journalists and media owners can act as gatekeepers to control the content of the press and the way of presenting the news. Furthermore, Okwuchukwu (2014) assesses the influence of the concentration on media ownership and control in Nigeria. The finding reveals that most of the media businesses are owned by the government in Nigeria, and it further reveals the media ownership pattern and the level of media control in Nigeria hinder the media from independently setting society's agenda. Another study carried out by Corneo (2006) investigates the effects of concentration of media ownership on welfare as the research believes that news coverage is essential to democracy and the media industry has the power to influence news content. After the investigation of Corneo (2006) on a sample group of individuals who are uncertain and derive information regarding welfare from mass media, the results show that a higher level of media concentration gives a higher chance of media bias.

Besides the effects of media concentration on news content and diversity, there is a study analysed by Dertouzos and Trautman (1990), which explores the relationship between economic side effects (i.e. newspaper circulations) and media concentration by applying a 5-equation model of newspaper operations. Their results indicate the following key points: firstly, on the cost side, the results show significant scale economies exist in the production of newspaper circulations. Secondly, on the demand side, a rival newspaper located in contiguous geographic markets has competitive effects on the demand for newspaper circulation. Thirdly, on the other hand, the evidence suggests that chain newspapers cannot be more efficient than independent newspapers. A very recent study carried out by Lizares (2022) explores the influence of ownership concentration from other aspect, which is the

firm concentration. This study includes 235 listed firms from the Philippines and desires to see if control of shareholders' structure could allow entrenchment or alignment effects to prevail. Results show that ownership concentration is positively associated with the proportion of non-independent and non-executive directors on the board and the likelihood of CEO duality, indicating that boards are not completely independent and are likely to generate entrenchment effects.

For the displayed studies regarding media concentration and ownership concentration, it is believed to include the following effects: (i) media concentration is negatively related to media pluralism (Leandros, 2010; Okwuchukwu, 2014); (ii) high concentration of media is believed to control individual's opinion and manipulate information (Corneo, 2006; Klimkiewicz, 2010; Mala and Hao, 2018); (iii) media concentration of newspaper is related to the market efficiency (Dertouzos and Trautman, 1990); (iv) ownership concentration of firm is positively related the control power of board (i.e. non-independent directors) (Lizares, 2022). It can be concluded that media concentration has similar effects on news content with media ownership. Hence, it may behave similar effects on the financial system. However, how actually it affects financial system? This chapter will explore this question.

For media freedom, García-Sánchez *et al.* (2016) mention that media freedom is also important to political activities in their study of an election process. According to their study, media freedom may reduce information asymmetries and hence it is vital to political activities. Their study reveals that during the election process, when media freedom is high, politicians could strive to deliver good services and lower electoral manipulation. They also

illustrate that a freedom media environment can obtain desirable effects as it requires lower-level political knowledge. When media is controlled by the government and under a low freedom environment, it will distort and manipulate information and weaken democracy. On the contrary, a freedom media environment provides unbiased information. Either in the financial or political process, it will give more rational information to the public, which makes information less manipulated by powerful organisations. Besides the political effects of media freedom, some financial and economic effects are also revealed. Chang *et al.* (2019) examine whether the media freedom level of a country plays a foundation role in the interaction between CSR (Corporate Social Responsibility) and B2C (Business to Customer) industries or between CSR and advertising intensity, and has effects on firm value. Their study analyses a sample from over 40 countries, and they find that the interaction terms are positively correlated to financial performance in countries with a higher level of media freedom while being negatively or insignificantly associated with countries with a low level of media freedom. These empirical findings indicate that CSR activities enhance the value of firms located only in countries where media freedom is guaranteed. Ambrey *et al.* (2016) investigate the role a freedom press playing in bolstering control of corruption, which they find that freedom of the press supports the control of corruption. Apart from that, they also reveal that freedom of the press is associated with greater levels of social welfare and national income via controlling corruption. These findings suggest media freedom is associated with long-run economic development in terms of real GDP per capita through enabling the control of corruption.

For exploring the media freedom effects on economic growth, Pal *et al.* (2011) analyse a sample of over 100 countries, and they identify a channel through which a relatively high level of media freedom stimulates economic growth and development in that a freedom media environment may act as a means of enhancing socio-political stability that creates a favourable investment environment leading to higher investment. In their study, for indicating socio-political stability, various factors are included such as ethnic tensions, external and internal conflict, government stability, law and order, military participation in government and religious tensions. The final results indicate that a relative high level of freedom media has positive effects on socio-political stability by pursuing the government to act in the interest of the people and socio-political stability provides a favourable business environment which in turn promotes investment and then economic growth.

Back to the effects on corruption and democracy, Corke *et al.* (2014) carry out a report regarding the democratic situation in Turkey, which is a country with low media freedom and high government control over a decade. It is revealed that with the government pressure on the media, Turkey's crisis (i.e. continuous corruption) is worse and more systemic. From this regard, they believe that a low level of media freedom environment would increase the chance of corruption and only make the democracy situation worse than before. In addition, they point out that a relatively free media environment is essential for a country's democracy and a sounding public debate.

From the above mentioned studies, the effects of media freedom from previous literature mainly have the following characteristics: (i) media freedom is related to

information asymmetries, democracy and corruption (Corke *et al.*, 2014; Ambrey *et al.*, 2016; García-Sánchez *et al.*, 2016); (ii) media freedom has an impact on CSR and thus can affect firm performance (Chang *et al.*, 2019); (iii) media freedom can stimulate economic growth under some circumstances (Pal *et al.*, 2011). Similar to media ownership and concentration, media freedom has effects on political issues such as democracy. The difference is that there is a study believing the effect of media freedom on the economic system and socio-political stability. The question is if media freedom could further impact financial stability as it may link to the release and the content of financial information.

2.3. Financial stability

A stable financial environment is an essential requirement for a sounding economic system, any instability situation could lead to serious economic outcomes such as financial crisis and deficits. As financial stability is a general topic and can be defined from different aspects, this chapter focuses on two aspects of financial stability, which are financial market stability and banking stability. For the financial market stability, it is mainly viewed from the stock market side in this chapter, as the stock market is a key element in the financial market. It includes the daily stock exchange, a large number of currency transactions and security trade. A failure of the stock market or large volatility of it may lead to a serious crisis in the whole financial system. Hence, the stable situation of the financial market should be noticed and wheatear it would be affected by media needs to be investigated. For banking stability, the failure of a bank could raise a series of bankruptcy and bank failures

as the contagious risk arise, and banks always play a central role in the financial system. For example, the government could stimulate the economy via controlling bank interest rates. From this point of view, it is also important to keep banking function in a healthy condition and monitor bank stability. From the discussion above, the literature review regarding financial stability will be displayed from two aspects, which are financial market stability and banking stability. The discussion of financial stability studies includes the most relevant topics to this thesis (i.e. the information or media effects on financial stability), and any studies emphasise the importance of financial stability as there is a limited quantity of studies exploring media side effects, especially media concepts effects on financial stability.

2.3.1 Financial market stability

The importance of the financial market (security market) situation cannot be ignored as it has already been emphasised over the last century since the famous Minsky's (1982) hypothesis was published. The Minsky's (1982) hypothesis ('economic agents observing low financial risk are induced to increase risk-taking, which in turn may lead to a crisis') reveals that financial market volatility may have a direct impact on the likelihood of a financial crisis. This is the foundation of his famous statement that "stability is destabilising," which can be explained as low volatility inducing economic agents to take more risk, endogenously increasing the likelihood of future shocks. If the economic conditions deteriorate and result in bad investment decisions, volatility then will increase, signalling a pending crisis. Rounaghi and Zadeh (2016) emphasise the role of the financial

market again, which they define that the investigation of the security market is an essential part of the nations' economic situation for the greatest amount of capital which is exchanged through security markets around the world. Therefore, the whole economic situation (whole financial stability) would be directly affected by security market performance. An example of the famous stock market crash in the history of 1929 could reveal the importance of the security market to the whole economy. This 1929 stock market crash finally led to the great depression in the 1930s. Recent scholars (e.g. Rounaghi and Zadeh, 2016) give some explanations to reveal the reason behind the vital factors of the security market to financial stability. First, it is one of the most important parts of capital markets, taking a key role in directing the distributed liquidity and savings into an optimal path in case of making sure that financial resources are adequately allocated to the most profitable activities and projects. Second, the optimal allocation of resources is one of the most basic economic issues in the capital market. Resource allocation is possible when resources are directed toward high returns investments with rational risk.

According to Baur and Schulze (2009), financial market stability can be defined as the impact extracts from systematic shocks under a normal and extreme situation. In their study, they investigate the financial stability from the stock market side and test the systematic and systemic shocks in the stock market. In addition, they test whether a country meets a financial market stability condition. Systemic shock is different from systematic shock in terms of the severity and frequency of shocks. The systematic shock is more frequent but not extreme while the systemic shock is opposite to systematic shock (less frequent but extreme) and thus it is an element of the systematic shock. For testing the relationship

between the financial market stability and the reaction of different economies, they conduct the regression analysis through developing and developed countries and the results indicate that the influence of systematic shocks is larger in volatile areas for some developing countries. On the opposite, in highly developed countries, the impact experiences less volatility and is more stable. The potential reasons may include as follows. First, in a developed country, it has a better system of government control and policy monitoring. Second, a developed economy has a larger scale of market capitalisation and liquidity, which also be diversified better. Finally, the emerging market seems to be more likely to be affected by the investors' sentiment. In addition, Baur and Schulze (2009) find that the stock market volatility could be used for indicating developed economies but not emerging countries. There are also some arguments that believe that full access to information may reduce the financial stability of the market side, as Caccioli and Marsili (2010) point out. They investigate the trading activities of informed and non-informed traders in the stock market, which they find that the non-informed traders only affect trading activities when the market is informationally efficient and non-informed traders have little effect on market stability. From their results, it reveals an association between information efficiency and market fluctuation, and thus the possibility of market instability. From the mentioned studies above, they also indicate a difference may exist between developed and developing economies. The effect will also be considered in this chapter and will apply appropriate way to check this effect.

As the argument provided above, the importance of the financial market and its stability to the whole financial system has been stated from the following aspects: (i) information is

essential as a tool to access the financial market and decides the direction of future returns, which indicates that information has an influence on financial market (Baur and Schulze 2009; Rounaghi and Zadeh 2016; Caccioli and Marsili 2010); (ii) financial market volatility has direct impact on financial crisis (stability) (Minsky 1982; Baur and Schulze 2009; Rounaghi and Zadeh 2016); (iii) emerging economies are more sensitive to financial market stability (Baur and Schulze 2009).

2.3.2 Banking system stability

Besides financial market, financial stability can be affected by many different factors and bank also plays an important role in the financial system. The importance of bank function and keeping it in a sounding condition has been mentioned and explored by many studies. Ingves (2015) mentions that bank facilitates efficient capital allocation and maturity transformation, which reveals that bank plays an essential role in financial intermediation. In addition, bank is also influential in the creation of high liquid debt claims in the financial system.

From the above information, it should be noticed that banking stability is vital for the financial system. When we imagine the banking system starts to show an imbalance condition, banks may reluctant to finance profitable projects, payments may not arrive on time, and thus lead to a sharp decrease in liquidity. This can lead to excessive risk-taking behaviour, and increase vulnerability to the stock market. A typical example of a banking failure resulting in financial instability is the well-known global financial crisis of the 2007-

2008. Moreover, these negative impacts are indiscriminate, affecting a wide variety of sectors including even the labour market and spreading distress across regions. Hence, major banking instability can lead to bankrupts and then may lead to severe consequences to the whole economy (e.g. hyperinflation and stock market crash) due to the contagion effects among banks.

Based on the discussion and common acknowledgement, the banking system is one of the most important parts of the whole financial system. The 2007-2008 financial crisis highlights the importance of monitoring the performance and regulations of the banking system. After the financial crisis, it has been witnessed that the government set up massive interventions to control and monitor banking behaviour, especially in mergers and bank bail-outs. The control of banking system can also be revealed from the updated Basel III framework, which mainly regulated the banking system in enhancing financial system stability. The banking industry serves as a major conduit through which instability may be transmitted to other sectors of the economy by disrupting the interbank lending market and payments mechanism, by reducing credit availability, and by freezing deposits. In addition, bank failures also have direct impacts on market concentration and therefore, impact the whole financial system.

Apart from the information above, it is also believed for a long period that an effect exists between banking stability and financial stability (Repullo, 2004; Jokipii and Monnini, 2013; Creel *et al.*, 2015; Holmström, 2015; Ingves, 2015; Acharya and Ryan, 2016; IJtsma *et al.*, 2017; Lewis and Roth, 2019). Specifically, Creel *et al.* (2015) point out that as bank

risk is contagious, financial stability thus must be monitored and preserved to prevent idiosyncratic shocks from generating a systemic impact through different contagion links (e.g. contractual, informational or psychological) during a banking crisis. They mention the bankruptcy of Lehman Brothers in 2008, which affect the entire banking system in different aspects. The bankruptcy induces uncertainty and suspicion among banking institutions. These informational and psychological links are transmitted around the world, and extreme tensions appear in the European and US money markets, then affecting the real economy as a result. This leads to an indiscriminate rise in risk aversion, exacerbating the financial distress. Therefore, the banking instability could lead to severe financial instability and it is indeed harmful to the whole financial system. Moreover, payment systems are central to the smooth functioning of market economies, so banking instability could potentially disrupt them. Ingves (2015) also emphasises that during the 2007-2008 crises, bank credit supply declined, and private sector credit in some advanced economies begin to drop, as the crisis unfolded. In addition, cross-border lending decline as global banks retrenches their home markets. After that, the contagion effects spread broadly and fast even to other healthy banking systems and distort the global economy. Apart from the bank failure effects, Acharya and Ryan (2016) investigate the debt side effects of banks on financial stability, which point out that banks' development of debt and risk overhangs in the economy has effects on financial stability, especially when these debt and overhangs issue happens on the asset side of a bank, which will lead to a liquidity problem on the liability side, and the problem would result in a sever outcome of the financial environment.

For banking side effects on financial stability, not only the bankruptcy or banking instability effects, but the program of the central bank could lead to similar outcomes, as Lewis and Roth (2019) estimate the effects of the ECB's (European Central Bank) asset purchase programs on financial stability. Their investigation is based in German, where they find that ECB balance sheet policies, in the form of direct asset purchases, have an expansionary effect on economic activity, and even after some delays also on prices in Germany. The results indicate that stock market volatility, liquidity risk and contagion risk all increase in response to the policy measure. It is clear that bank activities and stability have links to financial system stability in various aspects. Another study carried out by Jokipii and Monnini (2013) give some evidence here regarding the effects of the degree of banking sector stability on the subsequent evolution of real output growth and inflation. After analysing a sample of 18 OECD countries, they find a positive link between banking sector stability and real output growth, and they reveal that if the banking stability is experiencing an unstable stage, it would increase the risk of future output growth. However, there is no clear evidence of the influence between banking stability and inflation. The results of Jokipii and Monnini (2013) indicate that banking stability could lead to a significant underestimation of GDP growth in the subsequent quarters. Based on the study of Jokipii and Monnini (2013), this chapter will also pay attention to the GDP growth rate.

After discussing the link between banking stability and financial stability, it is obvious that banking stability has a close relationship with financial stability. As this chapter desires to investigate the information or media effects on financial stability, it is also important to analyse banking stability as a part of financial stability aspect and find the relationship

between media and banking stability. A recent study indicates the relationship between corruption and banking stability (Toader *et al.*, 2018). When introducing the media effects, there are many works of literature that mention that media has the power on the control of corruption (Corke *et al.*, 2014; García-Sánchez *et al.*, 2016). From this point of view, when there is a relationship exists between corruption and bank stability, it may indicate that media may have indirect effects on banking stability. Back to the study carried out by Toader *et al.* (2018), who investigate the effect of corruption on banking stability in emerging markets, reveals that a lower level of corruption has a positive effect on bank stability and is associated with fewer credit losses as well as more moderate credit growth. Furthermore, their results also indicate that a country where the banking stability is easily affected by corruption would reveal a higher possibility of non-Corporate Governance accepted. Hence, when a country with unstable banking stability, it may reduce the instability situation via implementing Corporate Governance.

From the view of the academic literatures (e.g., Repullo, 2004; Jokipii and Monnini, 2013; Creel *et al.*, 2015; Holmström, 2015), there is no doubt that bank has connections with financial stability. It is commonly believed that bank is essential to the whole financial system stability as it is the primary backstop providers of liquidity in the economy and issuers of federally guaranteed deposit. Second, stability is enhanced by restraining banks' undisciplined investment financed by readily available credit in the economy (Ingves, 2015; Acharya and Ryan, 2016). Some literature reveal that bank opacity could either enhance or impair financial stability (Holmström, 2015; Lewis and Roth, 2019). To sum up, financial stability cannot be defined and driven by one single aspect as the financial market and

banking stability could both impact financial stability, and each of them is one part of the whole financial system stability. Hence, this research intends to explore financial stability from both the financial market and banking side.

3. Research hypotheses

Many previous works of literature related to media ownership effects reveal its influential impact from different aspects. The most common effects of media ownership mentioned by previous studies (e.g. Dunaway, 2013; Dunaway and Lawrence, 2015; Abdenour, 2018; Archer and Clinton, 2018; Hedding, 2019) are on news quality and contents, Dunaway (2013) indicates that media ownership in news outlets could affect the possibility of tones in news (i.e. positive, negative and neutral); Abdenour (2018) finds that stations owned by publicly traded corporations are more likely to produce investigative stories, which provide important information to citizens about potential abuses of power; Hedding (2019) emphasises the 'Sinclair Effects' (i.e. Sinclair-owned stations display more cable news-style elements and it produces more stories with dramatic elements) on news quality and contents, indicating an existing relationship between media ownership and the information sharing type or the information manipulation, which is agreed with Archer and Clinton (2018), who believe that press is an important chain for delivering information and informing citizen. As it is discussed before, information has an important function in financial activities. From this point of view, as media ownership could affect information or news content, it may have effects on the financial world.

More literature reveals the media ownership impacts. For example, Okwuchukwu (2014) reveals that the media ownership pattern and the level of media control hinder the media from being independent. Simiyu (2014) indicates that independence of the media is important to democratic life and media ownership has a direct editorial influence on political work. Although literature does not link media directly to financial environment (stability), it still can be sure that the controlling type of media ownership (such as government, or family) will have effects on the independence and the quality of information. A study carried out by Houston *et al.* (2011) investigating the relationship between media ownership and banking reveals that state ownership of media is associated with higher levels of bank corruption. As bank corruption is related to economic growth and banking stability (Toader *et al.*, 2018), it may also affect financial market stability,

Based on the discussion above regarding media ownership, I assume that media ownership will have a significant influence (could either be positive or negative) on financial stability (both financial market and banking sector).

H1: Media ownership has a significant impact on financial stability

According to previous studies, the effect of media concentration is quite similar (i.e., relating to media pluralism, information manipulation, media content and market efficiency as well as corruption) with media ownership but with a clearer sign. As Leandros (2010) states that a high level of media concentration may constitute a hinder to media pluralism, it reveals a negative relationship between media concentration and media pluralism, which is consistent

with Okwuchukwu (2014) who reveals that the high level of media control in Nigeria hinders the media from independently setting society's agenda. Media concentration is also believed to have the power to control and manipulate information, which indicates a negative correlation with media information reliability (Klimkiewicz, 2010). Corneo (2006) also believes that a higher level of media concentration gives a higher chance of media bias, which agrees with the statement of Klimkiewicz (2010). For controlling the news content, Mala and Hao (2018) provide evidence that both journalists and media owners can act as gatekeepers to control the content of the press and the way of presenting the news when the media concentration is high. These studies mentioned above all indicate the harmful effects of media concentration on information, news, and the political world.

Besides the media concentration effects, a very recent study by Lizares (2022) explores the firm concentration influence. Results show that firm ownership concentration is positively associated with the proportion of non-independent and non-executive directors on the board and the likelihood of CEO duality, indicating that boards are not completely independent and are likely to generate entrenchment effects. This result reveals that a firm with high ownership concentration has a higher chance of group owners (i.e., this group of directors easier to get a common opinion). From this point of view, it makes directors a higher chance to control the management opinions and plans.

From the economic and financial aspects, Dertouzos and Trautman (1990) believe that media concentration is related to market efficiency, and they suggest a positive relationship between media concentration and newspaper market efficiency. Houston *et al.* (2011) reveal

a relationship between media concentration and bank corruption, which they find that media concentration increases the risk of bank corruption both directly and indirectly through its interaction with media state ownership.

From all analyses of studies regarding media concentration, I assume that media concentration has negative effects on financial stability, which is the higher media ownership concentration (government owned) the higher chance of the financial instability.

H2: Media concentration harms financial stability

According to literature provided in section 2, media freedom is commonly believed related to the political world and has an influence on the election, as García-Sánchez *et al.* (2016) mention that during the election process, politicians could deliver better services and lower the chance of electoral manipulation when there is a high media freedom. Hence, on the contrary, when media is in a low freedom environment, it will distort and manipulate information and weaken democracy. In this regard, media freedom could reduce information asymmetric, and it is a benefit to information sharing. Other studies believe that media freedom is also related to economic activities and financial performance. For example, Chang *et al.* (2019) find that only when the media freedom is relative high, the relationship between the CSR interaction terms and financial performance exists, and is positively correlated. Pal *et al.* (2011) indicate a relationship between media freedom and economic growth. Specifically, they believe that media freedom stimulates economic growth and development. In addition, Pal *et al.* (2011) mention socio-political stability, and they reveal

that stability could be enhanced via a high media freedom in that it pursues the government to act in the interest of the people and socio-political stability provides a favourable business environment which in turn promotes investment and then the economic growth.

It is clear from the previous studies that corruption is an influential factor in banking stability (Houston *et al.* 2011; Toader *et al.* 2018). Ambrey *et al.* (2016) find that freedom of the press supports the control of corruption, which indicates that a freedom media environment reduces the chance of corruption. Furthermore, they suggest that media freedom is positively related to long-run economic development. Corke *et al.* (2014) also find the secret between media freedom and corruption in Turkey, which they believe that a low level of media freedom environment would increase the chance of corruption and make the democracy situation worse.

From the above analysis, it is obvious that media freedom reduces information asymmetries, benefits democracy and reduces corruption (Corke *et al.*, 2014; García-Sánchez *et al.*, 2016). The relationship between CSR and firm performance only exists when media freedom is relatively high (Chang *et al.*, 2019). Media freedom can stimulate economic growth (Pal *et al.*, 2011). Based on the discussion above, I assume that media freedom has a positive influence on financial stability (both financial market and banking sector).

H3: Media freedom enhances financial stability.

The effects of most common traditional media platforms (i.e., Radio, Newspapers and TV) are believed to impact the stock market, which could impact stock returns and volatility (Birz *et al.* 2011; Yu *et al.* 2013; Jiao *et al.* 2020) and predict future performance (Ammann *et al.* 2014; Lepori 2015; Strauß *et al.* 2016; Birz 2017; Xie and Jiang 2019). For the prediction power of traditional media on the stock market, Ammann *et al.* (2014) find evidence that the power has increased over time, particularly since 2000, and several studies also imply this power. Xie and Jiang (2019) confirm the relationship between traditional news and the prediction of Chinses stock market. Strauß *et al.* (2016) illustrate the sentiment, especially the negative newspaper article could reflect the movements of the stock price on the following day after an increase showing on the opening price on the Dutch stock market. Birz (2017) also finds statistically and economically evidence that news regarding unemployment affects the stock returns in the following week, and this effect will then completely reverse in the next trading week. These findings show that investors are sensitive and overreact to stale macroeconomic news reported in newspapers. Apart from the newspaper effects, another traditional media-TV is also indicated as an influential factor in the stock market by Lepori (2015), who shows that an increase in the proportion of Americans watching a TV show on a given day would immediately be followed by a decrease in U.S. stock returns (stronger in small-cap and high-volatility stocks).

On the other hand, when referring to the effects of traditional media on stock returns and volatility, Birz *et al.* (2011) indicate that news about GDP and unemployment does affect stock returns. Yu *et al.* (2013) indicate that the cover of traditional media (including newspapers, TV, broadcasting companies and business magazines in their study) reduces

the uncertainty of short-term firm stock prices, which reveals a negative relationship between the volume of traditional media and stock price volatility. Their results are also supported by Jiao *et al.* (2020), finding that coverage by traditional news media decreases subsequent volatility and turnover. These studies mentioned above demonstrate an existing relationship between traditional news and stock volatility and returns. More specific, they believe that coverage of news media can reduce volatility.

From the above analysis, traditional media as an information intermediate, it is indicated that news coverage could reduce the stock price volatility (Yu *et al.*, 2013; Jiao *et al.*, 2020). Hence, I assume that all traditional media tested in the sample will benefit the financial system environment, which has a positive effect on financial stability

H4: Traditional media (Radio, Newspaper and TV)) has a significant positive effect on financial stability

According to the studies regarding modern or the Internet-based media, it is commonly considered an influential factor in corruption, trust and the financial aspect, stock market and firm performance. Specifically, Sundar *et al.* (2012), Ceron (2015) and Shin *et al.* (2015) both believe that consumption of news from information/news websites is positively associated with higher trust in the interactivity of online media, allowing organisation–public interactions, conversations, and user engagement, which are associated with positive outcomes, including increasing consumers' trust, and higher positive attitude toward online advertising and purchasing, as well as maximising organisations' profit. Their results are

also supported by Hoffmann and Lutz (2015), which illustrate that online media provides new opportunities for citizens and stakeholders to be informed, identify common interests, and express and share opinions and demands. Therefore, the Internet could be expected to increase stakeholders' engagement in corporate affairs and facilitate good governance. From this point of view, a higher trust between the government/firm and the public can be built. Chong *et al.* (2018) emphasis this point but viewed from other aspects. They investigate the relationship between social media effects and bank loan contracting, and they find that banks provide a more favourable price of their loan contracts to those who receive positive feedback from social media. Based on that, their study provides evidence that social media reduces the cost of bank loans by decreasing information asymmetry between borrowers and lenders in the capital markets.

On the other hand, Enikolopov *et al.* (2018) suggest that the Internet-based media can discipline corruption. However, it may negatively affect their market returns as more corruption is exposed. Starke *et al.* (2016) also believe that the global rise of the Internet access increases the opportunities for realising the e-government, which reduces the likelihood of corruption. Based on the information above, it can be inferred that the online media give more opportunities to the public to gain additional information from either the official agencies or the government, and control corruption.

For studies analysing modern media and the stock market, the effects are indicated differently but show as an important factor as well (Bollen *et al.*, 2011; Mao *et al.*, 2012). Yu *et al.* (2013) suggests that the volume of social media has a strong interaction effect on

stock performance, and reduces the uncertainty associated with stock prices. Jiao *et al.* (2020) believe that the coverage of modern media predicts increase in stock price volatility and turnover. From the views demonstrated by Yu *et al.* (2013) and Jiao *et al.* (2020), it is quite clear that modern media has an influence on the stock market. However, if this effect is positive or negative, it still cannot be confirmed. Hence, based on the discussion above, I assume that the modern media has significant effects on the financial system

H5: Internet-based media has a significant effect on financial stability

4. Empirical analysis

4.1. Data

To examine the link between media and financial stability, firstly, this study collects 7 media factor variables (media ownership, media concentration, media freedom, TV household ratio Radio ratio, Newspaper ratio and Internet usage ratio) and 2 main indicators of financial stability (stock price volatility and banking Z-score), plus 7 financial stability indicators for checking the robustness. Details will be discussed below in section 4.2.

For the time-period, all data are yearly frequency and cover the period from 2002 to 2016. For the sample country selection, this chapter focuses on the OECD economies, which not only have the most sophisticated financial systems but the most developed media system both in terms of traditional media, as well as the Internet-based media. According to the World Economic Outlook database, in 2018, the OECD member states collectively

comprised 62.2% of global nominal GDP and 42.8% of global GDP at purchasing power parity. Therefore, the economic condition of OECD members would be an important part of the world's development of economy, thus the world's financial stability. Most OECD members are the world's most advanced countries but also emerging countries like Mexico, Chile, and Turkey. From this regard, a dummy variable will be introduced as controlling the developing economy, which will be discussed in detail in the later section.

Due to some limitations of data availability for selected variables, an OECD economy will be removed from the final sample country if more than 50% of the relevant data on media and/or financial stability are missing. The removed process is described as follows. (i) For the traditional media data, it cannot be found any TV household data or missing large proportion of TV household data for Estonia, Iceland, Lithuania, and Slovenia. Hence, these four countries are removed from the sample county; (ii) For the media ownership and concentration data, two countries (Latvia and Luxembourg) do not have any available data based on the Djankov *et al.* (2003) Index. Hence, Latvia and Luxembourg also be removed from the final sample country.

In total, 6 countries are removed from the sample, and this study finally includes a 30-countries sample to analyse, areas including North and South America to Europe and Asia-Pacific.

4.2 Variables

To measure financial stability, this chapter is going to use 2 indicators as the main variables of financial stability, which are the stock price volatility and banking Z-score as the financial market stability indicator and banking stability indicator, respectively. Other 7 indicators including Bank non-performing loan to gross loan, Bank capital to total asset, Bank credit to bank deposit, Bank regulatory capital to risk-weighted asset, Liquid asset to deposit and short-term funding, provision to non-performing loan and the SRISK will be used as additional financial stability indicator to check robustness. All financial stability indicators mentioned above are collected directly from Global Financial Development Database and the NYU Stern Volatility Lab.

All variables in this chapter are cross-country annual data from the year 2002 to 2016. Specifically, as all independent variables are country-level data, the dependent variables will also be country-level data. A summary of all variables can be found in Table 1, which includes a detailed description of variables used and the method and databases that this chapter applies and collects. The following sub-sections include each variable this study used and the relevant studies using the same or similar variable. In addition, various methods of estimating financial stability also be introduced as a comparison of the final method used in this chapter.

4.2.1 Dependent variables

As this chapter distinguishes financial stability into two aspects, which are financial market stability and banking stability. In this regard, at least two appropriate measurements need to be utilised to indicate these two different aspects of financial stability. For the existing studies, there are various measurements of financial stability.

- Financial market stability indicator

When referring to the financial market, the stock price is the most representative character as a large number of studies use stock price when analysing the financial market. For example, studies mentioned in the Literature review section of Baur and Schulze 2009; Rounaghi and Zadeh 2016; Caccioli and Marsili 2010. These studies investigate the relationship between the financial market and the economic situation based on analysing stock price and market volatility. From this regard, it is acceptable that stock price or stock price volatility can be a measurement of financial market condition or financial market stability. The acceptance and application of stock price volatility as a monitor of financial stability has already been taken into the World Bank database (Global Financial Development Database published in the World Bank) when indicating financial stability of an individual economy. Gadanecz and Jayaram (2008) also emphasis stock price volatility as a common indicator of financial stability. In the study of investigating the relationship between central bank independence and financial stability, Papadamou *et al.* (2017) focus on the financial market aspect and indicate that central bank independence enhances the financial stability viewing from the financial market side. To reveal the financial market

stability, Papadamou *et al.* (2017) also use the financial market volatility, i.e., stock price volatility as the indicator. Hence, based on the previous studies, stock price volatility is believed to be an appropriate financial market stability measurement. Recent studies of Liu *et al.* (2020) indicate that stock market volatility can be a measurement of financial stability on the stock market side, and they both apply stock price volatility in their regression analysis. In addition, Liu *et al.* (2020) further point out the multidisciplinary of financial stability (i.e., when referring to financial stability, it is hard to define it from only one aspect, as financial stability includes a multifunctional financial system). For indicating other aspects, they introduce the financial stability index, which includes banking effects and exchange rate effects, plus the equity market effects. As the aim of this chapter is to focus on two aspects of financial stability (i.e., financial market and banking side), the financial stability indicator of stock market volatility followed by the mentioned studies could realise the objective of investigating financial market stability.

From the other aspect, the importance of stock price volatility and its effects on the financial system has been addressed since the last century, as the Minsky's (1982) hypothesis reveals that financial market volatility may have a direct impact on the likelihood of a financial crisis, which can be explained as low volatility inducing economic agents to take more risk, endogenously increasing the likelihood of future shocks. If the economic conditions deteriorate and result in bad investment decisions, volatility then will increase, signalling a pending crisis. In addition, the famous stock market crash in the history of 1929 could reveal the importance of the security market to the whole economy. This 1929 stock market crash finally led to great depression in the 1930s.

Based on the discussion above, this chapter is going to use stock price volatility to indicate the financial market stability, which specifically is the average of the 360-day volatility of the national stock market index. This method is provided by the Global Financial Development Database on the World Bank Database, and all the figures are collected directly from the World Bank. From the common situation, we prefer a more stable stock price and not high volatility change over the time-period. In this regard, a higher stock price volatility indicates higher risk and therefore, lower financial stability, and vice versa.

- *Banking stability indicators*

For the banking stability indicator, there are various methods of indicating it including the accounting-based and market-based methods. For the market-based method, Berger *et al.* (2020) and Leroy and Lucotte (2017) use the 'Expected Capital Shortfall' or the so-called 'SRISK' which was firstly proposed by Brownlees and Engleto (2017) to indicate the financial stability of the banking side. This indicator is believed to provide an early warning of distress in indicators of real activities. SRISK is described from the systemic risk aspect, which is an important supervision part of financial stability. The larger value implies that the contribution to the instability of the financial system as a whole increases. The calculation of the SRISK is analogous to the stress tests but it is done with publicly available information only, making the index widely applicable and relatively inexpensive to implement. As for the market-based method and stress test, CoVaR is also an option to indicate the systemic risk. However, Brownlees *et al.* (2020) compare the prediction power

and ranking of systemically important financial institutions (SIFIs) between CoVaR and SRISK, and they find that both methods meet the SIFIs, but the SRISK shows a higher prediction power under some situations. Berger *et al.* (2019) provide the Systemic Expected Shortfall (SES) model as another market-based method for measuring the organisation's "propensity to be undercapitalised when the system as a whole is undercapitalised". The SES is a linear combination of two key components: Marginal Expected Shortfall (MES) and Leverage (LVG). MES estimates how individual institutions' stock returns react to those of the entire market (including non-financials) when aggregate returns are low. MES is calculated using the 5% of the worst days of market returns over the previous quarter of return data and LVG is approximated using book liabilities and market equity. This model is similar to the SRISK, indicating financial stability based on the expected shortfall. However, compared with SRISK, the data requirement and calculation of SES are stricter and more complicated. Apart from that, Leroy and Lucotte (2017) also indicate that the DD (Distance-to-Default) model can be used to express financial stability from the market level. It estimates the bankrupt risks and defines them as the difference between the current market value of assets of businesses and the estimated default point, then divided by the volatility of assets. As this chapter requires all country-level data, it is hard to define the asset value under one specific country. Hence, the DD model will not be an appropriate choice of indicating banking stability.

Other two different models of CISS (Composite Indicator of Systemic Stress) and CLASS are introduced when use to indicate financial stability from specific country areas. The CISS model is also a market-based approach developed by the ECB for the euro area,

used by Duprey *et al.* (2017). This model has been introduced in 1999 and it describes financial stability from the macroeconomic aspect. The CLASS model is used by Hirtle *et al.* (2016), which is a top-down capital stress testing framework utilising public data, simple econometric models, and auxiliary assumptions to project the effect of macroeconomic scenarios on U.S. banking firms specifically. According to Hirtle *et al.* (2016), the CLASS model is designed to address the net income and capital of individual banks and bank holding companies over a future period of 2 to 3 years under different macroeconomic and financial market scenarios. Moreover, the macroeconomic scenarios are determined by a set of macroeconomic and financial market factors such as GDP growth rate, unemployment rate, housing prices, equity prices, short-term and long-term interest rates, and credit spreads, which could influence the profitability of banking institutions. As these two methods are limited by country areas (i.e., Europe and the U.S.), it is not appropriate to use in this study.

For the accounting-based method of capturing financial stability, the most acceptable and popular one is the so-called Z-score, which is used in a large number of studies (e.g., Beck *et al.* 2013; Fu *et al.*, 2014; Fiordelisi and Mare, 2014; Leroy and Lucotte, 2017; Goetz 2018). The Z-score measures the default risk of a banking system and considers banks' buffers (profits and capital) and risk, which is measured through the standard deviation of returns on assets. As the Z-score is an accounting-based measurement based on information on asset returns, volatility, and leverage, it mainly captures the microeconomic dimensions of financial stability. Amidu and Wolfe (2013) reveal that Z-score can potentially measure

the accounting distance-to-default and implies that the Z-score could also be used as a bank systemic risk measurement using accounting data.

For the other accounting-based measurement, several ratios can be used to indicate financial stability, or measurements to monitor the condition of financial stability. Following Berger *et al.*, (2019), the Bank non-performing loan to gross loan is the ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans (total value of loan portfolio). The loan amount recorded as non-performing includes the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue. A higher ratio indicates a higher bank credit risk, and thus lower financial stability.

Fratzscher *et al.*, (2016) point out that Bank capital to total assets is the ratio of bank capital and reserves to total assets. Capital and reserves include funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments. Capital includes tier 1 capital (paid-up shares and common stock), which is a common feature in all countries' banking systems, and total regulatory capital, which including several specified types of subordinated debt instruments that need not be repaid if the funds are required to maintain minimum capital levels (these comprise tier 2 and tier 3 capital). Total assets include all nonfinancial and financial assets. A higher ratio indicates a higher bank stability.

Bank credit to bank deposit ratio of which credit includes the financial resources provided to the private sector by domestic money banks as a share of total deposits. Domestic money banks comprise commercial banks and other financial institutions that

accept transferable deposits, such as demand deposits. Total deposits include demand, time and saving deposits in deposit money banks (Noman *et al.*, 2018). A higher value indicates higher bank stability.

Bank regulatory capital to risk-weighted asset is a ratio of total regulatory capital to its assets held, weighted according to the risk of those assets. It reveals the capital adequacy of deposit takers (Fratzscher *et al.*,2016). A higher ratio indicates higher bank stability.

Liquid asset to deposit and short-term funding is the ratio of the value of liquid assets (easily converted to cash) to short-term funding plus total deposits (Noman *et al.*, 2018). Liquid assets include cash and due from banks, trading securities and at fair value through income, loans and advances to banks, and cash collaterals. Deposits and short-term funding include total customer deposits (current, savings and term) and short-term borrowing (money market instruments, CDs, and other deposits). A higher value indicates higher bank stability.

For the Provision to non-performing loan ratio, non-performing loans are loans for which the contractual payments are delinquent, usually being overdue for more than a certain number of days (e.g., usually more than 90 days). A higher ratio indicates higher bank stability (Goetz, 2018).

From the above description, this study will focus on two main financial stability indicators, for indicating financial market stability and banking stability, respectively. For indicating financial market stability, the stock price volatility is used following the World Bank and studies by Acharya *et al.* (2012), Papadamou *et al.* (2017), Berger *et al.* (2020)

and Liu *et al.* (2020).This variable is collected from the Global financial development database directly provided by the World Bank. For banking stability, the so-called Z-score is used to capture bank individual and systemic risk following studies of Amidu and Wolfe (2013), Beck *et al.* (2013), Fu *et al.* (2014), Fiordelisi and Mare (2014), Leroy and Lucotte (2017) and Goetz (2018). This variable is also collected from the Global financial development database via the World Bank. Both the stock price volatility and banking Z-score are in yearly frequency and country-level data.

Besides two main dependent variables, this chapter will use a market-based method of SRISK plus 6 different ratios in the robustness check. As mentioned before, compared to other market-based measurements, the data availability, calculation and importance of SRISK is better than other indicated approaches (i.e., SES and CoVaR). SRISK is mainly based on market data, corresponding to the expected capital shortfall of a financial organisation, conditional on a crisis affecting the whole financial system. More specific, SRISKi,t measures how much capital that bank i would need during a crisis at time t to maintain a given capital ratio. The aim to use SRISK is to find out if media has an influence on the systemic risk-taking behaviour of banks. SRISK is constructed from size, leverage, and exposure to market risk. Exposure to market risk is based on co-movements of firm equity with broad equity measures. This is roughly analogous to a downside beta of the firm and is correlated with the firm's CAPM beta. For further check the accuracy of the results. All the ratios introduced before will be used in the robustness check. These ratios may not completely represent banking stability, but they work as essential factors and be required to report regularly to the World Bank as the elements of monitoring financial stability. Hence,

this chapter is going to use the ratio method to indicate and analyse the results. For the data frequency and collection method, all these data are yearly frequency and country-level. For the SRISK, it is collected from the Volatility Institute of NYU-Stern, and for other ratios, they are collected from the Global financial development database on the World Bank.

4.2.2 Independent Variables

- *Main independent variables*

For the independent variables, as this chapter is regarding media effects, all independent variables are relevant to media and can be categorised from two aspects, which are media types and media concepts. For media type, it contains traditional and modern types of media platforms. For traditional media platforms, this chapter picks three representative tools including TV, Newspaper and Radio, and for modern media platforms, this chapter chooses the Internet to indicate all modern media as it is essential to get the Internet access. For media concept variables, this chapter includes media ownership, media concentration and media freedom. Detailed information regarding each and every variable will be provided below and summarised in Table 1.

For capturing the variables regarding both traditional and the modern/Internet-based media, this chapter will pick the TV household ratio, Radio listener ratio and Newspaper ratio as the measurement of traditional media. According to Lu and Hindman (2011), the top common forms of using traditional media are television, radio, and newspaper. The TV household ratio will be collected directly from TekCarta from the year 2002 to 2012 and

calculated from the year 2013 to 2016 using TV household data from Statista. For calculated this ratio, this chapter will collect the total number of TV households directly from the Statista website of each country each year, and then divide it by the total households (Total number of TV households/ Total households) followed by the method used in TeKCarta for keeping the data consistency.

For capturing the other two traditional media variables – Radio and Newspaper. This chapter will use the Radio listener radio, which is the average number of daily radio listeners to the total population of the country. The data is collected from various data sources to cover the whole time-period, including Statista, the official radio websites, World Bank and Eurostat. For capturing newspaper variables, this chapter will use the Newspaper ratio, which is the average daily newspaper circulations to the total number of households in the country. The Newspaper ratio is collected from various databases including Statista, UIS statistic and official newspaper websites.

As for the Internet-based media, this chapter is going to use the Internet user proportion published by the Internet World Stats to represent the online media proxy as the Internet is an essential requirement of using online media. This proportion is published annually, and it is a cross-county statistic. Hence, the Internet user proportion can directly link to the condition of a country's online media usage. Therefore, the Internet user proportion can be an appropriate approach to measure online media usage. The Internet usage ratio will be collected directly from the Internet World Stats.

For capturing the three media concepts variables, this chapter will mainly follow the method provided by Djankov *et al.* (2003) and Houston *et al.* (2011), which demonstrates that both media ownership and media concentration can be proxy by the Djankov *et al.* (2003) Index (Houston *et al.,* 2011). This index refers to 97 countries and relies upon data on ownership patterns of newspaper and television firms. Data are from December 1999 or the closest date for which reliable data are available. This means that the Index is static although it can also be used to proxy the ownership status of media for the two years before and the two years after 1999 as ownership structures have been rather stable over time -at least for countries that have not been in transition. In addition, Kanagaretnam *et al.* (2014) use a cross-country sample of 32 countries to study the relationship between media independence (including media ownership) and corporate tax aggressiveness based on the year 2000. In their process of indicating media ownership, they follow and develop the index established by Djankov *et al.* (2003). For capturing media ownership and concentration, the Djankov *et al.* (2003) dataset is the most popular data used throughout the year and literature, which it be used by many scholars (e.g., Houston *et al.*, 2011; Kanagaretnam *et al.*, 2018; El Ghoul *et al*., 2019; Kennedy and Prat, 2019). Following the dataset established by Djankov *et al.* (2003), they use five variables to measure media ownership, which is press state ownership (measured by count and share, respectively), TV state ownership (measured by count and share, respectively) and state-owned ratio (a dummy variable which 1 means state-owned top radio station and 0 otherwise). They give an example of the calculation if two out of the top five newspaper enterprises in the Philippines are state-owned. The Philippine press ownership is then recorded as 40% when measured by count (Djankov *et*

al., 2003). In contrast, press ownership (by share) measures the market share of state-owned newspapers out of the aggregate market share of the five largest daily newspapers.

From the discussion above, in this chapter, the first media variables of media ownership will be collected and calculated following the method provided by Houston *et al.* (2011) via Djankov *et al.* (2003) Index. The variables needed to be calculated include the Top 5 newspaper brands, Top 5 TV stations and Top Ratio Station of each country. All these mentioned variables can be found in the Djankov *et al.* (2003) Index. For indicating media concentration, this chapter will also follow the Djankov *et al.* (2003) Index. Similar to the indicator of media ownership, four variables are required to calculate/indicate media ownership of a country (i.e., Top 5 concentration of press and TV, respectively and Top 3 concentration of press and TV, respectively) to illustrate the media concentration, which is calculated as the Top 5 or 3 largest daily newspapers/TV station to the aggregate market share. For example, when illustrating the Top 5 concentrations of press, it needs to use the market share of Top 5 newspaper brands divided by aggregate market share of press. All the Newspaper and TV station information can be found in the Djankov *et al.* (2003) Index.

As this chapter is not only focus on the traditional media (TV, Radio, and Newspaper) but the modern media Internet platform. Hence, it desires to find ownership and concentration of data related directly to the Internet. According to the current existing media studies, there is seldom indicating these data. Therefore, this chapter will follow the methodology the Djankov *et al.* (2003) used and then collect the Internet website data to indicate the Online ownership and concentration for reaching a more accurate analysis (i.e.,

including both traditional and modern media data of ownership and concentration). For obtaining the Online ownership and concentration data, the first step is to find the Top 5 websites related to the financial area from the SimilarWeb website, and then record each website and check whether these websites are state-owned or not. In the meanwhile, the market share data of the websites are collected using their search traffic recorded by Alexa Amazon. Finally, this chapter applies the same method that Djankov *et al.* (2003) provided to indicate the Online ownership and concentration variable. Since both media ownership and concentration data are sticky (the data that Djankov *et al.* (2003) provided is still used in the most recent journal articles regarding media ownership and concentration data), this chapter hereby assumes that they keep the same throughout the observation time period.

For demonstrating media freedom, the Freedom of the Press Index developed by Freedom House is a popular indicator of media freedom, which is used by much previous literature (e.g., Leeson and Coyne, 2007; Ambrey *et al*., 2016; Sapiezynska and Lagos, 2016). This index assesses media freedom in 197 countries and territories, meanwhile, it includes the most comprehensive dataset available on global media freedom. This index also contains print, broadcast and internet freedom assessments over every calendar year and is based on 23 methodological questions and 109 indicators divided into three categories: (i) the legal environment; (ii) the political environment; and (iii) the economic environment. Apart from that, the Freedom House ranks the freedom of each country as either "Free," "Partly Free" or "Not Free." In particular, the variable scores values from 0 (most freedom) to 100 (lowest freedom). This ranking provides some means of quantifying the extent to which each country permits the free flow of information and also allows for comparative

and trend analysis. (n.b. the methodology used in Freedom House to indicate media freedom index has been changed after year 2018, but it has no effect on the content in this chapter).

Studies that employ the Freedom House Index in their empirical analysis can be found in cross-country analysis. Ambrey *et al.* (2016) employ data from 135 countries to explore the role a free press plays in controlling corruption and to what extent this may lead to greater national income and enhanced societal welfare. Leeson and Coyne (2007) investigate the relationship between media freedom, foreign aid, and economic development using a dataset of 26 transition countries. Transformations of the Freedom of the Press Index are also used in the empirical literature. Freille *et al.* (2007) test the relationship between aggregate media freedom and corruption using a modified extreme bounds analysis, incorporating the three individual components of the Index (laws and regulations, political influences, and economic influences) in their regression analysis.

Considering the Freedom House Index is the most popular and appropriate method to measure media freedom. Hence, this chapter will use it as the indicator of media freedom, which is also consistent with previous literature (e.g., Ambrey *et al*., 2016; Sapiezynska and Lagos, 2016). All data will be directly collected from the Freedom House official website.

- *Control Variables*

As this chapter is a muti-national regression analysis and considers financial stability for different countries, from this aspect, it considers bank regulatory and national institutional variables (which are most common variables to include in a cross-country analysis) in

assessing the relationship between financial stability and media. Fu *et al.* (2014) reveal two reasons why we should consider these two aspects. First, it provides a simple robustness test. Second, it provides additional information on the links between bank regulations, national institutions, and financial stability. Hence, bank regulation and institutional environment variables are firstly considered in this chapter as contril variables in investigating the effects of media on financial stability. These variables will be obtained from the Barth *et al.* (2012) survey (year means the time of first published). Since country-level regulations change slowly over time, this chapter will use the most recent available survey data until a new survey data becomes available. For controlling the country development situation, this chapter also indicates variable to capture if a country is developed economy or not. In addition, the macro-economic variable is also essential to include for a macroeconomic factor of financial stability.

For bank regulatory variables, deposit insurance is a regulatory measurement that constructively builds financial safety nets for the depositors and promotes financial intermediation and stability by promising the depositors that their deposits are safe and protected. The deposit insurance system is mainly implemented in a banking system in order to prevent bank runs that could spill over to other banks prevent banking crises, and promote financial stability (Noman *et al.*, 2018). Deposit insurance allows banks to deal with maturity mismatches in the assets transformation process and allows banks to offer higher return opportunities for the rational depositors who are likely to share the risk with the banks (Diamond and Dybvig, 2000). It also builds depositors' confidence in the banking system which helps to protect banks from the risk of early withdrawal of funds due to panic in the

financial market. Thus, theoretically, government-backed deposit insurance promotes financial stability by eliminating the risk of bank runs. Even during a crisis, the deposit insurance system works as a risk minimizer by protecting the deposits of major depositors and deposit insurance schemes can enhance financial stability by decreasing the likelihood of depositor runs. Hence, in this chapter, deposit insurance will be included as a control variable and will be in a dummy format that takes a value of 1 if a country has deposit insurance and a value of 0 otherwise.

Furthermore, powerful official supervision is related to the Basel Accords which promote governance in the banking system by restricting banks from excessive risk-taking and enhancing financial stability (Basel Committee on Bank Supervision, 2011). Barth *et al.* (2004) demonstrate that the power of official supervisors may increase monitoring in banks' operations, protect them from a contagious run and reduce the moral hazard of excessive risk-taking in the presence of deposit insurance, despite that it may result in sub-standard bank operations if supervisors have private interest and/or are politically connected. In this connection, Beck *et al.* (2006) propose that the alternative 'Public Interest View' and 'Private Interest View' of powerful official supervisors may affect the incentive and risk-taking of banks. In the study of Laeven and Levine (2009) argue that official supervision improves governance in banking and increases competitiveness, which may have impacts on financial stability. From the above disscusion, the power of official supervision will be added as another control variable in the regression analysis. To obtain this variable, the supervision index will be used. This index is calculated by incorporating the following 14

questions of Barth *et al.* (2012). The question takes the value of 1 if the answer is found as yes, otherwise, it takes the value of 0. The questions are as follows:

1) Does the supervisory agency have the right to meet with external auditors to discuss their reports without the approval of the bank? 2) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? 3) Can supervisors take legal action against external auditors for negligence? 4) Can the supervisory authority force a bank to change its internal organisational structure? 5) Are off-balance sheet items disclosed to supervisors? 6) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? 7) Can the supervisory agency suspend the directors' decision to distribute dividends? 8) Can the supervisory agency suspend the directors' decision to distribute bonus? 9) Can the supervisory agency suspend the directors' decision to distribute management fees? 10) Can the supervisory agency legally declare-such that this declaration supersedes the rights of bank shareholders that a bank is insolvent? 11). Does the banking Law give authority to the supervisory agency to intervene that is, suspend some or all ownership rights-a problem bank? 12–14). Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency do the following: 12) supersede shareholder rights? 13) Remove and replace management? 14) Remove and replace directors?

Following the study carried out by Fratzscher *et al.*, (2016), this chapter also controls for institutional and governance quality factors, which is the rule of law as it reflects

perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. The Rule of Law variable will be collected from the Worldwide Governance Indicator Dataset provided by the World Bank.

In addition, as the OECD group is combined with developed and emerging economies and based on the study carried out by Baur and Schulze (2009) revealing the different sensitivity of developed and emerging economies to financial stability, this chapter includes a dummy variable to control the country economic situation for distinguishing the possible differential effects on financial stability, and further to check the significance of this possible effects. In addition, this dummy for distinguishing the development situation of OECD economies also helps to distinguish the media development. As different economic environments may have different media development and system. In this regard, this economic development dummy variable is essential for both media and financial stability aspects.

In addition, this chapter is going to include GDP growth rate as the macroeconomic control variable, which controls the organisational environment (Houston *et al.*, 2011). As the GDP growth rate implies fluctuations in economic activities, or a movement in the business cycle, which is likely to affect the country's financial institutions' performance. The GDP growth rate is collected directly from the World Bank and OECD official website.

Table 1 below indicates all dependent and independent variables used in this chapter with detailed descriptions (including the Name, Symbol, Definition and the Data Source of collection). All data are from 2002 to 2016

Table 1: Variable description

Variable	Symbol	Definition	Data Source
Dependent Variables			
Main indicator- Bank Z-score	*Z-SCORE*	The country-level Z-score indicates both bank individual and systemic risk based on the accounting method; a larger value means lower overall bank risk and higher financial stability	Global Financial Development Database
Main indicator- Stock Price Volatility	*STOCKVOL*	The average of the 360-day volatility of the national stock market index; a larger value means lower financial stability	Global Financial Development Database
Alternative indicator- Bank Non-performing-loans to Gross Loan	*NONPERL*	The country-level Ratio of defaulting loans to total gross loans; a larger value means lower financial stability	Global Financial Development Database
Alternative indicator- Bank Capital to Total Asset	*CAPTA*	The ratio of bank capital and reserves to total assets; a larger value means higher financial stability	Global Financial Development Database

Alternative indicator- Bank Credit to Bank Deposit	*CRETD*	The ratio of the financial resources provided to the private sector by domestic money banks as a share of total deposits; a larger value means higher financial stability	Global Financial Development Database
Alternative indicator- Bank Regulatory Capital to Risk-weighted Assets	*REGTRWA*	The ratio of total regulatory capital to its assets held, weighted according to the risk of those assets; a larger value means higher financial stability	Global Financial Development Database
Alternative indicator- Liquid Assets to Deposits and Short-term Funding	*LIQTD*	The ratio of the value of liquid assets to short-term funding plus total deposits; a larger value means higher financial stability	Global Financial Development Database
Alternative indicator- Provisions to Non-performing loans	*PROVTNL*	The ratio of Bank provision to non-performing loans overdue for more than a certain number of days; a larger value means higher financial stability	Global Financial Development Database
Alternative indicator- SRISK	*SRISK*	The country-level SRISK indicates bank systemic risk based on the market method; a larger value means higher bank risk and lower financial stability	Volatility Institute of NYU-Stern

Independent Variables

Traditional Media Ownership	*TOWN*	The country-level traditional media ownership indicator; a larger value means higher government/state ownership Followed by Djankov *et al.* (2003) Including five variables are as follows: press state ownership (by count and market share); TV state ownership (by count and market share); State-owned ratio	Djankov *et al*., (2003)
Traditional Media Concentration	*TCONC*	The country-level traditional media concentration indicator; a larger value means higher government/state concentration Followed by Djankov *et al.* (2003) Including four variables are as follows: Top 5 newspapers and TV stations, respectively; Top 3 newspapers and TV stations, respectively	Djankov *et al.*, (2003)
Online Media Ownership	*MOWN*	The country-level online media ownership indicator; a larger value means higher government/state ownership Followed by Djankov *et al.* (2003) Indicating by the Top 5 financial websites	Alexa by Amazon
Online Media Concentration	*MCONC*	The country-level online media concentration indicator; a larger value means higher ownership concentration Followed by Djankov *et al.* (2003)	Alexa by Amazon

		Indicating by the market share of Top 5 financial websites	
Media Freedom	*FREE*	The country-level media freedom indicator; a larger value means a lower media freedom environment	Freedom House
TV Household ratio	*TV*	The country-level traditional media indicator; a larger value means higher traditional media usage	TekCarta; Statista
Newspaper ratio	*NEWS*	The country-level traditional media indicator (the average daily newspaper circulations to the total number of households of the country); a larger value means higher media usage	Statista; World Bank
Radio Listener ratio	*RADIO*	The country-level traditional media indicator (average daily radio listeners to the total population of the country); a larger value means higher media usage	Statista; UIS Statistic
Internet Usage ratio	*INTERNET*	The country-level modern/Internet-based media indicator; a larger value means higher media usage	Internet Live Stats; Statista; UIS Statistic
Control Variables			

Deposit Insurance	*DI*	A dummy variable which 1 implies a country has deposit insurance, otherwise 0	Barth *et al.* (2012)
Rule of Law	*RL*	The country-level variable captures the agents' confidence and quality of law; a higher value indicates a stronger governance performance	World Governance Indicator dataset (2018)
Supervision Power Index	*SUPERV*	The country-level variable capturing supervisory power; a higher value indicates a higher supervision power	Barth *et al*. (2012)
GDP growth rate	*GDP*	The country-level annual GDP growth rate	World Bank

N.B. when applying variables of traditional media ownership and traditional media concentration, the original approach of Djankov *et al.* (2003) provides five separate variables (shown above) to indicate media ownership, and four separate variables (shown above) to indicate media concentration. However, in the final process of applying variables of traditional media ownership and media concentration, some individual variables are dropped due to multicollinearity such as the media ownership by count and media ownership by market share are highly correlated, and the top 3 media concentration and top 5 media concentration are highly correlated. Hence, *TOWN* and *TCONC* are based on the rest individual variables.

4.3. Econometric modelling

For indicating the relationship between media and financial stability, this chapter uses two indicators as main dependent variables (stock price volatility and Z-score) in the baseline analysis to refer to financial market stability and banking stability, respectively. For testing financial stability, there are many studies (e.g., Anginer *et al.*, 2018; Blot *et al*., 2015; Degl'Innocenti *et al.*, 2018; Fiordelisi and Mare, 2014; Fu *et al.*, 2014; Goetz 2018) test the

relationship between different factors (e.g. bank competition, bank capital) on financial stability based on various econometric models.

For example, Fiordelisi and Mare (2014) investigate the relationship between bank competition and financial stability firstly employing the *Z-SCORE* as the dependent variable and the Lerner Index as the independent variable based on the pooled OLS model. Blot *et al.* (2015) investigate the link between price and financial stability using three methods: simple correlation, VAR (Vector Auto Regression) and DCC (dynamic conditional correlations) The simple correlation method looks at the simple static correlation between levels of the two variables of interest. The VAR assesses how exogenous shocks to one of the variables of interest affect the level of the other. The DCC method investigates the dynamic conditional correlation between price and financial stability based on the estimation of the two variables' conditional variances.

Goetz (2018) applies an OLS regression model firstly for investigating the relationship between bank competition and financial stability based on considering bank-level and macro-economic-level variables, as well as bank fixed effects and time fixed effects. Then Goetz (2018) extends the OLS model to capture the unobservable changes in bank stability at the state level, introduced by a set of state-specific time dummies. Finally, Goetz (2018) indicates the dynamic effects of the removal of the entry barrier, which is considered as associated with an increase in bank stability. This isolates the effect of a large increase in banking market competition on stability.

Beck *et al.* (2013) also use the cross-country regression analysis based on the OLS to determine the relationship between bank competition and stability, particular focusing on the heterogeneity aspect. They indicate the vector of bank-specific variables, that characterises a bank's business model. Adding proxies for the funding structure, asset, and revenue mix as well as bank size, credit risk and asset growth. In addition, they include specialisation dummies to control for different intercepts for commercial banks, saving banks and cooperatives, and also a dummy variable for each country-year pair.

In the literature, there are two main approaches to assessing the relationship of financial stability: a cross-country or single-country setup. In a cross-country setup, Beck *et al.* (2013) provide an insight view of analysing the relationship between competition and stability. For some specific country areas under investigation, such as developed countries and the European Union, usually control some country-specific factors such as macro-economic conditions, regulation, and supervision. However, single-country studies document a large degree of variation when exploring financial stability relationships. As previous literature indicates, the GMM is believed a better approach to obtaining a more accurate result and dealing with the possible problem of endogeneity due to the omitted variables (Fu *et al*., 2014; Noman *et al.*, 2018).

According to the methods used in the mentioned studies above, different methods such as VAR, DCC and OLS are provided. In the mentioned studies, they all study the relationship between bank competition and stability with mostly time-series and cross-country data. From this regard, the methods used in these studies may not be an appropriate

one for applying in this chapter as this chapter is to investigate the media effects on financial stability with panel data. For the similar investigating factors and purpose, this chapter will mainly follow the method used by Houston *et al.* (2011) and also consider factors applied in the mentioned studies regarding a multinational analysis. Hence this chapter will firstly apply for the OLS model to test the relationship between media and financial stability variables, which is also consistent with Beck *et al.* (2013) and Goetz (2018). After the OLS model results, then it will apply the pooled OLS (Fiordelisi and Mare, 2014) and GMM (Fu *et al.*, 2014; Noman *et al.*, 2018) to deal with endogeneity and heteroscedasticity issue.

Based on the above discussion, to examine the hypotheses between the media industry and financial stability, two main linear regression models are displayed below:

Model 1: (Banking stability)

$$Z-score = \alpha + \beta_0 OWN_{jt} + \beta_1 TCONC_{jt} + \beta_2 MCONC_{jt} + \beta_3 FREE_{jt} + \beta_4 TV_{jt} + \beta_5 RADIO_{jt} + \beta_6 NEWS_{jt} + \beta_7 INTERNET_{jt} + \gamma_1 K_{1,jt} + \gamma_2 K_{2,jt} + \vartheta_1 D_{jt} + \varepsilon_{jt} \quad (1)$$

Where *Z-SCORE* refers to the country-level Z-score for a specific country *j* at year *t*; *OWNjt* refers to Media Ownership for country *j* at year t; *TCONCjt* refers to Traditional Media Concentration for country *j* at year t; $MCONC_{jt}$ refers to Modern Media Concentration for country *j* at year t; *FREEjt* refers to Media Freedom for country *j* at year t; *TVjt* refers to TV household ratio for country j in year t; $RADIO_{jt}$ refers to Radio Listener ratio for country j in year t; $NEWS_{jt}$refers to Newspaper circulations for country *j* in year t; *INTERNETjt* refers to Internet usage ratio for country *j* in year t; $K_{1,jt}$ refers to the country-level intuitional control variables (Supervision power, Rule of law) for country j in year t; $K_{2,jt}$ refers to macro-economic control variables (GDP growth rate) for country *j* in year t; D*jt* refers to dummy variables (Deposit insurance) for country *j* in year t; β, γ and θ are vectors of coefficients to be estimated and ε refers to the error term.

Model 2: (Financial market stability)

$$STOCKVOL = \alpha + \beta_0 OWN_{jt} + \beta_1 TCONC_{jt} + \beta_2 MCONC_{jt} + \beta_3 FREE_{jt} + \beta_4 TV_{jt} + \beta_5 INTERNET_{jt} + \beta_6 RADIO_{jt} + \beta_7 NEWS_{jt} + \gamma_1 K_{1,jt} + \gamma_2 K_{2,jt} + \vartheta_1 D_{jt} + \varepsilon_{jt} \quad (2)$$

Where *STOCKVOL* refers to country-level stock volatility for a specific country *j* at year *t*; *OWNjt* refers to Media Ownership for country *j* at year t; *TCONCjt* refers to Traditional Media Concentration for country *j* at year t; $MCONC_{jt}$ refers to Modern Media Concentration for country *j* at year t; *FREEjt* refers to Media Freedom for country *j* at year t; *TVjt* refers to TV household ratio for country j in year t; $RADIO_{jt}$ refers to Radio Listener ratio for country j in year t; $NEWS_{jt}$refers to Newspaper circulations for country *j* in year t; *INTERNETjt* refers to Internet usage ratio for country *j* in year t; $K_{1,jt}$ refers to the country-level intuitional control variables (Supervision power, Rule of law) for country j in year t; $K_{2,jt}$ refers to macro-economic control variables (GDP growth rate) for country *j* in year t; D*jt* refers to dummy variables (Deposit insurance) for country *j* in year t; β, γ and θ are vectors of coefficients to be estimated and ε refers to the error term.

4.4. Summary statistics

In the summary statistics, both descriptive statistics and correlation test for all dependent and independent variables are included.

Table 2 below provides the descriptive statistics for each dependent, independent and control variable. This table includes all dependent variables that will be used either for the baseline model (*Z-SCORE*, *STOCKVO*L), or robustness check (*NONPERL*, *CAPTA*, *CRETD*, *REGTRWA*, *LIQTD*, *PROVINL*, *SRISK*), and all independent and control variables.

Table 2: Descriptive Statistics

Variables	*N*	Min.	Max.	Mean	Std. Deviation
Panel A: Dependent variables					
Z-SCORE	450	0.02	38.02	13.64	6.69

STOCKVOL	450	0.08	33.00	1.15	3.87
NONPERL	440	0.00	4.25	0.16	0.57
CAPTA	431	0.01	7.40	0.36	1.26
CRETD	444	0.00	160.82	6.40	23.97
REGTRWA	444	0.00	19.30	0.92	3.33
LIQTD	450	0.05	35.05	1.70	5.67
PROVTNL	379	0.00	54.90	3.36	10.56
SRISK	436	0.00	800.31	69.12	129.36
Panel B: Independent Variables					
TV	437	0.06	1.00	0.97	0.05
RADIO	346	0.42	0.91	0.72	0.12
NEWSPAPER	389	0.17	1.75	0.77	0.23
INTERNET	450	0.00	0.97	0.65	0.22
FREE	450	8.88	71.00	21.78	11.45
OWN	450	0.00	0.89	0.44	0.25
TCONC	450	0.00	1.00	0.80	0.17
MCONC	450	0.51	1.26	0.86	0.23
Panel C: Control Variables					
GDP	450	-0.09	0.26	0.02	0.03
DI	450	0.00	1.00	0.87	0.34
SUPERV	450	5.00	14.00	9.77	2.34
RL	450	-0.67	2.10	1.29	0.63

Notes: *Z-SCORE* is the bank Z-score; *STOCKVOL* is stock volatility; *NONPERL* is bank nonperforming loan to gross loan ratio; *CAPTA* is bank capital to total asset ratio; *CRETD* is bank credit to deposit ratio; *REGTRWA* is bank regulatory capital to risk-weighted asset; *LIQTD* is liquid asset to deposit and short-term funding ratio; *PROVTNL* is provision to nonperforming loan; *SRISK* is the market-based financial stability indicator in worldwide measurement; *TV* is TV household ratio; *RADIO* is Radio ratio; *NEWSPAPER* is Newspaper ratio; *INTERNET* is Internet user ratio; *FREE* is media freedom; *OWN* is media ownership; *TCONC* is the Traditional media concentration; *MCONC* is the Modern media concentration; *GDP* is GDP growth rate; *DI* is dummy variable deposit insurance which 1 implies a country with deposit insurance otherwise 0; *SUPERV* is supervision power; *RL* is Rule of Law.

For dependent variables, two main indicators of financial stability have a similar range based on the table shown. For *Z-SCORE* and *STOCKVOL*, they have relatively large maximum values for 38 and 33, respectively. As the figure of each variable represents for a whole year time range, it is possible to reach a high value. From the range of two main indicators, it can be concluded that the bank stability and financial market experienced an unstable time-period during the whole-time horizon, For *Z-SCORE*, as the main measurement of bank stability, it shows a relatively high volatility compared with *STOKVOL* (stock volatility), as the standard deviation of it reaches 6.69, yet the *STOCKVOL* is only the half amount of it (3.87). This implies that the *Z-SCORE* experiences some fluctuations over time, which reveals that the bank stability behaves higher unstable than stock market stability. As this chapter includes the time-period from 2002 to 2016, the 2007-2008 financial crisis is driven by the bank and also within the time period of this chapter, which may cause a bank instability issue and thus a higher stand deviation.

For the rest dependent variables, it can be seen that the *NONPERL* (non-performing loan/gross loan) and *CAPTA* (bank capital/ total assets) have quite similar characteristics. They all behave relatively stable with a small range and low standard deviation (around 1.0), which indicates that both two ratio indicators are affected in a minor behaviour during the crisis period. For *REGTRWA* (bank regulatory capital/ risk-weighted asset), it has a similar high standard deviation around 3.5 with *STOCKVOL*, yet *STOCKVOL* has a higher range than *REGTRWA*. For *LIQTD* (liquid assets/ deposits and short-term funding) and *PROVTNL* (provisions/ non-performing loans), they behave float during the sample time-period with a standard deviation of 5.67 and 10.56, respectively. As for *CRETD* (bank credit/ bank

deposit), it has the largest standard deviation among the other ratio indicators mentioned above, with 23.97 and a relatively high range of 160. This also confirms that bank experiences unstable stage during the whole time-period. The *SRISK* is the most volatility indicator with a large range and high standard deviation (over 100), it may because that the *SRISK* is not used as a ratio format and the true value of it can be very high. In addition, it is sensitive to the financial environment and fluctuates fiercely over time. From this point of view, in the regression analysis, this chapter will use the natural logarithm of *SRISK* for reducing its volatility and improve the accuracy of the results.

For independent variables, besides the *FREE* (media freedom), other independent variables perform relative stable range and standard deviation, as all other variables are sticky variables (e.g., *OWN* (media ownership) and *CONC* (concentration)) or are measured in a small ratio format (e.g. *TV*, *NEWSPAPER*, *RADIO*) among the selected time period, *FREE* is measured in an index format with a value from 0-100. Hence, *FREE* can have a higher range (63) and the standard deviation (11.45), which is acceptable and indicates that the media environment is not consistent free among sample countries and some countries may have relative strict media environment, as the freedom index can be quite higher in some developing countries and relatively low in most developed countries. What should be noticed is that the modern media ownership variable is removed, as there are no stated-owned websites among the selected sample countries, all ownership is shown as 0. Therefore, this chapter drops the modern media ownership variable in the final regression analysis, and it will only use the traditional media ownership variable running into the regression model.

For control variables, the four variables keep stable during the sample time-period, especially the *GDP* (GDP growth rate) with a standard deviation of 0.03. As for the country-level intuitional control variables, compared with other control variables, the *SUPERV* (supervision power index) could be regarded as the most unstable variable among the sample, which has a range of 9 with a standard deviation of 2.34. The *SUPERV* index is collected from the Barth *et al.*, (2011) database, which is also used by Anginer *et al.* (2018), and it is combined with 14 questions, in each country, the results may vary and so that may cause this unstable figure shown. The statistical results of *DI* (deposit insurance), revels that most of the sample countries have deposit insurance as the mean value of it is 0.87 (n.b. deposit insurance is a dummy variable with 1 indicating with insurance and 0 otherwise).

The following Table 3 provides the correlation test results of dependent and main independent variables used in this chapter.

Table 3: Correlation Test

Panel A

Dependent Variables	*Z-SCORE*	*STOCKVOL*	*NONPERL*	*CAPTA*	*CRETD*	*REGTRWA*	*LIQTD*	*PROVTNL*	*LnSRISK*
Z-SCORE	1								
STOCKVOL	0.02	1							
NONPERL	-0.02	0.92*****	1						
CAPTA	0.08	0.84*****	0.83*****	1					
CRETD	0.08	0.75*****	0.69*****	0.88*****	1				
REGTRWA	0.03	0.95*****	0.94*****	0.95*****	0.82*****	1			
LIQTD	0.02	0.92*****	0.90*****	0.81*****	0.68*****	0.94*****	1		
PROVTNL	0.04	0.90*****	0.90*****	0.90*****	0.81*****	0.97*****	0.97*****	1	
LnSRISK	**0**.21*****	0.06	0.04	0.04	0.04	0.06	0.06	0.06	1

Panel B

Independent Variables	*TV*	*INTERNET*	*FREE*	*RADIO*	*Newspaper*	*OWN*	*TCONC*	*MCONC*
TV	1.00							

INTERNET	0.11	1.00						
FREE	-0.09	**-0.44***	1.00					
RADIO	0.03	-0.06	-0.07	1.00				
NEWSPAPER	-0.11	**-0.38***	-0.02	0.21	1.00			
OWN	-0.11	0.43	-0.46	0.01	-0.01	1.00		
TCONC	-0.11	-0.06	0.05	-0.06	0.02	**0.21***	1.00	
MCONC	0.04	-0.13	0.11	**-0.41***	0.03	**-0.18***	-0.06	1.00

Notes: *Z-SCORE* is the bank Z-score; *STOCKVOL* is stock volatility; *NONPERL* is bank nonperforming loan to gross loan ratio; *CAPTA* is bank capital to total asset ratio; *CRETD* is bank credit to deposit ratio; *REGTRWA* is bank regulatory capital to risk-weighted asset; *LIQTD* is liquid asset to deposit and short-term funding ratio; *PROVTNL* is provision to nonperforming loan; *LnSRISK* is the natural logarithm of market-based financial stability indicator in worldwide measurement; *TV* is TV household ratio; *RADIO* is Radio ratio; *NEWSPAPER* is Newspaper ratio; *INTERNET* is Internet user ratio; *FREE* is media freedom;; *OWN* is media ownership; *TCONC* is the Traditional media concentration; *MCONC* is the Modern media concentration; *GDP* is GDP growth rate; *DI* is dummy variable deposit insurance which 1 implies a country with deposit insurance otherwise 0; *SUPERV* is supervision power; *RL* is Rule of Law.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively

For dependent variables, from the correlation test table, 7 financial stability indicator ratios *(NONPERL, CAPTA, CRETD, REGTRWA, LIQTD, PROVTNL*) are all correlated with each other at a relatively high level. The reason behind this could be from the similar calculation method regarding bank financial reports. From the calculation process of each of the 7 ratios, all of them are based on accounting data and related to bank loans and assets. Hence, from this regard, it is highly possible that each of the 7 ratios could be correlated. Checking the value of correlation, the minimum is around 0.65 and the maximum is around 0.90. The most significant correlation variable could be *PROVTNL,* which is correlated with the other 6 variables reaching a figure of 0.97. As this chapter intends to use these 7 financial stability indicators as alternative variables using in a robustness check, all 7 variables will hereby be kept. For two main dependent variables used in the baseline model, which are *Z-SCORE* and *STOCKVOL,* the correlation test indicates a reasonable significant level and figure, as they are not significantly correlated with each other and the correlation coefficient is merely 0.02 Hence, it will be appropriate that applying *Z-SCORE* and *STOCKVOL* into the baseline regression model to indicate banking and financial market stability, respectively.

For independent variables, based on the test results, the correlation value is overall acceptable and reasonable. Some variables show a significant correlation with each other. For example, the Internet ratio is significantly negatively correlated to media freedom and the Newspaper ratio, which implies a negative relationship between media freedom and the Internet users (with a higher press freedom environment, there are more Internet users, as a lower value of media freedom indicates a higher freedom press environment). Also, a negative impact between Newspaper ratio and the Internet ratio, which makes sense, as the proportion of using the Internet increases, Newspaper circulation will decrease in that the Internet provides an opportunity to individuals of reading news via the Internet. Hence, the correlation between the Internet and media freedom as well as Newspaper is acceptable, plus

the figures are also acceptable ((-0.44) and (-0.38), respectively) and will not be any collinearity issue. For media concentration, the correlation of both traditional and modern media concentration shows a significant level of media ownership with opposite sign (traditional media concentration reveals a positive relationship with media ownership, yet modern media concentration reveals a negative relationship with media ownership). The possible reason is that this chapter only includes traditional media ownership (as it mentioned in the last section that modern ownership keeps all same value, it will be meaningless to include it), and modern media is indicated by the Internet. Hence, it is reasonable to show an opposite relationship here between traditional media concentration and media ownership. For traditional media concentration and media ownership, it is much easier to understand, as higher ownership indicates a larger proportion of the government control, and therefore, higher concentration. Viewing from different aspects, as media ownership and concentration are all based on the same type of dataset besides the different calculation methods, it also makes sense that they are both significantly correlated. For the value between them, 0.21 and (-0.18) are acceptable. Finally, the Radio ratio is significantly correlated to modern media concentration, and a negative (-0.41) relationship exists, which implies that with more radio users, the modern media (online websites) market share will decrease. This result again confirms the opposite relationship between traditional and modern media.

For reaching a more accurate result, this chapter also checks the collinearity issue based on the VIF index (which is included in the appendix), as shown in the chart, all VIF index values of independent variables are below 5. Hence, it is believed that there will be no server collinearity issue in the regression models.

4.5. Main regression analysis

Table 4 and Table 5 below show the main regression results for the baseline model of the two main financial stability indicators (*Z-SCORE* and *STOCKVOL*). In the regression analysis, this chapter firstly applies the OLS model to test all hypotheses mentioned in the previous section and the relationship between the media variables and financial stability variables following the similar method used in study of Houston *et al.* (2011). After applying the OLS, complex models including the 2SLS and system GMM estimator used to test the empirical relationship for check a more accurate result and dealing with the potential heteroscedasticity and endogeneity issues. When applying the 2SLS and system GMM regression, it uses the lag value as instrumental for each dependent variable according to the SIC and AIC criteria (for choosing the optimal lag value for each dependent variable). In addition, before running the 2SLS and system GMM estimator, the multicollinearity issue has been checked via the Variance Inflection Factor (finding in Appendix Table a), which indicates the value of less than 5 throughout the models and free from the multicollinearity issue. For each regression model, this chapter controls the institutional and macroeconomic situation.

Table 4: Regression results for model 1- Banking stability

Dependent variable: *Z-SCORE*

Independent variables	OLS	2SLS	GMM
TV	-0.83***	-2.69***	-2.48***
RADIO	-0.03	-0.39***	-0.50***
NEWSPAPER	0.05**	0.12***	0.20***
INTERNET	0.04*	0.08*	0.09*
FREE	0.11*	0.21*	0.54***
OWN	-5.88***	-12.20***	-13.90***
MCONC	-0.96	-6.89**	-8.52***
TCONC	-11.22***	-16.97***	-12.62***
GDP	0.42***	0.59***	0.77***
RL	1.87	5.55*	11.46***

SUPERV	0.09	0.31*	0.34*
DI	-3.54***	-6.87***	-6.31***
Adj.R²	0.11	0.09	0.09

Notes: *Z-SCORE* is the banking stability indicator bank Z-score; *TV* is TV household ratio; *RADIO* is Radio ratio; *NEWSPAPER* is Newspaper ratio; *INTERNET* is Internet user ratio; *FREE* is media freedom; *OWN* is media ownership; *TCONC* is the Traditional media concentration; *MCONC* is the Modern media concentration; *GDP* is GDP growth rate; *RL* is Rule of Law; *SUPERV* is supervision power; *DI* is dummy variable deposit insurance which 1 implies a country with deposit insurance otherwise 0.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From Table 4, the empirical results of all traditional media (*TV*, *NEWSPAPER* and *RADIO*) are overall highly significant (significant at 1% and 5%) to *Z-SCORE* (apart from the OLS result of *RADIO*), which demonstrates that traditional media significantly affect financial stability (viewing from the banking aspect). For each traditional media format, the interesting finding is that both *TV* and *RADIO* show negative impacts on *Z-SCORE*, while *NEWSPAPER* illustrates a positive relationship with *Z-SCORE*. As I mentioned in the previous section, the higher *Z-SCORE*, the lower risk. Hence, I believe that the *NEWSPAPER* would be benefit for the overall banking stability. As showing in the last statistical analysis, both figures of *TV* and *RADIO* are relatively high and it might be not easy to change both *TV* and *RADIO* in a short-time horizon. Therefore, I assume that *TV* and *RADIO* may not show economic significant over a short-term time, yet we still need to monitor these figures especially for *TV*, as the figure of it reaches 2.69. From a long-term view, it would be economical significant to bank stability. Although the coefficient value of *NEWSPAPER* is not high, its original figure is relatively low compared with other two factors (around 0.7). I believe that it is possible to change quickly over time. Hence, I consider the *NEWSPAPER* is still economic significant to bank stability. For the modern media aspect, the *INTERNET* also shows a significant effect on *Z-SCORE* at a 10% level. Similar to the *NEWSPAPER*, it also reveals a positive relationship to financial stability, which is consistent with Sundar *et al.* (2012); Ceron (2015) and Shin *et al.* (2015)

who illustrate that the *INTERNET* is related to higher public trust, and Enikolopov *et al.* (2018) who demonstrate the Internet limits corruption. One thing needs to be noticed here is that as the *INTERNET* is extremely high (around 95%) in the sample countries. Hence, the modern media is not economically significant under this situation as its coefficient value is also low.

For the media concept aspect, *FREE* significantly enhances the *Z-SCORE*, and it is obvious from both its significance level (1% in GMM) and coefficient value (0.54 in GMM). This finding confirms the hypothesis 2, that media freedom enhances financial stability and consistent with the findings of Corke *et al*. (2014) and García-Sánchez *et al.* (2016), who believe media freedom could reduce the bank corruption. As for the *OWN*, the results show a significant (1% level) negative relationship between the *OWN* and *Z-SCORE* and the coefficient value is high across three estimators (-5.88, -12.2 and -13.9), which indicates that state-owned ownership would harm financial stability. This finding is consistent with the indication of Houston *et al.* (2011), who mention that state ownership is related to higher bank corruption, which could be a reason leading to the bank system failure and thus result in banking system instability. From the results of all three regression results, there is no doubt that *OWN* is statistically significant to financial stability. For media concentration, Both *MCONC* and *TCONC* are negatively related to bank *Z-SCORE*, which is consistent with Klimkiewicz (2010) and Mala and Hao (2018). For the *TCONC*, it is also significant (as the coefficient value is relatively large- around 10) to *Z-SCORE* throughout all three different regression estimators, yet the *MCOCN* does not show significance to *Z-SCORE* when applying the OLS estimator. As the OLS is used as baseline model and 2SLS and GMM are for a robustness purpose, it cannot be confirmed of the significance for the effects between *MCOCN* and *Z-SCORE*. However, based on the results of 2SLS and GMM, it shows *MCOCN* as a significant factor towards *Z-SCORE*. Based on the figures from all three estimators, I assume that both *TCONC* and *MCONC* have the significant ability to harm banking stability, which

indicates that the higher the concentrated state-owned media, the higher risk of the banking stability. However, in the reality, these media figures are quite sticky among years, which means their economic significance might not be obvious to the real financial system. Although these media factors are sticky and not easy to change over years, we can still see how powerful of these factors, especially for the ownership and concentration (coefficient value is over 10). If one of these media factor has change, it will definitely affect the financial system.

As for the control variables, they all behave significantly to bank *Z-SCORE* through GMM, of which the *GDP* and *DI* are revealed the most influential. From the Table 4, the coefficient figure of *DI* is quite high (over 3 in OLS and over 6 in 2SLS and GMM), plus its high significance level, I believe whether a country has a deposit insurance could be a vital factor to its banking system, especially its banking stability condition. The *GDP* shows similar position with *DI*, yet its economic significance shows less influential to *DI*.

From the above description, I believe that media factors indeed have strong power to affect financial stability (from the banking side). The results also confirm my hypotheses regarding media ownership, concentration and freedom. In addition, we need to pay extra attention to the Newspaper and news from the Internet, especially for the policy makers to stabilise banking stability

Table 5: Regression results for model 2- Financial market stability

Dependent variable: *STOCKVOL*

Independent variables	OLS	2SLS	GMM
TV	0.07*	0.12	0.07
RADIO	-0.06***	-0.24***	-0.25***
NEWSPAPER	0.15***	0.06***	0.07***
INTERNET	-2.38***	-4.27***	-3.83***
FREE	0.06***	0.21***	0.24***
OWN	1.91***	1.91***	1.22***

MCONC	-1.67***	-4.42***	-4.26***
TCONC	0.06	-0.03	-0.02
GDP	-2.16	-1.57	3.11
RL	1.47***	5.60***	5.89***
SUPERV	-0.07**	0.07*	0.19***
DI	-2.05***	-1.66***	-1.02***
Adj.R²	0.14	0.09	0.11

Notes: *STOCKVOL* is financial market stability indicator stock volatility; *TV* is TV household ratio; *RADIO* is Radio ratio; *NEWSPAPER* is Newspaper ratio; *INTERNET* is Internet user ratio; *FREE* is media freedom; *OWN* is media ownership; *TCONC* is the Traditional media concentration; *MCONC* is the Modern media concentration; *GDP* is GDP growth rate; *RL* is Rule of Law; *SUPERV* is supervision power; *DI* is dummy variable deposit insurance which 1 implies a country with deposit insurance otherwise 0.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table 5 provides the regression results of *STOCKVOL* as a dependent variable. Overall, all media variables show significant effects (1% significance overall except *TV*) on financial market stability. For the traditional media, *TV* reveals a positive relationship with *STOCKVOL*, which indicate a negative relationship with financial market stability (as a higher stock volatility value lower financial market stability). This finding is consistent with the relationship between banking stability and TV. However, compared with *Z-SCORE*, *TV* does not behave quite significant to *STOCKVOL* here (only significant at the 10% level based on the OLS). I hereby consider TV is not economic significant to financial market stability, as the coefficient value of it is also low (around 0.1 across three estimators). As for the other two traditional media platforms, both *RADIO* and *NEWSPAPER* are highly significant to *STOCKVOL*. The novel finding is that both signs of *RADIO* and *NEWSPAPER* to *STOCKVOL* are the same as the sign to bank *Z-SCORE*, which means that *RADIO* and *NEWSPAPER* have adverse effects on financial stability when viewed from different financial environments (i.e., *RADIO* has a significant negative influence on banking stability, while has a significant positive influence on financial market stability. *NEWSPAPER* reveals a significant positive effect on banking stability, yet a significant negative effect on financial market stability). Possible reason behind

this could come from the different reacts of traditional accounting-method Z-score and stock market. For Z-score, it is based on a more traditional method, yet stock price volatility is based on stock market, which is believed to less rely on traditional media. Hence, The *NEWSPAPER* may show opposite effects to *STOCKVOL*. For modern media, the *INTERNET* reveals a significant negative (both statistical and economic significance as the highest coefficient value is (-4.27)) relationship with stock volatility, which demonstrates a positive effect on financial market stability. This impact is the same with its effect on bank stability. Hence, this chapter illustrates that the modern media-*INTERNET* would enhance financial market stability. Similar reasons for the economic significance with banking stability, as the *TV*, *RADIO* and *INTERNET* are relatively difficult to change over a short-term period, I hereby believe these three factors are not economic significant to financial market stability over a short-time horizon. However, if we consider these factors for a long-term horizon, it still needs to be noticed.

For the effects of media concepts, according to the results, *FREE* behaves a positive and highly significant (1 %) influence on *STOCKVOL*, thus, *FREE* is believed to harm financial market stability, which is not expected as the hypothesis and a novel finding here. The possible reason is that a higher free environment decrease the stock price synchronicity and leads to higher stock volatility as indicated in the study of Kim *et al.* (2014). *OWN* reveals a positive significance (1%) impact on *STOCKVOL*, which implies a harmful effect on financial market stability. This result is consistent with the relationship between media ownership and bank stability as well as the studies of Houston *et al.* (2011) and Toader *et al.* (2018). For media concentration, different from bank stability or the effects of media concentration indicated by Mala and Hao (2018), only *MCONC* significantly affects *STOCKVOL* here (show 1% significance). *TCONC* shows a less important position in financial market stability compared with banking stability. This may because the stock investments and transactions highly rely on the digital platform rather than the traditional way. In addition, both *TCONC* and *MOCON*

reveal a positive influence on financial market stability, which means that the higher the concentrated government control media platform, the higher the stable financial market. This could explain why media freedom harm financial market stability.

For control variables, the results of financial market stability show quite different to bank stability. The *GDP* is totally not significant to *STOCKVOL*. However, the rest of the three control variables all behave significantly to *STOCKVOL*, especially the *RL* and *DI*, which show 1% significance level to *STOCKVOL*. From this point of view, it can reveal the importance of the rule and government control as well as deposit insurance in the financial market. However, *GDP* will not be an important factor in financial market stability, it is more related to bank stability. From the discussion above, I hereby the deposit insurance still an important factor in financial market, and it also shows its economic significance here. Compared with banking system, the *RL* indicates its vital function here, which means the control and law could be more important in financial market.

5. Robustness analysis

Below the table 6 provides all replacement indicators used as robustness check of their results

Table 6

Independent variables	NONPERL		*CAPTA*		*CREDT*		*REGTRWA*	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
TV	-0.64**	-0.74***	0.41**	0.37	-0.26***	-0.26***	-0.69*	-0.70*
RADIO	-0.27***	-0.32***	0.11***	0.12***	-0.04**	-0.04**	-0.03	-0.01
NEWSPAPER	-0.01	-0.00	-0.02	-0.03	-0.02*	-0.01*	-0.08***	-0.09***
INTERNET	-0.08***	-0.07**	0.01	0.01	-0.01*	-0.01*	0.05***	0.05***
FREE	0.02	0.07	-0.05	-0.07*	0.01	0.01	-0.03	-0.04
Adj.R²	0.11	0.08	0.08	0.08	0.12	0.11	0.14	0.09

	LIQTD		*PROVTNL*		Ln*SRISK*	
	(a)	(b)	(a)	(b)	(a)	(b)
TV	-0.59***	-0.49***	-0.71***	-0.48**	0.38*	0.31
RADIO	-0.07*	-0.06*	-0.15**	-0.10*	-0.13***	-0.12**
NEWSPAPER	-0.05*	-0.04*	-0.06	-0.04	0.16***	0.13***
INTERNET	-0.04**	-0.04***	-0.07**	-0.05*	0.07**	0.05**
FREE	0.01	0.01	0.09	0.06	0.33***	0.30***
Adj.R²	0.10	0.10	0.09	0.10	0.14	0.15

N.B. (a) is the regression results for 2SLS, (b) is the regression results for GMM; *NONPERL* is bank nonperforming loan to gross loan ratio; *CAPTA* is bank capital to total asset ratio*; CRETD* is bank credit to deposit ratio; *REGTRWA* is bank regulatory capital to risk-weighted asset; *LIQTD* is liquid asset to deposit and short-term funding ratio; *PROVTNL* is provision to non-performing loan; Ln*SRISK* is the nature logarithm of SRISK; *TV* is TV household ratio; *RADIO* is Radio ratio; *NEWSPAPER* is Newspaper ratio; *INTERENT* is the Internet user ratio; *FREE* is media freedom.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

For the robustness check, I apply 7 different financial stability indicators (Bank Non-performing Loan to Gross Loan, Bank Capital to Total Asset, Bank Credit to Bank Deposit, Bank Regulatory Capital to Risk-weighted Asset, Liquid Asset to Deposit and Short-term Funding, Provision to Non-performing Loan and *LnSRISK*) to check the accuracy of the main results. Here two media concept variables are excluded (media ownership and media concentration) for the significant correlation between each other provided in Table 3 that may raise only concerns regarding the collinearity issue. In addition, the main objective of this chapter is to address the importance of traditional and modern media. The media concepts hereby are not the primary factors to check. Hence, in the robustness check, only *FREE* is included to check the freedom concept of media as it does not have any significant links to other media factors. From the results of Table 6, I observe that for each different indicator, the traditional media, especially the TV shows a negative correlation with the financial indicators, which is consistent with the main findings. Hence, it is strongly believed that the traditional

media may harm financial stability. and it is similar with modern media as it also shows a high significance level to most financial stability indicators. For media freedom, it shows various impacts (either positive or negative) on the financial indicators, and it is not a vital factor in financial stability in the sample as the significant level is relatively low. This result is also consistent with the discussion in the main findings. In this regard, it could conclude that media freedom is not as important as the media platform. The reason behind this may come from the sample county, as most of the OECD countries are with high free media environment.

6. Conclusion and policy implications

From the analysis above and regression results for both two financial stability indicators, it indicates that media factors are able to affect financial stability from both banking and financial market stability aspects, which is consistent with Houston *et al.* (2011); Yu *et al.* (2013); Goodrich and De Mooji (2014) and Enikolopov *et al.* (2018). In the empirical results, it demonstrates that TV can significantly harms financial stability. However, this effect may not be a threat to financial stability at this moment, as the TV household ratio is quite high recently (over 90%). Even if the ratio increases by 1%, the *Z-SCORE* just drop by 0.08 and stock volatility climbs by 0.03. For other traditional media, the influence of Radio and Newspaper is varied, depending on the market type. Both Radio and Newspaper are regarded as less influential compared to TV as their coefficient value are lower, but Newspaper should be paid more attention in the reality as it could change rapidly during a short time. The Radio show a negative impact on both banking and financial market stability. The Newspaper show negative effects on banking stability but a positive effect on financial market stability. As the Newspaper effects on the stock market volatility (financial market stability) are not significant, hereby it could only pay attention to this positive effect. This finding is quite interesting and should be

noticed as no previous studies show the same media factor could have a different impact viewing from different financial markets. For the modern media, the results indicate that the Internet could be used to stabilise financial stability. This finding also supports the hypothesis that modern media significant positively affects financial stability and is also consistent with Sundar (2012); Ceron (2015); Hoffmann and Lutz (2015) and Starke *et al.* (2016). In addition, both two financial stability indicators are sensitive to the Internet.

For media concepts, the results show that media freedom, ownership and concentration have significant effects on financial stability (either the banking stability or the financial market stability), which agrees with Houston *et al.* (2011) and Enikolopov *et al.* (2018). Specifically, the finding supports the hypothesis that state-owned ownership would harm financial stability viewing from both the banking and financial market. As for media freedom, it shows that a relatively free media environment is needed for both banking and financial market stability. The difference is that the results are only significant for banking stability. For banking stability, a more freedom environment would increase the chance of exposing bank corruption. Houston *et al.* (2011) also point out that bank corruption could be a severe problem for the whole banking system. Hence, from both the banking stability and financial market stability side, it is believed that the level of freedom for the media should be controlled in a relatively free and reasonable zone. From this point of view, this finding should be addressed by not only the investor but the government and business owner. For the media concentration, the results indicate that a high concentration environment (i.e. a high proportion of government-controlled media businesses) may hinder financial stability. Especially the negative effects of traditional media concentration on banking stability and the modern media concentration on stock market stability.

In conclusion, for both banking and stock market system, the finding indicates that the stability condition may benefit from a reasonable media freedom environment, less state

control, and more Internet access. The TV access and contents should be noticed by the government and policymakers as it may have a chance of stimulating financial instability.

The findings of this chapter would benefit the government and banking owners, as well as market players for keeping the whole financial environment stable and sounding via monitoring different types of media platforms (paying attention to the ownership, and market share of different owner types). The results of this chapter would also contribute to current literatures as new evidence showing differences between traditional and modern media effects on financial world other than similar effects indicated by previous studies (Sundar *et al.*, 2012; Ceron, 2015; Lepori, 2015). More importantly, it demonstrates a statistical and economic significance exists between the Newspaper effects and financial stability. As it is the first empirical study to explore the relationship between media factors and financial stability, it still has some media data availability limitations and the choice of some media variables. For the next stage of research, the author could concentrate on different geographical areas and emerging countries, and also use some other more specific modern media data. For the data analysis part, it does not control for fixed effects as the dataset is not suitable for running the fixed-effects model. The media concept data included in this chapter (i.e media ownership and concentration) for one country keeps the same throughout the sample period as the media ownership and concentration are sticky and this dataset also applies to the study from Houston *et al.* (2011). For dealing with the potential issue for the data, 2SLS and GMM are used to improve the accuracy of the regression results. For future study, researchers could explore more methods to access the media ownership and concentration data for indicating a higher accuracy level.

Chapter 2

Twitting financial stability: evidence from the banking stock market

1. Introduction

Information plays an essential role in our daily life as there are plenty of media tools providing us to let information sharing. The functions of information sharing include several aspects such as political, economic, entertainment and general communication. For the economic aspect, information could be a vital part of the financial life in that private investors require basic financial information and any announcements regarding financial activities for predicting or monitoring their investment activities. Moreover, information in the financial world takes much important part in corporate finance, the banking system, accounting, and the stock market. Almost all financial activities rely on data and financial information to make an investment decision (e.g. M&A, mortgage issue and investment appraisal). For the entertainment and communication aspects, the media lets individuals chat with others, read news, share an opinion, and even seek help.

The essential role of media can be reflected by the study carried out by Fang and Peress (2009), which states that several newspapers which equal approximately 20% of the U.S. population are sold every weekday. According to this phenomenon, it indicates that mass media plays an important role in disseminating information to a broad audience, especially to

individual investors. From this regard, media effects could be much more powerful than our expectations.

In the 21st century, information is not only a simple piece of the message but a useful tool to handle financial trades. The amount of available public information has enormously increased since the EMH was firstly introduced by Fama (1970). Under EMH, the stock market is associated with messages, announcements, and news. In the financial world, investors rely on the available information to predict the market and earn expected future outcomes. Even though the fundamental analysis, it is required and based on the accounting and market information. Hence, it reveals that financial markets and especially security markets strongly depend on information. In this regard, the effects of information on financial markets or even whole financial systems should be addressed. From the other aspect, it is possible that information could be manipulated and controlled of its content. Under this situation, we need to ask if the content of financial information also is controlled or manipulated and if it does, to what extent it will affect the financial world, or if it will affect the financial market system.

To investigate the information effects, Chapter 1 mainly focuses on the types of media platforms (traditional or modern), and a large proportion of traditional media tools are introduced. Different from Chapter 1, this chapter will concentrate on modern media and more specific, social media effects. Compared to the past, social media, which refers to a real-time information sharing platform including political news, career interests, financial ideas, stock market price, and other forms of expression via the network (Bukovina, 2016) is now an essential and vital platform for delivering and sharing information. The main difference between traditional and social media is the information origins (i.e., publisher, sources). When seeking information via a traditional tool (e.g., newspaper, radio), the publishers usually are official and authority institutions (e.g. BBC, Telegraphy). The information posted on these institutions will be reviewed and then approved by special agents. However, compared with

traditional media, social media is a relative free and private platform. Individuals can post kinds of information and views via social media in a second. From this point of view, it is becoming important to check the social media effects on the financial market.

With the rapid increase in information demand and trading activities (especially for the stock market), the importance of information (sentimental information or volume of information) has been studied more frequently (e.g. Bollen *et al.* 2011; Chen 2011; Behrendt and Schmidt 2018). Various studies investigate social media effects. Kietzmann *et al*., (2011) point out that social media introduce substantial and pervasive changes to communication between organisations, communities, and individuals. It can be argued that social media has significantly impacted our daily life and has changed the way that individuals and businesses perform, create awareness, and seek advice. Apart from our essential life activities, several studies reveal that social media affects financial activities in many aspects including the financial market (Kalampokis *et al.,* 2013; Sun *et al.*, 2016), firm performance (Luo *et al.,* 2013; Wang and Kim, 2017; Tajvidi and Karami, 2021) and corporate governance (Chaher and Spellman, 2012; Ang *et al.*, 2021). When referring to financial markets, Hu *et al.* (2018) observe that instead of only focusing on experts' recommendations, investors increasingly turn to follow online users' opinions when looking for investment recommendations. Kalampokis *et al.* (2013) and Sun *et al.* (2016) review studies exploring social media effects and its predictive power of it for various applications, which they find that social media information has become a popular source for the stock market prediction. This chapter seeks to understand the relationship between social media and financial stability, it will be analysed from the financial market aspect based on the literature.

When referring to social media, nowadays, there are various kinds of different social media platforms to gain information such as Twitter, Facebook, Instagram (mainly for sharing information and status) and WhatsApp (mainly for chatting). Twitter can be regarded as the

most influential platform among these, as it is widely studied and used to indicate the relationship between text information and financial markets (Behrendt and Schmidt 2018; Bollen *et al.* 2011; Chen 2011). Those studies confirm a Twitter sentimental effect on predicting stock price on some index stock markets (e.g., S&P500, NYSE), derived from behaviour finance concepts, which believe that investment action is affected by emotions.

When simply focusing on Twitter, which is a social media platform where an individual is able to post personal opinions or statements regarding any legal topics in real-time, plus the hashtag and retweet functions, a simple piece of Tweet could be viewed by thousands even millions of users, especially for Tweets from famous individuals such as politicians and business CEOs. By the end of 2020, it is recorded over 300 million Twitter users according to its official data. Hence, Tweets effects on financial markets could be more influential than our image. Recent research such as Ranco *et al.* (2015); Piñeiro-Chousa *et al.* (2016) and Shen *et al.* (2019) has explored whether the so-called 'Twitter effect' is economically substantial. The Twitter effect has already been proven to be particularly relevant to experiential media products (e.g., movies, music, and electronic games) as it can be used to predict future trends while gaining useful insights into individual behaviour (Piñeiro-Chousa *et al*. 2016).

With the posting and basic functions, Twitter becomes the most popular information-sharing tool among social media platforms, and has been widely used to proxy investor sentiment. For example, Behrendt and Schmidt (2018) analyse the relationship between intraday stock return volatility and sentiment extracted from Tweets. Bollen *et al*. (2011) study the text sentiment from daily Tweets and indicate that mood contents can significantly improve the accuracy of DJIA prediction. A study carried out by Sprenger *et al*. (2014b) also find a relationship existing between stock-related Twitter sentiment and returns.

After reviewing existing studies, it is believed that there is indeed a relationship between social media (Twitter) text sentiment and the stock market. It is believed that text-based sentiment is useful when making trading decisions on the stock market (Oliveira *et al.*, 2017). For example, it is confirmed that social media sentiment has an influence on stock price direction (Nguyen *et al.*, 2015); stock price prediction (Bollen *et al*., 2011) and trading volume (Oliveira *et al.*, 2017). However, these studies empirically analyse this relationship from the common stock index perspective (e.g., the most common one includes S&P500, FTSE100 and DJIA). From this point of view, a research gap still exists, in which studies neither analyse the relationship between social media and a more specific stock market such as focusing on the banking stock market, nor link it to the whole financial system such as financial stability. Hence, this research aims to empirically analyse this relationship via sentiment analysis and focus on the banking stock market (i.e., selecting specific banking stock from index stock markets and seeing bank stock market stability as a whole). The purpose of focusing on the banking stock market or bank-side stability includes two main reasons based on the economic functions of banks. First, banks operate a payments system, and a modern economy cannot function well without an efficient payments system. The second key function of banks is financial intermediation, lending or investing the money we deposit with them or credit themselves create to business enterprises, households, and governments. For extracting text sentiment from social media, this chapter will focus on Twitter to explore its effects on the banking stock market, as Twitter holds the largest users among other social media platforms and has over 300 million active users producing about 500 million tweets per day based on its official data, which is believed to be the most powerful social media platform that may influence the financial world.

Based on the above discussions, this chapter carries out for answering the question regarding how daily Twitter mood and counts could affect the stock market, inspired by the

announcement tweets by famous people such as Elon Musk. The stock market is associated with financial market stability. A simple tweet may be powerful to influence or even manipulate the stock price, and so that affects the whole financial market. Therefore, understanding how the stock market could react to Tweets is vital to the financial market and investors.

According to the above studies, this research designs four specific questions to analyse. As it indicates that Twitter could impact stock price and stock trading volume (e.g., Bollen *et al*., 2011; Nguyen *et al.*, 2015; Oliveira *et al.*, 2017), and this chapter is going to analyse the Twitter effects on banking stability from a banking stock market perspective, the four questions are hereby based on stock market volatility (the method used to indicate bank stability) and trading volume. For Twitter effects, this chapter will indicate the effects from two aspects of Twitter, which are Twitter counts and Twitter moods (consistent with Zhang *et al.*, 2011; Zheludev *et al.*,2014; Ranco *et al.*, 2015; Zhao 2020). The counts indicate the number of Tweets, and the moods indicate the sentiment of Tweets. For those studies investigating Twitter effects on the stock market, Zhang *et al.* (2011) show that emotional tweet percentage significantly correlated with all the stock indexes including NASDAQ, S&P 500 and VIX. Zhao (2020) points out that the volume of Tweets affects stock price. Hence, the first question arises regarding Twitter counts, which if the Twitter counts affect bank stock stability. Furthermore, Bollen *et al*. (2011) and Nguyen *et al.* (2015) both confirm that social media sentiment has an influence on stock price direction. Souza *et al.* (2015) show that the Twitter sentiment for five retail companies is related to stock returns and volatility. From this regard, this chapter also asks if the Twitter mood also affects bank stock stability.

For other studies related to Twitter effects such as Zheludev *et al.* (2014), which indicate that the number of Tweets impacts stock price movement. Ranco *et al.* (2015) find a significant dependence between Twitter sentiment and abnormal returns during the peaks of Twitter

volume. Based on the two studies, a question should be asked is that if Twitter counts could affect the stock price, will it also affect stock trading volume? For the Twitter mood effects, Nofer and Hinz (2015), find that a positive mood could increase the returns (the portfolio increases by up to 36 % within six months) and could increase the transaction volume at a specific period. From this point of view, the final question is will Twitter mood affect stock market trading volume throughout the time?

As the questions are clear, the primary aim of this chapter is to find out the answers to each question, which is to investigate whether Twitter affects financial stability. Specifically, if the Tweets sentiment and counts have any impact on banking stock market stability and stock trading volume.

For the more detailed objectives of this chapter, firstly, this chapter desires to fill a research gap to benefit the banking system and provide new evidence and literature information on the banking aspect as the stock market is the most important part of the financial market and the stock price change will be a key factor to influence the whole financial market stability. Secondly, this chapter would like to distinguish the Twitter effects into Twitter counts and moods for analysing and comparing different aspects of Twitter effects. It will be the same for financial stability as it will be observing the banking stock market stability from banking price volatility and the trading volume. Finally, this chapter designs to benefit investors using Twitter more frequently and researchers seeking links between social media and the financial stability.

The results of this chapter confirm a significant relationship between Twitter (sentiment and counts) and banking stability using selected banking stocks from NYSE and FTSE100. Both Twitter sentiment and counts can significantly affect the stock volatility and daily trading volume. The empirical results also testify the Twitter counts have positive effects on banking stability. However, when Twitter mood is considered, the mood effects are opposite to the

counts. It is harmful to banking stability. From this point of view, it reveals that much sentimental information may become biased text and hinder a sounding financial system. Hence, it is important to be rational when receiving much information from social media platform and making financial decisions. This can also be explained by the EMH theory and behavioral finance.

For carrying out this chapter, I believe it will contribute to the literature in both social media and financial system subjects. Based on the currently existing literature regarding text sentiment research, it is confirmed that social media sentiment has an influence on stock price direction (Nguyen *et al.*, 2015); stock price prediction (Bollen *et al*., 2011) and trading volume (Oliveira *et al.*, 2017). However, there is seldom research linking text sentiment to a financial system condition. Up to now, based on the knowledge from literature, this is currently the first study attempting to reveal the relationship between text-based sentiment and banking stability. Plenty of literature studies how text-based sentiment could predict stock market trending via affecting an Index (such as S&P 500) stock price, trading volume or volatility. This study, instead of investigating a whole Index fund, focuses on the banking stability via choosing the appropriate stock market index and selecting the listed banking stock tickers. Moreover, this chapter intends to study if the sentiment or posting volume of a social media platform could affect the daily transaction volume of banking stocks. It is not only for the research gap, but the intermediation function of banks is extremely important as supporting to finance generations of entrepreneurs who built the economy as well as the ordinary businesses that keep it going from year to year. Apart from that, the results from this chapter firstly confirm the Twitter power mentioned in existing studies such as Bollen *et al*. (2011) and Oliveira *et al.* (2017). Moreover, I find Twitter has the power to affect banking stability through its Tweets sentiment and Tweets volume. This is a novel finding and based on studies investigating the predicting power of Twitter in stock market (Nguyen *et al.*, 2015; Al Guindy, 2021; Duz Tan

and Tas, 2021). Specifically, I find that with the number of Tweets regarding one stock increase, the banking stability shows more stable. However, when the sentiment Tweets increase, the banking stability shows less stable. Through this new finding, I believe it can firstly provide new directions to researchers desiring to investigate this topic. Secondly, showing the Twitter power to individuals, investors and policy makers, who intend to seek investment opportunities, searching information and monitoring bank behaviors, to help them aware of the Twitter effects on bank stocks and make decisions.

The rest of Chapter 2 is structured as follows. The following section will provide the relevant literature from recent years regarding Twitter and other social media platform effects on the financial market including the stock market and cryptocurrency markets such as Bitcoin. Section 3 will discuss the main hypotheses of this research based on the literature. The research methodology will be found in section 4, which includes the data description (time-period and variables), and the econometric model used to test the empirical relationship. Section 5 will provide essential statistical analysis and main regression results. The main outcomes and policy implications will be demonstrated in section 6.

2. Literature review

This section reveals some previous studies related to social media (mostly Twitter) effects on financial markets (e.g. stock markets, cryptocurrency markets), which we can find that previous studies are increasingly concentrating on Twitter sentiment effects after the 21st century (e.g. Chung *et al*. 2012; Sprenger *et al*. 2014a; Yang *et al.* 2015; Oliveira *et al.*, 2017; Behrendt and Schmidt, 2018; Al Guindy, 2021; Duz Tan and Tas, 2021; Klaus and Koser, 2021). Those studies include investigating the relationship between Twitter mood and stock markets (e.g., S&P 500, FTSE 100 and S&P100) and using Twitter as a tool to predict stock price movement.

The sub-section 2.1 provides several studies exploring social media topics including the social media platforms (e.g., blogs, social websites) effects and specifically, the Twitter effects on the financial world. Section 2.2 describes the financial stability aspect to indicate the importance of banking stability.

2.1 Social media effects

Social media effects are regarded as important factors not only to consumers but in the financial world, especially since the emergence of the social network. A large amount of social media text makes mood data available in recent years. In the past, social media is used mainly to manage the customer relationships and take part in business transformation when applied to finance areas. Now, social media attracts more attention to the financial and economic world such as financial markets and corporate performance.

Social media is described as an Internet-based application which incorporates technology from Web 2.0 and also allows individuals to create and exchange their web contents (Kaplan and Haenlein, 2010). Kietzmann *et al.* (2011) define social media from a technical aspect as web-based or mobile technologies necessary for operating highly interactive platforms where users create, modify and share user-generated content. Bukovina (2016) and Al-Nasseri and Ali (2018) provide and summarise academic research related to links between social media and capital markets. They mention that the theoretical rationale behind this social media relationship is predominantly defined by Behavioral Finance, which augments the standard model of efficient markets and considers less rational factors including investors' sentiment or public mood as influential for asset pricing and capital market volatility. In this context, social media is a novel tool to enable the collection of data about such less rational factors at the level of society.

There is currently a large number of studies to investigate the social media effects including viewing from big data aspect. The most popular social media platforms can be Twitter and Facebook, and this chapter is going to focus on Twitter as it is a relatively more popular and influential social media platform compared with Facebook and other popular social media platforms. Twitter owns the largest number of active users also including official government members (e.g., U.S. president and prime minister from different countries) and famous people (e.g. Elon Musk). From this regard, this section will not specifically introduce Facebook or other social media platform effects but the overall social media effects and then introduce Twitter effects to provide detailed information regarding its influence on the financial world.

2.1.1 Media platform effects

Currently, there are various studies investigating the social media effects not only from the firm level but the financial market level. The first impressive function of social media could trace back to the advertising and customer relationship for a firm. It is indicated by Luo *et al.* (2016), who believes that a company is increasingly advocating social media technologies to transform businesses and improve organisational performance. They focus on analysing the predictive relationships between social media and firm equity value, the relative effects of social media metrics compared with conventional online behavioural metrics, and the dynamics of these relationships. The results suggest that social media-based metrics (Web blogs and consumer ratings) significantly lead to indicators of firm equity value. In addition, they find that conventional online behavioural metrics (Google searches and Web traffic) are found to have a significant yet substantially weaker predictive relationship with firm equity value than social media metrics, and social media has a faster predictive value than conventional online media,

which they emphasise the importance and influential position of social media. Similarly, Yu *et al.* (2013) investigate the effect of social media and conventional media, the relative importance, and their interrelatedness on short-term firm stock market performances. They use a large-scale dataset that features daily media content across various conventional media (major newspapers, television and broadcasting companies, and business magazines) as well as social media outlets (blogs, forums, and Twitter) across 6 industries. The sentiment analysis technique is applied to analyse the overall sentiment of each media resource toward a specific company on the daily basis. The stock return and risk are used as indicators of the short-term performance of companies. Their findings suggest that overall social media has a stronger relationship with firm stock performance than conventional media, which is consistent with the findings of Luo *et al.* (2016). Moreover, they find that the impact of different types of social media varies significantly. Different types of social media also interrelate with conventional media to influence stock movement in various directions and degrees.

Apart from firm performance, social media is also believed an important factor to influence the cryptocurrency market, as Mai *et al.* (2018) investigate the dynamic interactions between social media and the monetary value of Bitcoin based on textual analysis. Their findings show that more bullish forum posts are associated with higher future Bitcoin values. What is interesting to them is that the effects of social media on Bitcoin are driven primarily by the silent majority, which means that 95% of users who are less active and whose contributions amount to less than 40% of total messages. Based on the overall results, their findings reveal that social media sentiment is an important predictor in determining the value of Bitcoin, but not all social media messages are of equal impact. In addition, Phillips and Gorse (2017) apply the hidden Markov model to indicate that social media data can be used to predict the bubbles in the cryptocurrency market. Similar to Phillips and Gorse (2017), in the cryptocurrency market, Lamon *et al.* (2017) intend to analyse the prediction ability of online

news and social media data of price fluctuations. In their study, three main cryptocurrencies are chosen (Bitcoin, Litecoin and Ethereum) to be analysed and sentiment text analysis is applied. Finally, based on news and social media data, their results indicates that social media could affect the price change of cryptocurrency.

Apart from cryptocurrency, it is also believed to affect the stock market such as stock returns. Ding *et al.* (2020) develop a model to analyse the interplay between the social media coverage of a firm, financial reporting opacity, and stock return movement. Their results indicate a negative association between social media coverage and stock return movement as social media facilitates the incorporation of firm-specific information into the stock price. In addition, their results also show that the effect of social media coverage on stock price movement is more pronounced among firms with higher financial reporting opacity.

From the summarised literature regarding social media effects on the financial world above, the social media effects could be from the following aspects. The first is firm level, which indicates that social media could affect firm equity by exposing information (Luo *et al.*, 2016) and firm stock performance (Yu *et al.*, 2013). The second is the cryptocurrency market, which is believed to be affected by social media posting and sentiment (Lamon *et al.*, 2017; Phillips and Gorse, 2017; Mai *et al.*, 2018). The third is the stock market such as Index stock, which is indicated by Ding *et al.* (2020) believe that social media coverage could affect stock price fluctuation and stock returns.

2.1.2 Twitter effects

When referring to the Twitter effects, the most ‘popular’ effects from it should be extracted from its texts or Tweets. There are several ways of indicating its text effects, including sentimental text effects and attention effects (the two relative popular factors). Through the

previous studies, there is growing literature examining the impact of Twitter on stock markets, such as Sun *et al.* (2016); Behrendt and Schmidt (2018) ; Piñeiro-Chousa *et al.* (2018); Duz Tan and Tas, (2021) who all find that Twitter has a significant impact on stock markets. Nofer and Hinz (2015) replicate some existing findings from the sentiment studies by measuring the mood states on Twitter. The sample consists of roughly 100 million tweets that were published in Germany between January 2011 and November 2013. The results show that it is necessary to take into account the spread of mood states among Internet users. They find that a positive mood could increase the returns. Based on the results, a trading strategy for the German stock market is created. The portfolio increases by up to 36 % within six months after the consideration of transaction costs. Sun *et al.* (2016) use of textual information from Twitter to predict the stock market. Piñeiro-Chousa *et al.* (2018) explore the relationship between investor sentiment (extracted from Twitter) and the S&P 500 Index and gold returns. Their results suggest that both sentiment and gold returns can predict S&P 500 Index returns.

Moreover, Behrendt and Schmidt (2018) explore the relationship between stock return viewed from an intraday perspective and Twitter sentiment and activities, which they find statistically significant co-movements between stock return volatility and information from stock-related Tweets of the DJIA. However, the results fail to indicate an economic significance when adding Twitter sentiment and activities as exogenous variables. From the practical point of view, Behrendt and Schmidt (2018) summarise that daily Twitter information seems not particularly predictable for highly active investors with data access when considering individual-level stock returns. Similar to Behrendt and Schmidt (2018), Duz Tan and Tas (2021) investigate the impact of social media on the S&P index for the U.S., European, and emerging markets with the international investor perspective using firm-specific Twitter sentiment and activity. Their results show that Twitter activity and sentiment are related to stock trading volume and returns and are able to predict subsequent-day trading volume. They

also find that firm-specific Twitter mood contains information for predicting stock returns and this predictive power remains significant after controlling news sentiment.

Other literature regarding Twitter and stock markets also find linkage between Twitter and financial market. For example, Mao *et al*. (2012) carry out a study and indicate that the daily number of tweets can predict the S&P 500 stock indicators. Another line of research explores the contents of tweets. In a textual analysis approach to Twitter data, the authors find clear relations between the mood indicators and DJIA (Bollen *et al.*, 2011a; Bollen *et al.*, 2011b; Mao *et al*. 2011). Souza *et al.* (2015) show that the Twitter sentiment for five retail companies has a statistically significant relation with stock returns and volatility. A study by Zheludev *et al.* (2014) compares the information content of the Twitter sentiment and volume in terms of their influence on future stock prices and shows that the Twitter sentiment contains significantly more lead-time information about the prices than the Twitter volume alone. Ranco *et al.* (2015) investigate the relations between Twitter volume and sentiment about the 30 stock companies that from the DJIA index, and they find a significant dependence between Twitter sentiment and abnormal returns during the peak of Twitter volume. More recent studies like Klaus and Koser (2021) who examine the predictive power of Twitter for the Volfefe Index, the quantification of the tweeting activity of ex-U.S. President Donald J. Trump, on the dynamics of European stock markets, show that Trump's Tweets contribute to the prediction of European stock market returns. In addition, the relationship between Volfefe and the European stock market is fit well with Trump's Tweets. Benton and Philips (2020) also analyse the Tweets from Does the @realDonaldTrump and desire to explore whether new information arise affects financial markets. They extract data on ex-U.S. President Donald J. Trump's Mexico-related policy tweets and the U.S. dollar/Mexican peso exchange rate. They find that Trump's Mexico-related tweets could raise Mexican peso volatility.

Apart from effects on the index fund, just like social media, the cryptocurrency will also be impacted by Twitter. Study carried out by Shen *et al.* (2019) examine the link between investor attention (captured from Twitter) and the cryptocurrency market (Bitcoin) returns, trading volume and realised volatility. They employ the number of tweets from Twitter as a measure of attention and they find that the number of tweets is a significant driver of next day trading volume and realised volatility which is supported by their Granger causality tests. Philippas *et al.* (2019) present a dual process diffusion model to examine whether Bitcoin prices behave with jumps attributed to informative signals derived from Twitter and their results indicate that Bitcoin prices are partially driven by momentum on media attention in social networks, justifying a sentimental appetite for information demand. Moreover, Li *et al.* (2021) investigate the relationship between cryptocurrency returns and investor attention (extracting from Twitter), including 27 cryptocurrencies in their sample and a non-parametric wavelet Granger causality test incorporates multiple time horizons. Their results indicate that from a short-term view, Twitter shows a significant effect on the returns of cryptocurrencies. Furthermore, during the Covid-19 period, Corbet *et al. (*2020) analyse the relationship between the performance of cryptocurrency and the sentiment of the Covid-19 related Tweets. They find evidence that the returns and volumes of cryptocurrency significantly react to the Tweet sentiment, which specifically, the returns are strongly related to the negative sentiment related to Covid-19 from Twitter.

When viewing from the whole financial market aspect, Yang *et al.* (2015) carry out a study of the existence of a financial community on Twitter in which users' interests align with financial market-related topics, and construct a weighted sentiment measure using Tweets messages from critical nodes. The results indicate that it is significantly correlated with the returns of the major financial market indices. Similar to Yang *et al.* (2015), Gomez-Carrasco and Michelon (2017) assess the influence of social media activism on the stock market

performance of targeted firms. They focus on information published on Twitter by two critical stakeholders: consumer associations and trade unions. To the extent that social media represent a valid medium to mobilise stakeholders' activism, protests on Twitter may damage the firm reputation, leading to capital market reactions. Using a corpus of over 1.5 million tweets referring to Spanish-listed banks, they analyse the impact of activism by looking at targeted firms' abnormal variations in price and trading volume. The finding suggests that the Twitter activism of key stakeholders has a significant impact on investors' decisions. Sibande *et al*. (2021) establish a direct link between (anti) herding behaviour in currency markets and investor sentiment, extracting from a social media-based investor happiness index built on Twitter feed data. They analyse the data from 9 developed market currencies and believes that the foreign exchange market is generally characterised by strong anti-herding behaviour. Based on the data, they show that the relationship between investor sentiment and anti-herding is regime specific, with anti-herding behaviour particularly prominent during states of extreme investor sentiment from Tweets.

There are many studies mentioning Twitter effects from other aspects, Lüdering and Tillmann (2020) focus on the “taper tantrum” episode in 2013, a period with large revisions in expectations about future Fed policy for investigating the Twitter effects on assets price change via analysing the discussion regarding the monetary policy. They find that the discussion about Fed policy on social media contains price-relevant information. Shocks to the discussion about the timing of the tapering, the broader economic policy context and worrying investors are shown to lead to significant asset price changes. Al Guindy (2021) uses Twitter to analyse the effects on the cost of equity, which investigates whether firms that communicate information on social media have a lower cost of equity capital. Using a dataset comprising the full universe of all firms listed on the NYSE, AMEX and NASDAQ since the inception of Twitter, the results show that firms using Twitter would have a lower cost of equity capital. Furthermore,

firms that face the greatest information asymmetries; namely, smaller companies, companies with few analyst followings, and companies with the least institutional holdings benefit particularly from tweeting financial information.

From the above descriptions, I conclude that when referring to the financial market (stock market specifically), Twitter could impact the stock price and stock returns (Zheludev *et al.*, 2014; Nofer and Hinz, 2015; Ranco *et al.*, 2015; Souza *et al.*, 2015; Yang *et al.*, 2015; Gomez-Carrasco and Michelon, 2017; Behrendt and Schmidt, 2018; Piñeiro-Chousa *et al.*, 2018; Duz Tan and Tas, 2021; Klaus and Koser, 2021); stock trading volume (Gomez-Carrasco and Michelon, 2017; Duz Tan and Tas, 2021) and stock volatility (Souza *et al.*, 2015). Apart from the stock market, Twitter is also believed to impact the performance of cryptocurrency (Philippas *et al.*, 2019; Shen *et al.*, 2019; Corbet *et al*., 2020; Li *et al.*, 2021) and the foreign currency market (herding behaviour) (Sibande *et al*., 2021). Apart from the financial market, Twitter also shows its influential power to firms, including asset price (Lüdering and Tillmann, 2020) and cost of equity (Al Guindy, 2021). From all the listed effects, Twitter may have a powerful influence on different aspects of the financial area. Hence, in this regard, the investigation of Twitter effects on the banking side needs to be addressed.

2.2 Financial stability

2.2.1 Banking role

Financial stability can be affected by many different factors and the most common and essential factors are related to banks because of the special role of banks in the financial system. Banking stability or its health conditions have direct links to financial stability and vice versa. When the banking system is in an instability condition, banks are reluctant to finance profitable projects, asset prices deviate excessively from their intrinsic values, and payments may not arrive on

time. The well-known global financial crisis of the 2007-2008 is a typical example of the failure of banking stability and exposes the issue of the banking system's fragility. Furthermore, major banking instability can lead to bankrupts and then may lead to severe consequences to the whole economy (e.g., hyperinflation and stock market crash) due to the contagion effects among banks. It is believed for a long period that the condition of banking stability has important impact on financial stability (Repullo, 2004; IJtsma *et al.* 2017).

As we know, one of the banks' central roles in the financial system is the creation of highly liquid, money-like debt claims. Acharya and Ryan (2016) point out that bank is essential to the whole financial system stability as it is the primary backstop providers of liquidity in the economy and issuers of federally guaranteed deposit. In addition, stability is enhanced by restraining banks' undisciplined investment financed by readily available credit in the economy. In the study of Holmström (2015), the author also agrees that the health condition of bank has direct connections with financial stability condition. When the banking system facing instability, it is highly possible to infect the whole financial system. Additional studies such as Creel *et al.* (2015), point out that during a banking crisis, financial stability must be preserved to prevent idiosyncratic shocks from generating a systemic impact through different contagion links: contractual, informational, or psychological. For example, the bankruptcy of Lehman Brothers in 2008 affected the entire banking system from different aspects. These informational and psychological links were transmitted around the world, and extreme tensions appeared in the European and US money markets, affecting the real economy as a result (i.e. 2007-2008 financial crisis). From the other aspect, Ingves (2015) indicates the important role of the bank playing in financial intermediation, including facilitating efficient capital allocation and maturating transformation. However, this can lead to excessive risk-taking behaviour, which can increase vulnerability to financial shocks. Moreover, these negative impacts are indiscriminate, affecting a wide variety of sectors including even the labour market and

spreading distress across borders. Apart from that, the new Basel III (regulatory targeting banking system) emphasises the importance of monitoring bank system conditions for enhancing greater financial system stability. This also indicates the importance of bank stability for the whole financial stability. From the view of the academic literature, there is no doubt that bank condition has connections with financial system condition and bank opacity could either enhance or impair financial stability (Holmström, 2015). Hence, how bank performs could have a direct link to the condition of financial stability.

For indicating the important role of banks in the financial system, Liu *et al.* (2015) mention that the banking sector interconnectedness effects (i.e., a greater interconnectedness demonstrates the rapid and extensive spread of stress among financial system) exist in the financial system. Specifically, interconnectedness can be summarised into two categories, including direct and indirect effects. Bilateral transactions and relationships between banks (e.g., lending and borrowing behaviours) lead to direct interconnectedness. A simple explanation can be shown as follows: when a bank lends money to each other, there will be a credit risk (e.g., suffering money loss) if the other bank experiences insolvency. Then imagine this loss spreads widely among banks, the banking system may face the risk of crushing and finally spread to the whole financial system. Liu *et al.* (2015) also reveal the indirect way of bank interconnectedness. For example, a distressed bank may seek to sell a large number of assets in a short period, which may lead to declines in asset prices and mark-to-market losses for other banks. Back to the 2007- 2008 financial crisis, due to the high interconnectedness, many banks face insolvency as shocks spread rapidly across the financial system. However, the stress has been spread among different financial intermediaries not only banks, including firms, individuals and international financial agents. From the discussion above, we can learn how the condition of banks could have severe outcomes to other financial institutions and thus we need to pay attention to any factors which may have significant impacts on banking system.

All in all, in a highly interconnected financial system, where banks are connected to each other both directly and indirectly, stresses in banks are likely to be transmitted to other parts of the system, resulting in a reduction in the aggregate provision of financial services even stability to the whole financial system. In this regard, as bank stability is directly linked to (or one of the parts of) financial stability, I will focus on banking system and investigate the factors which may have an influential impact on it. In this chapter, the factor is a popular social media platform-Twitter.

2.2.2 Stock market role

When referring to the stock market or financial market, it is an essential part of the whole financial system as its total market capitalisation is up to $93.7 trillion by the end of 2020 based on data from the World Bank (2020). Also, by 2016, there have been already 60 exchanges in the world, which indicates its large market capitalisation size in the financial system. From the individual level, the stock market offers the opportunity for whom to make a profit from shares. Form the firm level, the stock market enables companies to trade publicly and gather capital. From the financial system level, the stock market encourages investment, which is an essential factor for the financial system to raise funds and economic growth. Based on the important function of the stock market, it demonstrates a close relationship with the financial system. Hence, in this regard, the condition of the financial market/stock market (e.g., the market experiences price fluctuation or market volatility) would be highly related to the condition of the financial system/financial stability.

From the point of literature's view, the importance of the financial market (stock market) situation cannot be ignored anymore as Rounaghi and Zadeh (2016) define the investigation of the security market as an essential part of the nations' economic situation for the greatest

amount of capital is exchanged via security markets around the world. Therefore, the whole economic situation would be directly affected by security market performance. This view is also revealed in the argument in the last paragraph. Apart from the mentioned 2008-2009 financial crisis (related to the bank aspect), an example of the famous stock market crash in the history of 1929 could reveal the importance of the security market to the whole economy. This 1929 stock market crash finally led to the great depression in the 1930s. Khan *et al*. (2020) give some indications to explain the reason behind the vital factors of the security market to financial stability. First, it is one of the most important parts of capital markets, taking a key role in directing the distributed liquidity and savings into the optimal path in case of making sure that financial resources are adequately allocated to the most profitable activities and projects. Second, the optimal allocation of resources is one of the most basic economic issues in the capital market. Resource allocation is possible when resources are directed toward high returns investments with rational risk. Yu *et al.* (2010) also emphasise that it would make the transmit easily from one instability economy to another due to financial market integration, as intensified financial relations under a high capital mobility situation may harbour the risk of cross-border contagion. When the financial market is under a healthy condition, it would benefit the economy through more efficient allocation of capital, a higher degree of risk diversification, a lower probability of asymmetric shocks and a more robust market framework (Yu *et al.*,2010).

From other aspects when viewing the linkage between the stock market and financial stability, Minsky's (1982) hypothesis ('economic agents observing low financial risk are induced to increase risk-taking, which in turn may lead to a crisis') reveals that the stock market volatility may have a direct impact on the likelihood of a financial crisis. This is the foundation of his famous statement that "stability is destabilising", which can be explained as low volatility inducing economic agents to take more risk, endogenously increasing the likelihood of future

shocks. If the economic conditions deteriorate and result in bad investment decisions, volatility then will increase, signaling a pending crisis.

From the discussion above, it would be obvious that the financial/stock market has a direct relationship with financial system condition, that is financial stability. It owns a large capitalisation scale among the market (World Bank, 2020), which indicates its essential function of it in the financial system. If the stock market fails, the whole financial system will face the risk of breaking down (Rounaghi and Zadeh (2016) and a typical example of a financial market failure is the 2007-2008 financial crisis (Khan *et al*., 2020) due to the financial market integration and contagious. Hence, it is necessary to include the financial/stock market aspect when analysing financial stability.

From the review of all the studies, it still a gap here in investigating the social media (Twitter especially) effects on financial stability. Carrying out this chapter will fill in this gap of the linkage between the social media and financial stability literature and would indicate the possible benefits or drawbacks of social media on the financial system. At the same time, unlike other literature that only includes/focuses on whole index stock, this chapter reveals both the bank and stock market sides of financial stability as these two are the most relevant and important aspects in the financial system.

3. Research hypotheses

Based on the mentioned literature in section 2, I develop four research questions/hypotheses regarding Twitter and financial stability (the bank and stock market side). For Twitter effects, two aspects (Twitter counts and Twitter sentiment) are considered in this chapter as these two factors are believed to be more influential compared to others based on the current studies.

For studies indicating Twitter counts effects, Mao *et al*. (2012) test the Twitter effects on S&P 500 stock returns, of which they find evidence of the number of Tweets can be a factor in predicting the stock return. This indicates a Twitter counts effect on the stock market. In the later time, Ranco *et al.* (2015) investigate the relationship between Twitter volume and sentiment about the 30 stock companies that from the DJIA index, which they find a significant dependence between the Twitter sentiment and abnormal returns during the peaks of Twitter volume. Although this study does not directly link the stock return and Twitter volume together, it still demonstrates the Twitter count as an important factor for the time of peak Twitter volume when Twitter sentiment and stock return have a strong relationship. Zheludev *et al.* (2014) also investigate Twitter volume in terms of its influence on future stock prices and the results show that Twitter volume contains significant effects on price movements. This result is consistent with Zhao (2020), who investigates the relationship between the volume of Tweets and stock price. Moreover, Zhao (2020) further points out that the volume of Tweets is able to affect stock price. A very recent study carried out by Duz Tan and Tas (2021) also confirm that the daily volume of Tweets has significant effects on S&P index stock return.

Apart from the stock market, Shen *et al.* (2019) and Li *et al.* (2021) examine the link between investor attention (captured from the volume of Tweets) and the cryptocurrency market (Bitcoin) returns, trading volume and realised volatility. They find that the number of tweets is a significant driver of next day trading volume and realised volatility which is supported by their Granger causality tests.

Hence, based on all the studies regarding the Twitter count effects, I hereby assume that Twitter count (number of Tweets) has a significant effect on bank stability . The sign of the Twitter count effect cannot be identified at this moment as the literature merely indicate a significant effect of Twitter volume on the stock or cryptocurrency market without mentioning a positive or negative effect.

H1: The number of Tweets has significant effects on financial stability (driven by banking stock market volatility)

The studies regarding Twitter volume mentioned in the last section indicate significant effects of Twitter on the stock market (Mao *et al*., 2012; Zheludev *et al.*, 2014; Ranco *et al.*, 2015; Zhao, 2020; Duz Tan and Tas, 2021) and cryptocurrency (Shen *et al.*, 2019). These studies confirm the number of Tweets can impact the stock price movement (Zheludev *et al.*, 2014; Zhao, 2020; Duz Tan and Tas, 2021) such as S&P 500 (Mao *et al*., 2012); DJIA (Ranco *et al.*, 2015), so that could use to predict the stock returns.

Although these studies mention the relationship between Twitter volume and the stock market do not mention a direct linkage between the number of Tweets and stock trading volume, the study carried out by Shen *et al.* (2019) investigating the cryptocurrency market reveals that the number of Tweets can significantly drive the next day trading volume of cryptocurrency, which indicate a positive effect of Twitter number and trading volume of cryptocurrency, which revel a possible relationship between Twitter volume and trading volume of stock market. This result is also consistent with Li *et al.* (2021). From the other aspect, stock price/return has a direct link to trading volume. According to this view, as Twitter volume is able to affect stock market/price/return, it should have the ability to affect trading volume.

Hence, based on the argument above (Zheludev *et al.*, 2014; Zhao, 2020; Duz Tan and Tas, 2021; Li *et al.*, 2021), I hereby assume that Twitter count (number of Tweets) has a significant positive effect on stock trading volume. As the current literature do not state a clear view of this statement, it will make it important to investigate the relationship between Twitter count and stock trading volume.

H2: The number of Tweets has positive significant effects on stock transaction volume

For literature investigating the Twitter sentiment effects, Bollen *et al*. (2011) and Nguyen *et al.* (2015) both confirm that social media sentiment influences stock price movement. Other studies exploring the relationship between Twitter and stock price such as Zheludev *et al.* (2014), which compares Twitter sentiment and Twitter volume effects, the results confirm an important role of both Twitter sentiment and Twitter volume, yet the sentiment behaves significantly more during lead-time information regarding price than Twitter volume. Similar to Zheludev *et al.* (2014), Ranco *et al.* (2015) investigate the relationship between Twitter volume and sentiment about the 30 stock companies from the DJIA index, which they find that a significant impact is shown between the Twitter sentiment and abnormal returns when the Twitter volume reaches a peak. Behrendt and Schmidt (2018) also analyse the DJIA, which they find statistically significant co-movements between sentimental Tweets of the DJIA, and stock return volatility viewed from an intraday perspective.

In addition, Nofer and Hinz (2015) find that positive mood Tweets could increase stock returns via observing approximately 100 million Tweets published in Germany. Moreover, Souza *et al.* (2015) indicate that the Twitter sentiment for five retail companies has a statistically significant effect not only on stock returns but stock volatility. Recent studies such as McGurk *et al.* (2020), analysing the sentimental Tweets effects on stock return, find that positive or negative sentiment has significant effects on abnormal stock return. Duz Tan and Tas (2021) show that Twitter activity and sentiment are related to stock returns, via investigating the impact of social media on S&P index stock for the U.S., European, and emerging markets using firm-specific Twitter sentiment and activity. This finding is also supported by Piñeiro-Chousa *et al.* (2018), who find that firm-specific Twitter mood contains

information for predicting stock returns and this predictive power remains significant after controlling news sentiment.

Similar to Twitter count, Twitter sentiment is also believed to be able to influence the cryptocurrency market, as Huynh (2021) investigates the Tweets effect from Trump on Bitcoin, which the results indicate that the sentiment Tweets (negative or positive attitude) from Trump could reasonably predict the return of Bitcoin. Benton and Philips (2020) analyse the Tweets from Does the @realDonaldTrump and desire to explore whether new information arise affects financial markets. They extract data on ex-U.S. President Donald J. Trump's Mexico-related policy tweets and the U.S. dollar/Mexican peso exchange rate. They find that Trump's Mexico-related tweets raise Mexican peso volatility.

Based on all studies mentioned above, most studies reveal a significant relationship between Twitter sentiment and stock return/price movement (Zheludev *et al.*, 2014; Ranco *et al.*, 2015; McGurk *et al.*, 2020; Huynh, 2021), I assume that Twitter sentiment will have significant impacts on stock price volatility. The expected sign of Twitter sentiment cannot be decided as seldom studies mention a positive or negative effect on stock price, and the effects on stock volatility remain unclear.

H3: Twitter sentiment has significant effects on financial stability (driven by banking stock market volatility)

From literature regarding Twitter sentiment effects, studies carried out by Zheludev *et al.* (2014); Ranco *et al.* (2015); Souza *et al.* (2015); Yang *et al.* (2015); Sun *et al.* (2016); Behrendt and Schmidt, (2018); Piñeiro-Chousa *et al.* (2018); Klaus and Koser, (2021) provide evidence that Twitter sentiment could impact the stock price as well as stock returns. Specifically, Sun *et al.* (2016) and Piñeiro-Chousa *et al.* (2018) both predict stock market return based on Twitter

textual information. Zheludev *et al.* (2014) and Souza *et al.* (2015) both indicate that Twitter sentiment has a statistically significant relation with stock returns. Behrendt and Schmidt (2018) find statistically significant co-movements between stock return volatility and information from stock-related Tweets of the DJIA index.

Although these studies do not reveal the relationship between Twitter sentiment and stock trading volume, an influential factor of Twitter sentiment on stock price/return could indicate that there may be an existing linkage between Twitter sentiment and trading volume, as price rise or drop will affect the trading volume.

Many studies directly reflect the relationship between Twitter sentiment and stock trading volume such as Nofer and Hinz (2015); Gomez-Carrasco and Michelon (2017); Oliveira *et al.*, (2017); Corbet *et al. (*2020); Duz Tan and Tas (2021); Ganesh and Iyer (2021). Nofer and Hinz (2015) find that positive sentiment Tweets could not only increase stock returns, but the trading volume based on the analysis of roughly 100 million tweets published in Germany. Similar to Nofer and Hinz (2015), Duz Tan and Tas (2021) investigate the impact of social media on the S&P index for the U.S., European, and emerging markets with the international investor perspective using firm-specific Twitter sentiment and activity. Their results show that Twitter activity and sentiment are related to stock trading volume and returns, which the finding is also consistent with Oliveira *et al.* (2017), who also confirm that Twitter sentiment has an influence on stock trading volume and is also testified by Ganesh and Iyer (2021).

Furthermore, for the cryptocurrency side, during the COVID period, Corbet *et al. (*2020) analyse the relationship between the Twitter sentiment related to COVID-19 and the performance of cryptocurrency. They find evidence that the sentiment of Tweets could significantly affect the return and volume of a cryptocurrency.

As these studies provided could either indicate an existing relationship between Twitter sentiment and stock trading volume indirectly (as stock price may affect trading volume) or directly provide evidence of the Twitter sentiment effects on stock trading volume (Nofer and Hinz, 2015; Gomez-Carrasco and Michelon, 2017; Oliveira *et al.*, 2017; Corbet *et al.*, 2020; Duz Tan and Tas, 2021; Ganesh and Iyer, 2021). Based on these arguments, I hereby assume that the Twitter mood will affect the stock transaction volume at a significant level.

H4: Twitter sentiment has significant effects on stock transaction volume

4. Methodology

4.1 Data and sample

As I intend to analyse the relationship between Twitter (specifically number of Tweets and sentiment Tweets) and banking stock market stability, it requires Twitter variables/data and bank stability variable/data.

For the Twitter aspect, I capture the Twitter data through the Twitter API (Application Programming Interface) function, which is a popular method and also used by Ranco *et al.* (2015) Nisar and Yeung (2018) and Duz Tan and Tas (2021) to acquire daily Tweets-specific contents and variables. The API function of Twitter could be found via the official Twitter website through the Developer platform. Through the API function, it allows accessing various information such as historical Tweets, direct messages, users, retweets etc. As Chapter 2 focuses on the number of Tweets and Twitter sentiment, the historical Tweets are hereby essential for undertaking this analysis.

The aim of this chapter includes analysing the banking stock side effects. Hence I will collect Tweets related to relevant bank stocks (sample bank selection will be provided in the

later section). To gather the stock relevant Tweets, I follow the method applied and provided by previous literature (e.g., Oliveira *et al.*, 2017; Nisar and Yeung, 2018; Duz Tan and Tas, 2021), which is to precede the stock ticker symbol (e.g. AAPL, HSBC) with a dollar sign ($) to indicate that a tweet contains investment information about a specific bank stock (e.g. $AAPL, $HSBC). I collect all public tweets related to all selected banks using the "$" symbol with a listed banking stock ticker on Twitter via using a developer account and the potential public useful desktop program named Tweetcatcher, extract data from API as well (Nisar and Yeung, 2018). The software Tweetcatcher is similar to the API function only it is simpler to use than the API function as API needs to be programmed and coding to retrieve Tweets through program platforms such as Python. The results gathered from Tweetcatcher will be the same as the programmed API function.

As this chapter relates to bank stability/bank stock market, bank-related Tweets need to be collected. From this regard, I firstly select all banks which traded on New York Stock Exchange (NYSE) and Financial Times Stock Exchange 100 Index (FTSE100) and then collect all relevant Tweets related to these selected banks. After the Tweets collection, the total number of Tweets related to one bank for a specific trading day will then be counted and assigned to each bank in the sample on that trading day.

4.1.1 Economy selection

For the sample economy selection, I intend to analyse both the U.S. and the UK stock market for their capital size and interconnectedness as well as economic developments. The U.S. economy is bound to have important effects around the world as it has the world's single largest economy, accounting for almost a quarter of global GDP (at market exchange rates), one-fifth of global FDI (Foreign Direct Investment), and more than a third of stock market capitalisation

based on data from the World Bank. As we know, the US dollar is the most widely used and accepted currency in global trade and financial transactions, and changes in the U.S. monetary policy and investor sentiments play a vital role in driving global financing conditions (World Bank, 2020). Business cycles in the U.S., other AEs (advanced economies), and EMDEs (emerging market and developing economies) have been highly synchronous, which also reflects the strength of global trade and financial linkages of the U.S. economy with the rest of the world.

As for the UK, it is also a highly developed financial market and a market-orientated economy country as well as one of the most globalised economies in Europe. It is the sixth-largest national economy in the world measured by nominal GDP, ninth largest by PPP (purchasing power parity), and twenty-second-largest by GDP per capita, comprising 3.3% of world GDP based on data from the World Bank. It also has the second-largest inward FDI and the third-largest outward FDI.

From the above information, I hereby include sample banks from the U.S. and UK financial markets.

4.1.2 Stock market index & sample bank selection

For the stock markets, as it stated in the last section, the U.S. and UK markets will be analysed, I hereby choose two index stock markets from each economy. For the U.S. the index of the New York Stock Exchange (NYSE) will be selected. For the NYSE, it owns long history which could trace its roots back to 1792, and it is the largest stock exchange in the world by market capitalisation up to $27.21 trillion by 2022 based on data from Statista (2022). Almost all influential companies will be listed on NYSE. From this regard, its market size and leading position in the financial market should be a representative market in the U.S. and even the

world. In addition, as an important stock exchange, NYSE has also been analysed and explored by a large number of studies from the last century (e.g., Wood *et al.*, 1985; Huang and Stoll, 1996; Madhavan and Sofianos, 1998) to the present (e.g. Cenesizoglu and Grass, 2018; Dodd and Frijns, 2018; Zhao *et al.*, 2021). Hence, all banks including bank holding companies listed on NYSE will be included in the sample for analysis.

For the UK, I choose banks from the FTSE 100. Similar to NYSE in the U.S., the FTSE 100, which started in the last century, consists of the 100 largest qualifying UK companies with the highest market capitalisation and represents about 81% of the entire market capitalisation of the London Stock Exchange (Cenesizoglu and Grass, 2018; Dang *et al.*, 2018; Bibinger *et al.*, 2019; Battalio *et al.*, 2020). FTSE 100 is also a popular and representative index in research fields focusing on the UK market (e.g., Taylor *et al.*, 2000; Kollias *et al.*, 2013; Oehler *et al.*, 2017).

Hence, based on the information regarding U.S. and UK stock markets, NYSE and FTSE 100 will be selected to choose the listed banks. For selecting the whole sample of listed banks, this chapter chooses all listed banks trading in NYSE and FTSE 100 and uses tickers of each bank in the Tweets selection process. A full list of all sample banks will be provided in the Appendix. In the final dataset, for NYSE, there is a total of 68 banking-related stocks (including 34 U.S. banks and 34 foreign banks, the full list will be provided in the Appendix). For FTSE 100, there is a total of 5 banking-related stocks, which include Barclays, HSBC, Lloyds Bank, Royal Bank of Scotland and Standard Chartered.

As there are some data availability limitations, such as missing or no Tweets regarding specific banks in one trading time during the whole time, the final sample banks are different from the original banks listed on NYSE and FTSE 100. Specific data mining and sample bank

selection criteria will be provided in section 4.1.4., and the final banking list will be found in Appendix table (b), with the name, symbol, and country of each bank.

4.1.3 Time-period

Unlike other studies focusing on a short-time period (e.g., Nisar and Yeung (2018) focus on a 7-day period using an event study for predicting the stock market), this chapter designs to explore Twitter effects with a longer period to gain a better view and accurate outcome.

For selecting the total time-period to analyse all banks, I include a one-year time horizon for analysing the Twitter effects. As the Twitter API function has a strict limitation of the 30-day trace-back period, the Tweets can be only gathered from the most recent date at this stage. The final Tweets include data from Tuesday, 01st September 2020 to Wednesday, 01st September 2021. As the main purpose of this chapter is to investigate how the number of Tweets and Twitter sentiment could affect financial stability/banking stock market stability and to explore if these two factors affect the market differently or similarly, and to what extent. Therefore, it is believed that a one-year time-period is able to explain and be used to analyse the research questions in that plenty of Tweets are twitted every single day. Although for each bank, Tweets may not be numerous (i.e., for some non-popular banks, the daily posting Tweets could be 10, 20 or 50), the total daily Tweets for all banks would be a relatively large number.

Hence, the final time-period of this chapter includes a one-year time horizon data from 01st September 2020 to 01st September 2021.

4.1.4 Data mining

To keep a more fluent and concrete dataset, the following steps are utilised to clean and finalise the data.

(i) Excluding the date that the stock market closed/had no trading records

(ii) Excluding the banking stock if there are no Tweets recorded in one trading day

Carrying out process (i) is for keeping only the active trading stock price and trading volume. When the market is closed, the Tweets may still be posted, but the stock price/volatility or the trading volume will remain the same as the last active trading day. Hence, the Twitter effects will not be estimated based on a real situation as there will be no relevance between Tweets and the stock market. Twitter effects could only be revealed when the market is active. Proceeding process (ii) is for a similar reason to process (i). When a bank stock has no Tweets, its price changes cannot be estimated from the Twitter side, which is not consistent with the main objective of this chapter. From this regard, this research hereby will remove the bank from either NYSE or FTSE 100 index if there are no Tweets regarding it on a random trading day.

The text mining method used in this chapter is built on the approaches provided by Sun *et al*. (2016) and Nisar and Yeung (2018). After carrying out step (i), there is a total 138-day market closing period. Hence, these days will be excluded from the whole time-period. After carrying out step (ii), there are 8 banks excluded from the final sample list of which 7 banks miss the daily Tweets data with their hashtag of banking stickers, and one bank changes the sticker symbol. For keeping the consistency of the Tweets regarding bank stock (i.e., when referring to bank stock, the sticker is always the same) and to reveal accurate results of Twitter effects, this study decides to remove all 8 banks. After both steps (i) and (ii), there are a total of 71 selected banks and a one-year time-period in the final dataset.

Of the total 71 selected banks, there is a total of 66 banks trading in NYSE (with 34 U.S banks and 32 foreign banks) and 5 banks trading in FTSE100.

4.2 Sentiment analysis

The motivation for exploring the Twitter sentiment effects is driven by several previous pieces of literature. For example, Nofer and Hinz (2015) point out that according to behavioural finance studies, the stock market can be driven by the emotions of market participants. In several recent studies, mood levels have been extracted from social media applications in order to predict stock returns. As positive and negative sentiment may have different effects on the financial market (Sul *et al.*, 2017), it is important to track both positive and negative sentiment. Zheludev *et al.* (2014) and Duz Tan and Tas (2021) confirm that positive and negative Tweets have effects on the stock price. Ranco *et al.* (2015) and McGurk *et al.* (2020) also indicate the importance of positive and negative sentiment on Tweets as they find that a significant impact shows between the sentiment and abnormal returns. McGurk *et al.* (2020), analysing the sentimental Tweets effects on stock return, find that positive or negative sentiment has significant effects on abnormal stock return.

Previous literature also mentions different methods to extract sentimental text from Tweets. For example, Duz Tan and Tas (2021) use a three-step method developed by themselves to gather sentimental Tweets. The first step is defining a Tweet manually by a human expert, and then the annotated data are processed into a machine learning model. Finally, the story-level sentiment including score and confidence is calculated as a value at 0, 1 and -1 to represent the neutral, positive and negative sentiment. McGurk *et al.* (2020) create two sentimental indexes employing both the tokenisation approach and bag-of-words approach. They use the ticker symbol and cashtag ($) to represent the firm stock and keep only

token information. For the bag-of-words method, they create a Twitter finance dictionary of positive and negative unigrams that would be used in Twitter referring stocks. The bag-of-words method is also a common method when analysing the sentiment text. For example, Sul *et al.* (2017) use the bag-of-word analysis strategy. Each word in a tweet is matched to a dictionary of terms to determine its sentiment (positive or negative). The difference between the method used by McGurk *et al.* (2020) and other studies is the bag-of-word source. The Harvard-IV dictionary is the most commonly used source for word classification in the financial content analysis of popular press articles and Web news sites (Tetlock, 2007; Tetlock *et al.*, 2008; Da *et al*., 2011; Sul *et al.* 2017).

There is also some sentiment analysis software introduced by previous studies. In order to extract the sentiment of every tweet, a lexicon-based sentiment classifier, called "Umigon", which is a software to identify sentiment from the selected Tweets, is used by Nisar and Yeung (2018). The app uses a 4-step process to identify sentiment (positive or negative) with special attention paid to the use of smileys and the use of hashtags. Bollen *et al.* (2011) use OpinionFinder (OF) to analyse sentiment content, which is a publicly available software package for sentiment analysis that can be applied to identify the emotional polarity (positive or negative) of sentences. Piñeiro-Chousa *et al.* (2016; 2018) analyse the sentiment of the messages on StockTwits.com with Stanford CoreNLP (Natural Language Processing) Toolkit, developed by Manning *et al.* (2014). This software uses Sentiment Treebank, which is the first corpus with fully labelled parse trees that allows for a complete analysis of the compositional effects of sentiment in the language (Piñeiro-Chousa *et al.*, 2018). This analysis yields a sentiment value for each message classified on a Likert scale from −2 (very negative sentiment) to 2 (very positive sentiment), with 0 being the neutral sentiment. The DICTION 7 is also a widely used computer-aided text analysis program in recent studies (e.g., Hajek *et al.*, 2014; Wisniewski and Yekini, 2015; Brockman and Price, 2017; Alli *et al*., 2018). for determining

the tone of a verbal message. DICTION searches a passage for five general features as well as thirty-five sub-features. It can process a variety of English language texts using a 10000-word corpus and user-created custom dictionaries. DICTION produces reports about the texts it processes and also writes the results to numeric files for later statistical analysis. Output options include raw totals, standardised scores, word counts and percentages, which provide the user with a variety of ways of understanding the text they have processed.

As the coding process of extracting and distinguishing sentiment content is relatively complex and requires higher professional techniques, the software will be used for making the process simpler and clear to make the results more accurate. For a more efficient and effective reason, DICTION 7 will be used as the main sentiment analysis software. As mentioned above, DICTION 7 is used in many studies (e.g. Wisniewski and Yekini, 2015; Brockman and Price, 2017; Alli *et al*., 2018) and it is a professional software to deal with sentiment analysis, which is consistent with Brockman and Price (2017) and Alli *et al*. (2018), in the meanwhile, other software will be checked as an additional option (Stanford CoreNLP software) to analyse the sentiment and cross check the results.

4.3 Variables

This section explains each variable that will be used in the final data analysis in a detailed way, and Table 1 can be found at the end of this section, which includes all variables' descriptions and summarises.

To identify the relationship between Twitter volume and sentiment and bank stability, this chapter will capture the Twitter volume variable, which is the number of Tweets; the Twitter sentiment variables, which are the number of positive Tweets and negative Tweets; the bank

stock price volatility, which to indicate the bank stability. All variables are based on a daily frequency and will be introduced in a specific way in each of the following section.

4.3.1 The Twitter volume variable

To establish the relationship between Twitter volume and bank stability, *TWEETTOTAL* (variable symbol) is used in this chapter to indicate the daily number of Tweets regarding each sample bank. For example, if *TWEETTOTAL* is 10 on the 1st of May 2021 under "HSBC", then it indicates that on the 1st of May, there are total of 10 Tweets mentioning "HSBC". The total number of Tweets (*TWEETTOTAL*) is extracted from the Twitter API function via Tweetcatcher and counted by the author.

4.3.2 The Twitter sentiment variable

To investigate the relationship between Twitter sentiment and bank stability, two sentimental variables need to be extracted, which are positive and negative. For indicating positive and negative Tweets, I follow the method provided by previous sentiment analysis studies (e.g., Nisar and Yeung, 2018; McGurk *et al.*, 2020; Ganesh and Iyer, 2021), establishes the number of positive and negative Tweets as two sentimental variables. The volume of daily positive tweets will be expressed as '*TWEETPOS*' and the volume of daily negative tweets will be expressed as '*TWEETNEG*'.

For gathering *TWEETPOS* and *TWEETNEG*, there are several steps I follow. the first step is to collect all Tweets within a time-period among the selected banking stocks, and then follow the steps of getting the total number of Tweets in the last section. When the daily number of Tweets is confirmed, the next step is to find out which are positive or negative Tweets. For

getting the results, this chapter uses the software- 'DICTION' to distinguish if one Tweet is positive or negative. As DICTION is a text analysis software, it can divide the tone of words into different categories (such as 'sad' or 'happy'). Each collected Tweets will be analysed via DICTION and gather the tone of the words. To define a Tweet whether positive or negative, this study follows the points that DICTION concluded under each "tone word" category. For example, "happy"; "confidence": "sad"; "anger" etc. If the total positive points are higher, it will be defined as a positive Tweet and if the total negative points are higher, it will be defined as a negative Tweet. To define if a "tone word" is positive or negative, this chapter also follows the common method used in previous studies categorising words when doing sentiment analysis (Tetlock, 2007; Tetlock *et al.*, 2008; Da *et al*., 2011; Sul *et al.* 2017), applying the Harvard-IV dictionary. Finally, the total number of positive and negative Tweets is collected and will be applied in the empirical analysis.

4.3.3 The trading volume variable

To establish the relationship between Twitter volume and bank stability, I use the $LNVOL_{it}$ (variable symbol) to indicate the exchange volume of a specific banking stock i in day t. As the daily exchange volume could be enormous, I hereby follow the method used by Zhao (2020), applying the natural logarithm of the daily exchange volume to indicate the trading volume variable. The daily stock trading volume for each bank stock is collected directly from Yahoo Finance.

4.3.4 The financial stability variable

For indicating bank stability, I apply the daily stock price volatility – *STOCKVOL* (variable symbol) as the indicator of stability, which is also used and consistent with Aouadi *et al*. (2013); Baumöhl *et al.* (2018) and Azrak *et al.* (2021).

The reasons behind this indicator mainly come from the following aspects. The first one is also the simple one, which is the data frequency. As all data in this chapter is based on a daily horizon, it is essential to keep all data frequency consistent. Based on this reason, the popular indicator of accounting-based methods (e.g., bank Z-score) cannot be applied in this chapter. The bank *Z-SCORE* does not fluctuate or has daily change. Therefore, the daily *Z-SCORE* will remain the same and will be different from the last value every quarter and not representative of this analysis. Hence, the option is to find indicators based on market data and daily frequency. As it is mentioned from the start of this chapter, the background behind is supported by Minsky's (1982) hypothesis ('economic agents observing low financial risk are induced to increase risk-taking, which in turn may lead to a crisis'). This hypothesis reveals that financial market volatility may have a direct impact on the likelihood of a financial crisis (can be seen as financial instability). This is the foundation of Minsky's famous statement that "stability is destabilising", which can be explained as low volatility inducing economic agents to take more risk, endogenously increasing the likelihood of future shocks. If the economic conditions deteriorate and result in bad investment decisions, volatility then will increase, signalling a pending crisis. In addition, the famous stock market crash in the history of 1929 could reveal the importance of the security market to the whole economy. This 1929 stock market crash finally led to the great depression in the 1930s.

Apart from the theory of Minsky, several studies also investigate the stock price volatility change during some particular time periods when the market is unstable. For example, Schwert

(2011) shows how stock volatility changed over the financial crisis during 2008; Mun and Brooks (2012) explore the role of news and stock price volatility in explaining the changes in correlation in the national stock market during the financial crisis; Bouri (2015) investigates the oil price volatility and stock market volatility during the financial crisis. All studies find stock price volatility changes a higher amount of value or experiences unstable during a financial crisis. Specifically, Schwert (2011) finds that during the 2008 financial crisis, stock price volatility hits historically high levels of stock market volatility, especially for financial section stocks. The effect will not be lasting too long, and it will be back to a normal level after the crisis. Mun and Brooks (2012) confirm that the majority of correlations between the national stock market can be more strongly explained by stock price volatility other than news. Bouri (2015) highlights the dynamic effects of the global financial crisis on stock volatility.

Based on the discussion above, we can see that stock price volatility can explain/represent a financial crisis (market instability) situation at a specific level. From this regard, the daily stock price volatility (*STOCKVOL*) will hereby be used to indicate financial stability (both financial market and banking stability), which is the square root of the variance of a daily stock price. This method is also consistent with Aouadi *et al*. (2013); Baumöhl *et al.* (2018) and Azrak *et al.* (2021). Commonly, we prefer a more stable stock price overtime period, and a higher stock price volatility indicates higher risk and therefore, lower stock market stability.

The formula below describes how daily stock price volatility (*STOCKVOL)* will be calculated:

$$STOCKVOLit = \sqrt{\frac{\sum(\bar{p}-p_i)^2}{n}} \quad (1)$$

where the *STOCKVOLit* is the daily stock price volatility of banking stock i in day t; $\bar{p}$ is the mean of the stock price i in day t; p_i is the closing price of banking stock I in day t; n is the number of the daily stock price i be recorded; i stands for the i^{th} (number of) sample bank and t is for t^{th} trading day in the sample.

4.3.5 Control variable

For dealing with potential omitted variables and other non-independent variables that may influence financial stability, I apply three control variables to monitor the stock price movement, the country effects and bank type effects, which are *CLOSE*, *U.S*. and *BHC*. As all banks analysed in this chapter are chosen from the NYSE and FTSE 100 indexes, which are based on the U.S. and UK stock markets, the national effects on stock price need to be considered as well as the bank type.

CLOSE is the daily stock closing price movement, the calculation of it is using the daily stock closing price movement (i.e., the difference between the closing price on day 2 and closing price on day 1) divided by the closing price on the last day. The formula of how to calculate *CLOSE* is provided below in (2). The reason for including stock price movement as a control variable in the chapter is following the study carried out by Nisar and Yeung (2018) investigating the Twitter mood effects on stock price, they indicate that the closing price could be an effector for the change of stock price. Specifically, if the daily change of closing price experiences a higher range or volatility, it is likely to affect the willingness of trading, and the judgement of investors, or in another word, the mood. As previously indicated in the Literature section, mood can be a possible reason for stock price movement and then affect stock price volatility. For trading volume, it is commonly believed as a factor of influencing the stock price. Hence, based on the discussion, this chapter firstly introduces the *CLOSE* as a control variable to catch the possible effects of the daily stock closing price change other than Twitter effects.

CLOSE can be expressed as the formula below:

$$CLOSE_{it} = \frac{CLOSE_t - CLOSE_{t-1}}{CLOSE_{t-1}} \quad (2)$$

where *CLOSEt* is the closing price for day t, *CLOSEt-1* is the closing price for day t-1; i stands for the i^{th} (number of) sample bank and t is for t^{th} trading day in the sample.

The second control variable is the *U.S.* (the U.S or non- U.S. banking stock), which is for controlling the country/institutional effects, especially the U.S. banks, as a different country may have different power of affecting the stock price, and U.S. banks are commonly believed to have strong power to affect the market (Aubuchon and Wheelock, 2010). The evidence can be indicated from the 2007-2008 financial crisis, in which a bank failure started in the U.S. Hence, we should pay attention to the country/institutional effects when analysing the stock price volatility. The control of the *U.S.* will be used as a dummy format, in which 1 indicates it is a U.S. bank, and 0 indicates it is a non-U.S. bank.

The final control variable, *BHC* (Bank holding company or not), is for controlling bank types. The reason behind this is similar to controlling country effects, as the bank type could be a factor in stock price change when in a trade position (Jagtiani *et al.*, 2002). In this regard, the bank type is believed to have the ability to influence stock price and stock price volatility, it is essential to include it in the model as a control variable to capture bank type effects. Similar to the *U.S.*, the control of *BHC* will be used as a dummy format, in which 1 indicates it is a bank holding company, and 0 indicates it is not a bank holding company.

Table 1 below is the summary of all variables in the regression model

Table 1: Variable summary

Dependent variables

Symbol	Description	Collection

LNVOLit	Natural logarithm of the exchange volume of banking i in day t	By own calculation; Yahoo Finance
STOCKVOLit	Daily stock price volatility; financial stability indicator	By own calculation; Yahoo Finance

Independent variables

Independent variable	Description	Collection
TWEETPOSit	The volume of daily positive tweets of stock *i* in day *t*	Twitter API; Tweetcatcher; DICTION
TWEETNEGit	The volume of daily negative tweets of stock *i* in day *t*	Twitter API; Tweetcatcher; DICTION
TWEETTOTAL	The volume of Tweets in day t	Twitter API; Tweetcatcher

Control variables

CLOSE	The daily stock price movement	By own calculation; Yahoo Finance
U.S.	1= U.S bank; 0 otherwise	Yahoo Finance
BHC	1= Bank Holding Company; 0 otherwise	Yahoo Finance

4.4 The regression model

As I intend to explore:

(i) the relationship between Twitter volume and daily banking stock exchange volume;

(ii) the relationship between Twitter volume and financial stability;

(iii) the relationship between Twitter sentiment and daily banking stock exchange volume;

(iv) the relationship between Twitter sentiment and financial stability.

For realising these purposes in this chapter, two dependent variables (*LNVOL* and *STOCKVOL*) will be analysed for indicating banking stock exchange volume and financial stability. By applying an OLS model as the baseline model, includes the independent variables of *TWEETTOTAL*, *TWEETPOS* and *TWEETNEG*, for indicating Twitter volume and Twitter sentiment (positive and negative), and the control variable of *CLOSE*, *U.S.* and *BHC*, for indicating daily stock price movement, bank country effects and bank type effects. The baseline model follows a similar approach provided by Nisar and Yeung (2018).

In the later section, different models such as the Random effect model will also be applied as the robustness check, for dealing with any omitted variable, or endogeneity issue, and at the same time, to check further if the results from the baseline model are consistent.

The two regression models for this chapter can therefore be defined as follows:

$$STOCKVOLit = \alpha + \beta_0 TWEETTOTAL_{it} + \beta_1 TWEETPOS + \beta_2 TWEETNEG + C_{it} + D_{it} + \epsilon_{it} \quad (3)$$

where the *STOCKVOLit* is the daily stock price volatility of banking stock i in day t; α is the intercept, β_0 is the coefficient of the *TWEETTOTAL* (the volume of Tweets) in day t; β_1 is the coefficient of *TWEETPOS* (volume of daily positive Tweets); β_2 is the coefficient of *TWEETNEG* (volume of daily negative Tweets); C_{it} is the control variable for banking i in day t; *Dit* is the dummy variable and *ε* is a random error term for firm i in day t; i stands for the i^{th} (number of) sample bank and t is for t^{th} trading day in the sample.

$$LNVOL_{it} = \alpha + \beta_0 TWEETTOTAL_{it} + \beta_1 TWEETPOS + \beta_2 TWEETNEG + C_{it} + D_{it} + \epsilon_{it} \quad (4)$$

where the *LNVOL*it is the natural logarithm of exchange volume of specific banking stock i in day t; α is the intercept, β_0 is the coefficient of the *TWEETTOTAL* (the volume of Tweets) in day t; β_1 is the coefficient of

TWEETPOS (volume of daily positive Tweets); β_2 is the coefficient of *TWEETNEG* (volume of daily negative Tweets); C_{it} is the control variable for banking i in day t; *Dit* is the dummy variable and ε is a random error term for firm i in day t; i stands for the i^{th} (number of) sample bank and t is for t^{th} trading day in the sample.

5. Data analysis

5.1 Descriptive statistics

The descriptive statistic is provided below in Table 2.

Table 2

Variable	*N*	Mean	Std. Dev.	Min	Max
STOCKVOL	18,019	0.33	0.35	0.01	2.43
LNVOL	18,019	13.77	1.71	9.07	18.66
TWEETTOTAL	18,019	2220	503.77	1512	3718
TWEETPOS	18,019	18.32	51.19	0	646
TWEETNEG	18,019	12.09	37.63	0	456
CLOSE	18,019	0.05	1.03	-1	40.80

N.B. STOCKVOL is the Stock price volatility; *LNVOL* is the natural log of the daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close price (as a control variable here).

From the descriptive statistic table above, we can see that the dependent variable stock volatility has slightly fluctuated with a standard deviation of 0.35 and a mean of 0.33. This figure indicates that the overall *STOCKVOL* flatulates around a mean value. The range of 2.44 indicates that in the selected sample period, the overall stock market may be stable, but some stocks may experience unstable times. For another dependent variable-*LNVOL,* it shows a higher volatility than *STOCKVOL*, with a 1.71 standard deviation and the range is also high, which illustrates the daily exchange amount changed fast and reacted to the Tweets relatively sensitive throughout the time-period. Sentimental information may play a vital role in this

change, as it also be mentioned in the study by Oliveira *et al.*, (2017) and Ganesh and Iyer (2021).

For the independent variables, the *TWEETTOTAL* indicates that there are thousands of daily Tweets regarding the stock market, and the number varies (a range of 2206) depending on the dates. For the *TWEETPOS* and *TWEETNEG*, they have a quite similar mean of 18.32 and 12.09, respectively, which indicates that the number of daily positive and negative Tweets could be highly close. In addition, they both have a minimum of zero. It reveals that there are no positive or negative sentiment Tweets of one specific banking stock in at least one day. Compared to *TWEETNEG*, *TWEETPOS* is more volatile as a standard deviation of 51.19 higher than *TWEETNEG*. Furthermore, the maximum number of *TWEETPOS* is also higher than *TWEETNEG*, which indicates that the overall number of positive sentiments is higher than negative sentiments when users post Tweets regarding the selected stocks.

5.2 Regression results

The regression results of the baseline regression models are provided below in Table 3

Table 3

Independent Variable	(a)	(b)
TWEETTOTAL	-0.08***	1.56***
TWEETPOS	0.14***	-1.74***
TWEETNEG	0.13**	-0.86***
CLOSE	0.16***	-1.72
U.S.	0.24***	0.45***
BHC	0.07***	0.003
cons	0.20***	13.43***
Adj. R^2	0.13	0.13

N.B. (a) shows the regression results for *STOCKVOL*, which is the Stock price volatility; (b) shows the regression results for *LNVOL*, which is the natural logarithm of daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close

price (as a control variable here); *U.S.* is the dummy variable for a country (1 = U.S. banking, 0 = non-U.S. banking); *BHC* is the dummy variable for banking holding company (1= BHC, 0 = Bank).

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From Table 3, the regression results indicate that both Twitter counts, and moods significantly (under 1% significance) affect the *STOCKVOL*, which means that Tweets are indeed important to banking stock market stability, which has also been revealed by recent studies by Duz Tan and Tas (2021) and Ganesh and Iyer (2021). We need to pay attention to this result as Twitter owns a huge number of users and potential investors who may post and reference those Tweets for investing or other financial activities, the effects could be more influential than our expectation in the reality. Due to the importance of the financial system, these Tweets including sentimental Tweets could be a vital tool to monitor and control the financial market or could be a manipulated chance to harm the financial world. The results of Twitter importance are consistent with previous studies carried out by Oliveira *et al.* (2017), which reveal that Twitter mood and posting volume are informative for forecasting S&P 500 index; and Behrendt and Schmidt (2018), which confirm that Twitter sentiment and count are influential factors for predicting intraday stock returns.

In the results, the *TWEETTOTAL* (number of Tweets) indicate a negative relationship to the banking stock price volatility with a coefficient value of (-0.08), which reveals that, with higher Twitter posting volume regarding the selected banking stock (i.e., the Tweets posting with selected stock ticker symbol), the stock price will be less volatility by 0.08, thus higher banking stability. This result is also supported by Behrendt and Schmidt (2018), which show a negative correlation between Twitter posting volume on Walmart's intraday stock return volatility. One explanation for that is, with a higher volume number of Tweets, investors could gain more information or have a higher willingness to share information regarding the specific

stock, which will be more rational when making investment decisions or just following market trends. As this chapter uses banking stock price volatility to indicate banking stability, it hereby can only confirm that higher Tweets volume will not increase stock price volatility, but it cannot testify to the relationship between Tweets volume and stock price. Some previous studies such as Behrendt and Schmidt (2018) and Duz Tan and Tas (2021) reveal its effects on the stock price. As this chapter does not focus on the effects on price, the stock price change will not be considered.

As for the Twitter sentiment, it is obvious that Twitter sentiment will harm banking stability (as both *TWEETPOS* and *TWEETNEG* are significant positively correlated to stock price volatility), which is consistent with Oliveira *et al.* (2017) and Behrendt and Schmidt (2018). Based on their coefficient value around 0.15 to *STOCKVOL*, I believe the sentiment would also be economic significance to banking stability. Hence, compared to Twitter volume, the mood is more dangerous for banking stability as either a positive or negative mood will significantly increase stock price volatility, which indicates that the mood of a posting message specifically related to a stock choice is more influential than the volume of the message. This is relatively important to investors as they could make investment choices or activities based on personal mood information, which has a potential chance of controlling the stock price change. For the overall stock market, if it desires to be less volatile, it will require Twitter users and investors to be as neutral as possible, or in other words- rational. In addition, for the institutional and type controlling, the U.S. banking and bank holding company are more influential to banking stability as both *U.S* and *BHC* are significant to stock volatility.

For the results of Twitter volume, it is obvious that both Twitter posting volume and sentiment of everyday Tweets regarding the banking stock trading in NYSE and FTSE 100 significantly affect the stock market exchange volume. This result is consistent with Baker and Wurgler (2006); Chung *et al.* (2012); Ding *et al.* (2019). As this chapter narrows the stock

market definition to stock exchange volume, which is used by Oliveira *et al.* (2017) and Nisar and Yeung (2018), as well as the investor sentiment to Twitter sentiment, which is tested by Zhang *et al.* (2011), the results show a significant positive relationship between Twitter count and stock trading volume (Oliveira *et al.*, 2017), and a significant negative relationship between Twitter sentiment and trading volume.

For the volume of Tweets, it demonstrates that with the number of Tweets increasing, trading volume will significantly increase, which Piñeiro-Chousa *et al.* (2016) and Oliveira *et al.* (2017) also testify this. The stock exchange volume is also related to market stability. From this regard, this result also needs to be addressed. Higher exchange volume reveals a higher willingness of investors to invest in the stock market or take part in financial activities in the stock market. From the results, it is expected to have more active investors in the stock market with the daily Tweets increase. As Twitter has been developing and expanding, the number of Twitter users has also increased fast, which indicates a future financial trend may be affected by Twitter or other social media platforms. Hence, how will Twitter show its direction is important to businesses.

For the sentiment aspect, under the regression results, it is negatively correlated to trading volume. This result is similar to the sentiment effects on stock price volatility, which emphasise the importance of Twitter mood (positive or negative). It is obvious that when a mood word applies to one Tweet, its influence will be different from Twitter counts. Under a sentimental Tweet, investors show less willingness to trade compared with a neutral mood. In another word, investors desire to trade when receiving a relatively logical and rational message rather than information with high personal judgements. Ganesh and Iyer (2021) also mention this sentimental effect on their study. The results demonstrate that sentimental Tweets increase stock price volatility and reduce trading volume. This indicates that when investors receive

more ‘attitude words’ regarding one stock, it is more likely to experience price fluctuation during a time-period and these investors may choose to make fewer transactions.

For the institutional difference and types of banks, the U.S. banks also illustrate a relatively important position compared with non-U.S. banks. However, whether it is a bank holding company or a bank seems not essential under this model. The reason for a higher U.S. effect may be from the stock market index, as most of the selected banking stocks are from the NYSE index.

5.3 Robustness checks

For checking the robustness, different tests (Hausman test, random effects, include or exclude some variables) are applied to further check and test the relationship between Twitter and bank stability as well as stock trading volume. Detailed information can be found below in section 5.3.1.

5.3.1 Hausman test and Random effect

For testing the accuracy and dealing with the endogeneity issue, as well as the possible omitted variable problem, this chapter firstly follows the Hausman test, which is a commonly used approach to test if the Fixed or Random effect is appropriate for the data. The result is shown below. A 0.5 figure p-value indicates that the dataset includes in this chapter is more suitable for running a Random effect model.

Hausman test: $p = 0.5$

As the Hausman test result indicates that the random effect model is an appropriate one for applying to this chapter, this research follows the approach provided by Lahouel *et al.* (2019) to account for the potential endogeneity and omitted issue, using the random effect IV model.

The results of the Random effect are shown in Table 4

Table 4

Variable	(a)	(b)
TWEETTOTAL	-0.25**	0.13***
TWEETPOS	0.22*	-0.20***
TWEETNEG	1.36**	0.05***
CLOSE	0.21	-0.54
U.S.	0.25***	0.56*
BHC	0.08	0.0003
_cons	0.14***	13.55***
Adj. R²	0.13	0.05

N.B. (a) shows the regression results for *STOCKVOL*, which is the Stock price volatility; (b) shows the regression results for *LNVOL*, which is the natural logarithm of daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close price (as a control variable here); *U.S.* is the dummy variable for a country (1 = U.S. banking, 0 = non-U.S. banking); *BHC* is the dummy variable for banking holding company (1= BHC, 0 = Bank).

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From the results of Table 4, the Twitter effects (i.e., number of Tweets, sentimental Tweets) remain significant to the banking stability variable. This outcome is also consistent with the results in the baseline model. Hence, it is believed that Twitter has a powerful influence on bank stability, which shows in the bank stock market aspect. Apart from the significant level, each sign of the Twitter variables stays the same with the baseline model (i.e., number of Tweets stabilises bank stability but sentimental Tweets harm bank stability). From this regard, I hereby confirm the relationship between Twitter and bank stock volatility. From other aspects,

the U.S. bank indicates a higher level of an influential factor again in this model, staying the same as the baseline. This indeed illustrates an important role of the U.S. bank stock market among others. From the results of Table 2, for the trading volume, Twitter also indicates a significant relationship between Twitter volume and stock trading volume and Twitter positive sentiment and stock trading volume, which is consistent with the baseline model for the significant level. For the sign of the two influential factors (number of Tweets and positive Tweets), they stay the same with the baseline mode, in which Twitter volume enhances stock trading volume and sentimental Tweets reduce stock trading volume. However, the negative sentiment Tweets are not shown as a significant factor in stock trading volume compared with the baseline model. Based on the discussion above, when referring to stock trading volume, this chapter can confirm the Twitter effects exist but are not consistent depending on the aspect of Twitter.

5.3.2 Regression results of excluding a control variable- CLOSE

I intend to further test the effects of Twitter counts and sentiment on banking stability and stock market trading activities and thus exclude one control variable-*CLOSE* here to see if any obvious changes happen. The results are shown in Table 5.

Table 5

Variable	(a)	(b)
TWEETTOTAL	-0.08***	1.55***
TWEETPOS	0.14***	-1.74***
TWEETNEG	0.12*	-0.86***
U.S.	0.23***	0.44***
BHC	0.07***	0.00014
_cons	0.20***	13.44***

Adj. R²	0.13	0.13

N.B. (a) shows the regression results for *STOCKVOL*, which is the Stock price volatility; (b) shows the regression results for *LNVOL*, which is the natural logarithm of daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close price (as a control variable here); *U.S.* is the dummy variable for a country (1 = U.S. banking, 0 = non-U.S. banking); *BHC* is the dummy variable for banking holding company (1= BHC, 0 = Bank).

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From table 5, the results are similar with (including the sign of each variable) the baseline model results, in which it can be confirmed that Tweets have significant impacts on financial markets. Both stock market volatility and stock trading activities show highly correlated with Twitter activities even after excluding the control variable. As the control variable *CLOSE* is to reveal the daily percentage change of the stock close price, which is considered a potential factor of affecting the stock volatility, the significant result of both Twitter counts and sentiment here illustrate the importance of Twitter effects on financial markets.

5.3.3 Regression results of only using NYSE banking and U.S banking dummy variable

When the control variable- *CLOSE* is excluded, it still has similar results as the baseline model, in which the Twitter counts, and sentiment significantly affect stock volatility and trading activities. Based on that, this chapter intends to pay attention to the county-specific aspect in order to check if U.S banking or non-U.S. banking still shows a high correlation to the financial market. Hence, under Table 7 and 8, this study only uses the NYSE stock and include a country dummy (1 is for U.S. banking, and 0 is for other countries). The results are indicated below in Table 6.

Table 6

Variable	(a)	(b)
TWEETTOTAL	-0.08***	1.56***
TWEETPOS	0.14***	-1.74***
TWEETNEG	0.12**	-0.86***
U.S.	0.25***	0.44***
_cons	0.23***	13.44***
Adj. R²	0.13	0.13

N.B. (a) shows the regression results for *STOCKVOL*, which is the Stock price volatility; (b) shows the regression results for *LNVOL*, which is the natural logarithm of daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close price (as a control variable here); *U.S.* is the dummy variable for a country (1 = U.S. banking, 0 = non-U.S. banking); *BHC* is the dummy variable for banking holding company (1= BHC, 0 = Bank).

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From Table 6, the Tweets from the NYSE stock market significantly affect financial markets. In addition, U.S banking shows a significant impact on the financial market. From the results, the stock volatility will increase by 0.25 units as one U.S banking added, which indicates U.S banking could be a potential risk factor for the NYSE stock index, as it experiences mass trading activities and may be harmful to the financial stability when there are massive stocks.

On the other hand, Twitter counts, and sentiment still show similar signs and correlations with the baseline model results.

5.3.4 Regression results of only using negative Tweets

As the main objective of this chapter is to analyse Twitter sentimental effects on the financial market, the chapter hereby aims to specifically explore the sentimental relationship between

sentimental Tweets and banking stock price volatility via only including a single sentimental Tweets (negative or positive). The reason for only including one sentimental variable is for checking its influence level. When there are both positive and negative sentimental Tweets in the model, they could have effects on each other. When there is only one sentimental variable, the results will show whether this factor indeed affects the stability variable and if it is still significant. The reason for only including positive sentimental Tweets is the same. In Table 7, the results are specifically for negative Tweets.

Table 7

Variable	(a)	(b)
TWEETTOTAL	-0.05***	1.15***
TWEETNEG	0.22**	-2.07***
U.S.	0.23***	0.47***
BHC	0.07***	-0.008
_cons	0.20***	13.44***
Adj. R^2	0.12	0.12

N.B. (a) shows the regression results for *STOCKVOL*, which is the Stock price volatility; (b) shows the regression results for *LNVOL*, which is the natural logarithm of daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close price (as a control variable here); *U.S.* is the dummy variable for a country (1 = U.S. banking, 0 = non-U.S. banking); *BHC* is the dummy variable for banking holding company (1= BHC, 0 = Bank).

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From table 7, when I only consider the negative sentimental Tweets in the analysis, the regression results show a high significance level of both stock volatility and trading activities, which are 5% and 1%, respectively. It is also obvious that negative sentimental context indicates a positive effect on stock volatility, which means it is harmful to the financial system and increases the chances of experiencing an instability financial market condition. As for

impacts on trading volume, negative sentimental Tweets significantly influence stock transactions in a negative direction, which implies with a higher volume of negative Tweets, investors are less willing to trade. This finding is consistent with the baseline results.

5.3.5 Regression results of only using positive Tweets

Under this section, I move to the stage of focusing on positive sentimental Tweets at this moment, as it intends to explore if Tweets related to positive attitude show similar impacts with the baseline model after the negative Tweets are excluded. Table 8 is the regression results of that.

Table 8

Variable	(a)	(b)
TWEETTOTAL	-0.04**	0.65***
TWEETPOS	0.14***	-0.61***
U.S.	0.23***	0.53***
BHC	0.07***	-0.008
_cons	0.20***	13.45***
Adj. R²	0.12	0.08

N.B. (a) shows the regression results for *STOCKVOL*, which is the Stock price volatility; (b) shows the regression results for *LNVOL*, which is the natural logarithm of daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close price (as a control variable here); *U.S.* is the dummy variable for a country (1 = U.S. banking, 0 = non-U.S. banking); *BHC* is the dummy variable for banking holding company (1= BHC, 0 = Bank).

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From the regression results, it confirms that positive sentimental Tweets have significant impacts on financial market activities. In addition, the results also confirm that both sentimental

contents (either positive or negative) increase the risk level of financial stability and reduce daily trading activities. The results are consistent with the baseline findings, which implies investors, as well as financial markets, are sensitive to the sentimental contexts of social media.

5.3.6 Regression results of using sentiment index and neutral Tweets

In the previous sections, it already has been checked the sentimental Tweets effects on financial markets. I still intend to check further if non-sentimental context from social media has similar or opposite effects on financial markets. Hence, it applies the non-sentimental (neutral) Tweets in this step and adds the sentimental index (value range from -1 to 1, which -1 implies total negative and 1 implies total positive) to check the results. Table 9 is provided below of the regression results. The sentiment index is collected from the Tweetcatcher software.

Table 9

Variable	(a)	(b)
SID	0.038**	0.15*
TWEETNEU	-0.04**	0.02***
CLOSE	0.13***	-0.19
U.S.	0.25***	0.41***
BHC	0.08***	-0.03
_cons	0.15***	13.47***
Adj. R²	0.16	0.12

N.B. (a) shows the regression results for *STOCKVOL*, which is the Stock price volatility; (b) shows the regression results for *LNVOL*, which is the natural logarithm of daily stock exchange volume; *TWEETTOTAL* is the daily volume of Tweets; *TWEETPOS* is the daily volume of positive Tweets; *TWEETNEG* is the daily volume of negative Tweets; *CLOSE* is the daily percentage change of close price (as a control variable here); *U.S.* is the dummy variable for a country (1 = U.S. banking, 0 = non-U.S. banking); *BHC* is the dummy variable for banking holding company (1= BHC, 0 = Bank).

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From Table 9, the sentimental index shows a significant positive influence on stock volatility at a 5% level, which is consistent with the main findings of sentimental Tweets revealing a harmful factor to financial stability. A correlation of 0.038 indicates a slightly low economic significance (as in real life, a Tweet should be 100% negative/positive, so that the stock volatility will decrease/increase by 0.038). As for the trading activities, the sentimental index reveals a positive influence here. Although it confirms that as the volume of sentimental Tweets increases, the trading volume will decrease in the previous results, the results here still make sense. Different from the sentimental volume, the index here focuses on the degree/to what extent the positive/negative sentimental is. Hence, the novel thing I find is that with a higher confidence level of the positive/negative sentiments, investors show more willingness to trade, which is also confirmed by Oliveira *et al.* (2017).

For another factor- neutral Tweets, it shows significance impact to both variables, and within the expectation, neutral Tweets reveal opposite impacts on the financial market compared to sentimental Tweets. It indicates a negative relationship between stock volatility, thus benefits for stock stability and a positive relationship for trading activities. The results are also related and consistent with the findings of Tweets counts in the previous section 5.2.

6. Conclusion

In this chapter, I analyse how Twitter count (daily volume of Tweets), and Twitter mood (positive and negative Tweets) could affect banking stability as well as banking stock trading volume using a sample of a selected 71 banks from the U.S. (NYSE) and UK (FTSE 100) stock market. The results from the baseline model indicate that both Twitter volume and Twitter sentiment have significant effects on banking stability as well as stock trading volume, which is consistent with Oliveira *et al.* (2017), McGurk *et al.* (2020) and Huynh (2021). This finding

confirms the importance of the social media (Twitter) factor in the financial system and the sentimental information influences the stock market.

From the results, it is believed that Twitter count will benefit banking stability when without considering its mood. At the same time, for its effect on stock trading volume, it is also believed to increase stock trading volume with larger Tweets. This finding is supported by Oliveira *et al.* (2017). One explanation for that is Twitter provides an information exchange/sharing platform, with gathers a higher volume of efficient information, it increases the willingness of investors to trade while controlling massive, biased information and thus decrease the chances of price fluctuation.

However, when sentimental information is considered in Tweets, the mood effects are opposite to the counts. It will then show a harmful influence on banking stability. From this point of view, it reveals that much sentimental information may become biased text and hinder a sounding financial system. Hence, it is important to be rational under a social media platform when receiving financial information.

Furthermore, when testing the sentimental Tweets and non-sentimental Tweets effects in the robustness check, neutral Tweets are introduced. Similar to the baseline model, the number of neutral Tweets is used to check Twitter counts effects as well as non-sentimental Tweets effects, plus the sentimental index to better distinguish the sentimental and non-sentimental effects on financial markets. The results also confirm the findings mentioned above. When this chapter refers to Tweets volume, it reveals a beneficial factor for bank stability and stimulator of stock trading activities. However, when a social media platform such as Twitter includes much sentimental context related to stock markets, it indicates a harmful factor to our financial stability and investors show less willingness to trade except under a higher confidence level.

I also checked the country area-specific factor effects on the financial market. From the results, it is believed that the U.S market is still a core and potential risk factor when under pressure conditions for the financial market, as U.S banking show a significant positive relationship to stock volatility.

For the policy implication, the results can firstly benefit investors who use social media to gather financial information regularly, as well as social media managers to control and manage some biased information. The findings of this chapter could give hints to investors regarding using Twitter information to analyse market volatility to adjust investment portfolios and infer trading volume based on Twitter counts. In addition, the social media platforms especially Twitter, allow investors to gather information about the likely policy direction and policy resolve of government, which helps to prepare for the change of policies and potential stock price and exchange rate changes as Sibande *et al*. (2021) suggest that real-time investor sentiment signals can be utilised to monitor potential speculative activities in the currency market.

Chapter 2 is different from other studies investigating relationship between Twitter and financial market for it explores banking stability and focuses on specific banks rather than an index stock market, it will benefit researchers seeking information on social media and the financial system, especially on the bank aspect. One limitation of this chapter is the relative short-time horizon as the data availability issue. Future researchers could use a longer time period dataset to explore the relationship between Twitter and the financial system, at the same time, applying a relative complex model (e.g., SVM, GARCH) to and different approach (e.g. event-study) to analyse. For the country and the stock market, this study focuses on the banking market in the U.S. (NYSE) and UK (FTSE 100), future studies could consider a developing market to compare the effects.

Chapter 3

The impact of the Covid-19 pandemic on the liquidity and stability of the banking system through the lenses of media

1. Introduction

From the year 2020, The Coronavirus (COVID-19), an unexpected and unpredictable pandemic starts to spread around the world. Many countries including the most developed such as the U.S., UK, France, and Germany and developing such as China and India announce various approaches to limit the spread of COVID-19. With the increasing number of infected people around the world, many local governments come up with strict regulations to deal with the spreading speed, which include the closure of universities, un-essential shops, eat-in service of restaurants, and limiting the number of airlines. As we can see, after announcing these strict regulations, people stay at home and work from home, which results in a sharp decrease in travelling, shopping and other outdoor entertainment activities (e.g., eating outside). Firms related to these industries would face the challenge of a drop in cashflows, and then the payment for employees. Hence, a circle would arise that hit the whole economy and even lead to a recession in the world economy. For dealing with the possible worse economic situation, the governments start to take actions for stabilising the economy. Furthermore, different from the 2007- 2008 financial crisis, the COVID-19 virus crisis impact is rising by the day, due to the high level of interconnectedness of manufacturing and distribution around the world. More

importantly, COVID-19 is an exogenous crisis compared to the 2007-2008 financial crisis, which is believed an endogenous crisis for the whole financial system,

Firstly, under these strict regulatory circumstances, central banks and governments take action of reducing the sharp tightening of financial conditions in the short term. At the same time, supporting cash flows of firms (by distributing additional funds to firms within eligibility, and relaxing banks' constraints on the use of capital buffers. Banks firstly take responsibility for supporting the firms and injecting funds as Borio (2020) and Demirgüç-Kunt *et al.* (2021) mention the function of banks in their studies.

As COVID-19 has been spreading dramatically, especially during 2020, it has affected the global economy in many aspects. Governments act from both political and financial aspects aiming to stabilise the economy. By 2022, the virus has still been spreading and some outcomes could be revealed of how severely COVID-19 affect the economy. The Group of Seven (G7) agrees to work together and find appropriate political actions to mitigate damage to global economic growth. The U.S. Federal Reserve cuts its interest rate and other central banks follow. Among other measures, the Bank of Japan increased the purchase of government bonds in an attempt to maintain liquidity in the market.

There are some existing studies which investigate the COVID-19 effects from different aspects on the financial system. It is commonly believed that COVID-19 is related to the stock market (e.g., Ashraf, 2020; Cepoi, 2020; Corbet *et al.*, 2020; Haroon and Rizvi, 2020), financial stability (e.g. Zhang *et al*., 2020; So *et al*., 2021), and even cryptocurrency market (e.g. Conlon and McGee, 2020; Mariana *et al.*, 2021). For example, Ashraf (2020) examine the expected economic impact of government actions regarding COVID-19 on stock market returns and find evidence of an existing relationship. So *et al.* (2021) study the impacts of the COVID-19 pandemic on the connectedness of the Hong Kong financial market, and they find that the COVID-19 effects are different from other crises. Some studies mention COVID-19 effects on

financial market stability (Zhang *et al*., 2020), including country-specific risks and systemic risks among global financial markets, and stock market volatility (Haroon and Rizvi, 2020), revealing that news related to COVID-19 impacts the volatility of equity markets. Akhtaruzzaman *et al.* (2021) also examine the COVID-19 effects on the stock market but focus on listed firms in China and G7 countries, and they find the changes of conditional correlation among stock returns. Many studies also demonstrate the COVID-19 impacts on cryptocurrency. For example, Mariana *et al.* (2021) indicate that the two largest cryptocurrencies, Bitcoin and Ethereum are both affected by COVID-19. Similarly, Goodell and Goutte (2021) consider a relationship between COVID-19 confirmed case and Bitcoin price. From the studies mentioned above, it reveals the contagion effects of COVID-19 on the financial system, and its negative impacts among several aspects indicated by existing studies (e.g., Baig *et al*., 2020; Cepoi, 2020; Chu *et al.*, 2020; Conlon and McGee. 2020; Corbet *et al.*, 2020; Goodell, 2020; Heyden and Heyden, 2020 Shehzad *et al.*, 2020).

As an unexpected virus, COVID-19 seems not so relevant to the world economy and financial system. However, it has been lasting for almost two years and still been spreading with strict policies carried out by the governments during its spreading time. With strict policies plus long-lasting time, COVID-19 cannot be regarded as a simple virus effect on the health issue, but more importantly, on the economic environment.

As mentioned before, with the regulations and controlling actions (e.g., lockdown, closure of shops) being carried out, the first issue facing to the bank system is the liquidity problem. It is mentioned in the previous discussion, that if governments announce to close any non-essential shops and restaurants, it will definitely hit the cashflows of these businesses. When the issue mentioned above arises, the illiquidity institutions will firstly struggle to make the payment, and at the same time, their employees and even the banks (creditors). At the same time, banks need to support local firms with funding and also cut cashflows. Then, due to the

interruption of cash flows, financial intuitions may face solvency problems when their reserves are depleted, which even results in default and bankruptcy. There is no doubt that these actions mentioned above will cut the cashflows drastically and reduce the liquidity. Due to the contagious problems among financial systems, especially banks, the worst outcome of the COVID effects is the failure of financial institutions. It is commonly agreed that maintaining a healthy bank liquidity condition is an essential element in the whole financial system, as the bank liquidity not only determines the growth and development of the bank itself but to maintain the functions of the financial market (Acharya and Naqvi, 2012).

According to Valla *et al.* (2006), bank liquidity is commonly defined as "the ability to meet cash obligations when due" and is understood from a relatively narrow and broader aspect. For the banking system, it is commonly viewed as liquidity from a narrow definition- the "funding liquidity", which can be explained by the governments' operations in dealing with COVID-19 effects. Funding liquidity (i.e., cash or assets easily transformable into cash and hold for that purpose) is for either supporting withdrawal of short-term funds for counterparties or accommodating the bank's own operations (Valla *et al.,* 2006). Another way of understanding bank liquidity provided by Valla *et al.* (2006) is that considering the bank itself involved in the asset trading, which is more related to the "market liquidity", indicating the ability of the bank to liquidate a non-cash asset (i.e., investment security originally bought to be held to maturity).

Regarding bank liquidity, the main function of a bank is liquidity creation, in which banks create liquidity by financing relatively long-term illiquid assets with relatively short-term liquid liabilities and providing letters of credit and loan commitments to their customers (Zheng and Cronje, 2019). As a bank provides liquidity to not only itself but other financial intermediates, it is risky sometimes in that it can make the bank less liquid and increase the chance of exposure to risk (Andreou *et al.*, 2016). In addition, bank liquidity creation can be

risky as the bank injects liquidity into the financial system by disposing of illiquidity assets, and an increase in bank liquidity creation could result in bank illiquidity, which is considered the main reason for bank fragility (Acharya and Naqvi, 2012; Zheng and Cronje, 2019). Hence, bank liquidity is related to bank conditions and even the whole banking system. According to Valla *et al.* (2006), the first issue facing the bank of liquidity problem could arise from the liquidity deficit in its balance sheet of it, and if the situation becomes worse, it may jeopardise the whole financial stability as its contagions among the financial system.

Liquidity also plays an essential role in keeping a sounding condition of the whole financial system. It is regulated and obligated by the Basel committee with a liquidity ratio that must be satisfied by banks to maintain a minimum level of liquidity assets. For dealing with the outcomes for the economy of COVID-19, local governments release funding to firms by using bank functions of creating liquidity. Based on the information above regarding the risk of bank liquidity creation, it is possible that banks may face liquidity issues during the process of carrying out the actions from the governments. As bank liquidity is essential and important to the whole financial system (e.g., bank illiquidity may contagion whole financial system and leads to financial instability), it is worth investigating if COVID-19 indeed affects bank liquidity, and to what extent. Furthermore, different from the 2007- 2008 financial crisis, the COVID-19 virus crisis impact is rising by the day, due to the high level of interconnectedness of manufacturing and distribution around the world. More importantly, COVID-19 is an exogenous crisis compared to the 2007-2008 financial crisis, which is believed an endogenous crisis for the whole financial system, during this time wave, the liquidity problem shows up, and if left untreated, turns into a solvency problem for banks. On the other hand, banks may also face deposit problems as depositors may ask for redemption. From this point of view, the liquidity situation of banks needs to be noticed especially during the special time wave of COVID-19.

In many countries, the main creditors of business are banks, which built the loan loss provision, and banks provide funding to businesses (Demirgüç-Kunt *et al.*, 2021). In Italy, at first, banks started to grant moratoria for providing relief to corporate to avoid a default. However, the cashflow shortfall of business turns into a cashflow loss for banks. At this point, the government may offer help to the banks (Boot, *et al.* 2020). In this regard, banks are essential to keep the sounding economy and provide financial support to financial institutions, the COVID-19 is stimulating the risk of ceasing its functions.

As we know, it is essential to maintain a sounding banking system (keep banking function). One of the banks' central roles in the financial system is the creation of highly liquid, money-like debt claims. Acharya and Ryan (2016) point out that bank is essential to the whole financial system stability as it is the primary backstop providers of liquidity in the economy and issuers of federally guaranteed deposit. In addition, stability is enhanced by restraining banks' undisciplined investment financed by readily available credit in the economy. In the study by Holmström (2015), who also agrees that bank has connections with financial stability condition. An illiquidity banking problem would lead to server outcomes to the economic system including banking/financial instability. When the banking system starts to imbalance (instability), banks are reluctant to finance profitable projects, asset prices deviate excessively from their intrinsic values, and payments may not arrive on time. Thus, leading to severe results of financial instability, and even financial crisis. Hence, the banking stability situation is indeed relevant to the whole financial market and also an important factor that needs to be analysed. From the discussion above, this paper aims to investigate how COVID-19 affect banking liquidity and stability. In addition, if the effects behave any differences between server infected countries and non-server infected countries.

Since the start of COVID-19, it has been lasting two years and the effects of it on the financial market cannot be ignored and even bringing harmful effects more than our

imagination. For the special period from the end of the year 2019, COVID-19 has spread globally. Firstly, be reported in China, and then Europe, the United States, and Iran, in the middle of 2020, COVID-19 infected people around the world. We now live in a Network world as the Internet is becoming an essential tool for us to gather information. Every piece of the COVID -19 news can be found on news websites, social media, and some mobile apps. After the COVID-19 spread, the daily data of the virus (e.g., daily infected number, daily death number) is posted on specific websites for the public. It is obvious that with the increasing number of infected people, the retail firms, travel agencies and aircraft businesses are affected severely. However, a question arises, do these figures and news related to COVID-19 have direct effects on the banking system, even banking stability? From this point of view, I intend to find out if a specific relationship exists between the COVID-19 media aspect (e.g., media coverage; daily data related to COVID-19) and banking system stability.

Specifically, my main objectives of carrying out this chapter include: (i)to illustrate the influence of COVID-19 on bank liquidity and stability from its real figures; (ii) to confirm the sign and significant level of media coverage of COVID-19 and bank liquidity and stability based on the keywords (related to COVID-19) search volume; (iii) to investigate if any differences exist between the most developed and developing countries.

Through carting out this research, I believe it would contribute not only the current literature related to COVID-19, but the local government and financial opportunity seeker. The novel virus- COVID-19 has not been much explored its effects on the banking side. Some early studies such as Boot *et al.* (2020), Perotti (2020) and Turner (2020), they only analyse the COVID effects and possible problems to the economy from a literature-based approach, with no real quantitative data to support the argument. From this regard, this chapter is based on the empirical study to investigate the COVID-19 effects on the banking side issue. In addition, I add media coverage data extracted from the Google trend as well as including the real COVID-

19 figures (i.e., the total infection number, increasing cases etc.). Furthermore, the contributions of this chapter study also include: (i) it focuses on the whole time waves when COVID-19 spread which makes us able to analyse results with a full-time horizon; (ii) it concentrates on the public trade banks in the selected countries other than the worldwide and firm focus like most of the existing paper; (iii) it focuses on the most developed as well as developing economies; (iv) it includes the media coverage information of the COVID-19. At the same time, this chapter fills the gap in an empirical analysis of media coverage of COVID-19 and the banking liquidity and stability problem. For the results of this chapter, I firstly confirm that there is a significant relationship between COVID-19 and banking system. Specifically, the banking liquidity and stability indeed be negatively affected by the COVID-19, either from itself (i.e. causing infection, death), or from the website searching of keywords related to COVID-19. As the coefficient value is extremely small, for reaching a severe outcomes for the banking system, it would require the real figures of COVID-19 are quite high such as 1,000,000 infection number for a day. Under the most worst situation, it may hit the banking the banking system. However, from a post-pandemic view, the negative effects from COVID-19 could be less and might not be economic significance with time passing. My finding would contribute to the current studies of investigating how the real factors of COVID-19 affect banking system. Also, my finding includes a comparison of the real effects and media coverage effects from COVID-19. I believe the results could be applied in the reality such as the vaccine and for the academic purpose.

The rest of Chapter 3 is structured as followings: section 2 is the recent studies and literature related to COVID-19 effects and the financial system, as well as some studies, focused on the media coverage of the financial system. Section 3 introduces the main hypotheses based on the literature. Section 4 is the methodology used to analyse the data including the detailed data description, sample country, time waves and followed by section 5,

which introduces the econometric models and statistics summarise. Section 6 will mainly discuss the data analysis results from the baseline model and relevant implications driven by the main findings. The robustness check will be analysed in section 7 and a comparison of the results from the baseline model. Section 8 concludes all key findings and reveals some limitations as well as future research improvement.

2. Literature review

This section includes recent studies related to the topics (pandemic and the media coverage of it). Section 2.1 reviews the studies that investigate the effects of health crises on economic activity and the financial system, which are the real effects on the financial system. Section 2.2 introduces studies that explore the media coverage effects on the financial system.

For indicating the effects of COVID-19 on the financial system, I distinguish the effects into two categories, which are the real effects and media coverage effects for comparing if any differences between these two effects and makes the COVID-19 effects clearer to the financial world. The real effects, or the other word "actual effects", it extracts from the crisis itself. For example, the COVID-19 health crisis will infect individuals, let them sick and even lead to their death. These issues that arise from COVID-19 would be the real effects. The media coverage effects, it extracts from the media sides (e.g., the websites, news and searching volume). Hence, the main difference between real effects and media coverage effects is whether the effects come from themselves directly.

Section 2.1 and 2.2 below provide previous studies investigating either a real effect of a health disease or a media coverage effect on the financial system, which will introduce the "real" and "media coverage" effects in detail.

2.1 The real effects of health crises on the economy and the financial system

As COVID-19 is an unpredictable event and shown in the previous section of its potential effects on the financial system, which may lead to severe consequences, it is different from the typical crisis such as the real estate bubble and the large-scale 2008 financial crisis. For this pandemic, apart from the COVID-19, the virus pandemics also happened before, similar to COVID-19, which are also unpredictable (e.g., the SARS virus) and even could be traced back to the 1960s. According to Ftiti *et al.* (2021), the SARS virus, which occurred in 2002 has been transmitted to more than 20 countries in North and South America, Europe, and Asia, infecting nearly 10,000 people, with a fatality rate of approximately 8%. The character of the 2002 SARS virus and level of infection areas are quite similar to COVID-19 and Siu and Wong (2004) investigate the effects of the SARS outbreak on Hong Kong's economy, which a negative shock is found. Specifically, the most significant negative effects are on the demand side. Really similar to the COVID-19 pandemic, during the outbreak time, local stores and the export of services especially related to tourism and air travel are severely affected in the short run. In addition, restaurants and retail outlets also are affected hard, with a 10-50% sales drop. Land transport declined by 10–20% as work from home. Apart from the SARS virus, Gong *et al.* (2021) explore the impact of the seasonal HINI Swine Flu on bank loans, which they find that a higher level of flu spreading is associated with higher loan spreads and smaller loan sizes. The adverse impact of a pandemic can be alleviated by the approval of vaccines.

For the common type of disease effects, Leoni (2013) finds that the spread of HIV in developing countries is associated with large increases in deposit turnover. The reason behind this could be the increase to the need to pay for individual treatments forcing large-scale withdrawals of deposits. Finally, the current health crisis may translate into a full-blown banking crisis (banking instability) and the whole financial system instability.

As COVID-19 still spreading globally and has been lasting for two years, some potential effects on the economy have been illustrated by several studies. For instance, Pagnottoni *et al.*

(2021) investigate the SARS-CoV-2 epidemics outbreak effects on global financial markets, which examines the financial volatility of the selected stocks and bond markets of the U.S., UK, Spain, France, Germany and Italy to quantify the effects and political announcements related to the epidemics. Their results indicate that news announcements could affect financial markets, but the effects exhibit heterogeneous (different countries respond at different times to the financial market and the credit market react differently from the bond market).

Boot *et al.* (2020) indicate that the virus hit economic activities severely in the production and consumption aspects, which affects supply chains all over the world, particularly relating to goods and components imported from China, creating shortages throughout the production and distribution cycles. Starting locally, the consequences have spread quickly to ever larger regions, as is mirrored in the worldwide slide in stock prices. However, the impact of the virus is far from being limited to supply interruptions to the manufacturing sector. Massive interruptive effects can be observed in the services industries, including travel, tourism, mass events, as well as universities. Goodell (2020) indicates that an obvious way that pandemics can impact financial systems is through their enormous economic costs such as costs to the health system and social distancing control, which estimates the expected annual losses from pandemic risk to be approximately 500 billion US dollars, or 0.6% of global income.

Perotti (2020) also gives explanations of potential impacts on the financial environment from the current virus, which believes that the immediate effect would be a sudden repricing of financial and real assets, together with a heavy withdrawal of liquid reserves by households and firms. Hence, the liquidity problem should be noticed at the beginning, which is consistent with Boot *et al.* (2020) and Goodell (2020). Withdrawals made to fund spending are largely redeposited in other banks, and central banks can redistribute liquidity across the regulated banking sector. Banks will suffer credit losses. However, if banks survive will depend on the timely resolution of the crisis, since a default wave is likely to occur. Perotti (2020) believes

that the major risk is the systemic illiquidity shock on shadow banks.

For the effects of COVID-19 related to the financial market, some studies reveal the effect from different aspects. The impact of the COVID-19 pandemic on the volatility of stock markets has been testified in major African. The markets appear to respond to the external shocks caused by the health crisis, and Google search volume activity related to the COVID-19 virus, which is associated with an increase in market volatility of around 7% (Del Lo *et al.* 2021). The results show similar outcomes to other financial markets worldwide. In addition, the COVID-19-related news has also been indicated as a significant factor on the volatility of the financial market (Haroon and Rizvi 2020). Delis *et al.* (2021) explore the effects of the COVID-19 crisis and the associated skewness on the market price of risk. They specify the skewness price of risk as an additive component of the effect of variance on mean expected return. Their results indicate that during COVID-19, there is an obvious negative reaction in the skewness and market price of risk, and this negative effect is more obvious than in the 1987 crisis. Elnahass *et al.* (2021) examine the impact of the COVID-19 pandemic on global banking stability and assess any potential recovery signals. The results provide evidence that the COVID-19 outbreak has an influential impact on financial performance across various indicators of financial performance and financial stability (i.e., high-risk indicators including default risk, liquidity risk and asset risk). Furthermore, recent literature (Chodorow-Reich *et al.*, 2022; Çolak and Öztekin, 2021) suggest that the demand for U.S. bank loans experiences a significant increase in the first weeks of the COVID-19 pandemic. As it mentioned before, banks are providers of loans, which has a close relationship with the liquidity issue, when the demand increases, a question arises that if it will affect bank liquidity. Specifically, if COVID-19 will have a direct effect on bank liquidity?

Based on studies related to real effects of pandemic and virus, I conclude the results from several aspects. Firstly, it is believed to affect the economy from the demand-side (Siu and

Wong, 2004; Boot *et al.*, 2020) and make higher costs (Goodell, 2020). Secondly, it is believed to affect bank loan (Gong *et al.*, 2021; Chodorow-Reich *et al.*, 2022; Çolak and Öztekin, 2021) and bank deposit (Leoni, 2013). Thirdly, studies also reveal the outbreak effects on global financial markets (Perotti 2020; Del Lo *et al.* 2021; Delis *et al.*, 2021; Pagnottoni *et al.* 2021) and global financial system (Elnahass *et al.,* 2021).

2.2. The media coverage effects on the financial system

As media is an essential tool to deliver information, especially at this particular time, media coverage of COVID-19 should also be noticed. The importance of media coverage effects has been addressed in many different aspects. Many studies reveal the media coverage effects on CSR. For example, at an earlier time, Kölbel *et al.* (2017) explore the relationship between the media coverage of corporate social irresponsibility and financial risk. They posit that media coverage of corporate social irresponsibility generates risk by providing conditions that increase the potential for stakeholder sanctions. Through analysing an international panel of 539 firms during 2008–2013, they find that firms receiving higher corporate social irresponsibility coverage face higher financial risk. They show that the reach of the reporting media outlet is a critical condition for this relationship. Byun and Oh (2018) investigate how the media coverage of a firm's CSR could affect firm performance based on analysing news articles. They analyse the relationship based on the OLS and 2SLS and the results indicate that publicized CSR activities are positively associated with shareholder value and improve the future operating performance of the firm. In addition, they show that the media coverage on CSR engagements with local impact on companies' communities and employees, rather than those with broader social impact on the public, is the main factor of a higher performance of shareholder's value and operating profit. Similar to Byun and OH (2018), Gangi *et al.* (2018)

investigate whether and how CSR knowledge affects financial performance in the European banking industry. The findings show that, first, consistent with the concept of knowledge absorptive capacity, the internal CSR of banks positively affects citizenship performance; Second, in line with the reputational effect of CSR, citizenship performance is a positive predictor of a bank's financial performance.

Apart from the media coverage effects of CSR, Dang *et al.* (2019) examine the impact of the media coverage from the other aspect, which is the leverage adjustments of firms. They analyse the news from a sample including 33 countries and the results reveal find that a higher level of news coverage and more positive news sentiment are associated with greater leverage adjustment speeds. Their finding supports that media coverage could help lower the cost of firms' adjustment toward target leverage. In their finding, they also point out two factors of why media coverage could affect leverage adjustment, information dissemination and monitoring. In addition, Frijns and Huynh (2018) reveal the impact of media coverage on the herding behaviour of the stock market. For the effects of media coverage on stock herding behaviour, they find that analyst's herd less when stocks are covered more in the media. In addition, they also find that the herding behaviour is related to media sentiment, which when the firm has negative media sentiment, analysts tend to herd more.

Pagnottoni *et al.* (2021) indicate the media coverage effects of the pandemic, who carry out a study investigating the relationship between the political news related to the SARS-CoV-2 pandemic and the financial and bond market behaviour. The finding shows that the media coverage of the news related to SARS-CoV-2 indeed impacts the financial and bond market. Specifically, the financial markets heterogeneously react to news related to the pandemics, depending on countries, and their foreshock and aftershock behaviour; the volatility shocks induced by SARS-CoV-2 related events show high persistent in the credit market.

For some media effects of the recent COVID-19, some studies analyse the effects of the

government announcement regarding COVID-19. Viewing from a more recent time horizon, Demirgüç-Kunt *et al.* (2021) examine the impact of financial sector policy announcements on bank stocks around the world during the COVID-19 crisis. Their finding indicates that liquidity support, borrower assistance programs and monetary easing moderated the adverse impact of the crisis, but their impact varied considerably across banks and countries. By contrast, countercyclical prudential measures led to negative abnormal returns in bank stocks. Ashraf (2020) examines the economic impacts of government actions regarding COVID-19, such as social distancing measures, public awareness programs, testing and quarantining policies, and economic support packages, during the COVID-19 pandemic. In this study, data from 77 countries are tested and the results show that the announcements regarding the implementation of social distancing by governments have an impact on stock market retunes, yet the sign (positive or negative) is varied. Specifically, Ashraf (2020) mentions that a direct negative effect and an indirect positive both exist for affecting stock market returns. For government announcements regarding public awareness programs, testing and quarantining policies, and income support packages, the results indicate positive effects on stock market returns.

Ftiti *et al.* (2021) study the impact of non-fundamental news related to the COVID-19 pandemic on liquidity and returns volatility. The results show that the non-fundamental news, such as the number of deaths and cases related to COVID-19, raising the stock market returns volatility and reducing the level of stock market liquidity, increasing overall risk, whereas fundamental macroeconomic news remains largely immaterial for the stock market. Smales (2021) recognises that the response from the financial market to the COVID-19 pandemic provides the first example of a market crash instigated by a health crisis. From this perspective, investor attention, which is driven by Google trends used to investigate the COVID-19 news search effects on the stock market. The results illustrate that investor attention negatively influences global stock returns during this crisis period. A rise in the number of internet

searches during the COVID-19 crisis induces a faster rate of information flow into financial markets and so is also associated with higher volatility. The identified relationships are economically and statistically significant. Moreover, increases in Google search volume have less impact on government bond yields.

From the discussion above, the effects of media coverage include: (1) the CSR media coverage is believed to link to financial risk of firms and firm performance (Kölbel *et al.*, 2017; Byun and Oh, 2018); (2) the CSR coverage of media affects banking industry performance and herding behaviour (Frijns and Huynh, 2018; Gangi *et al.*,2018); (3) media coverage can affect leverage adjustment speed of firms (Dang *et al.*, 2019); (4) the media coverage of flu can affect financial and bond market as well as liquidity (Demirgüç-Kunt *et al.*, 2021; Ftiti *et al.,* 2021; Pagnottoni *et al.,* 2021).

3. Research hypotheses

Based on the literature mentioned above, I intend to explore the research questions shown below:

For the studies investigating the real effects of the previous virus and COVID-19, we should notice the bank liquidity issue. For example, Siu and Wong (2004) indicate a negative effect of the SARS outbreak on Hong Kong's economy, as a sharp decrease on the liquidity in tourism and air travel industries. Apart from the SARS virus, Gong *et al.* (2021) find that a higher level of HINI flu spreading is associated with higher loan spreads and smaller loan sizes, which is also related to the liquidity problems. Leoni (2013) indicates that the spread of HIV in developing countries is associated with large increases in deposit turnover. They attribute this to the need to pay for individual treatments forcing large-scale withdrawals of deposits.

Perotti (2020) holds a similar view to Leoni (2013), who also reveals some potential impacts on the financial environment from the current virus, which believes that a heavy

withdrawal of liquid reserves by household and firms would arise. Boot *et al.* (2020) and Goodell (2020) commonly believe that the current COVID-19 could bring a large number of liquidity needs and money withdraw from the bank and government for filling in their enormous economic costs. In addition, Chodorow-Reich *et al.* (2022) and Çolak and Öztekin (2021) also mention the negative effects of current pandemic on the U.S. bank liquidity issues.

Hence, based on the studies discussed above, which indicate a mostly negative effect from either the COVID-19 (Boot *et al.*,2020; Goodell, 2020; Chodorow-Reich *et al.*,2022)) or the virus disease (Leoni, 2013), I hereby assume that the real effects of COVID-19 will hit the bank liquidity.

H1: The real effects of COVID-19 have a negative effect on bank liquidity

For the real effects of health disease specially on stability issue, there are several studies reveal its adverse effects to the economy. For example, Leoni (2013) finds that the spread of HIV in is not only increase deposit turnover but may lead to a banking instability and finally result in the whole financial system instability, which indicates that an unexpected and unpredictable health issue could be a strong factor to hit the economy and financial system. In the other hand, the impact of the COVID-19 pandemic on financial system has been testified in major African by Del Lo *et al*. (2021) and it is believed to impact the volatility of stock markets. The markets appear to respond to the external shocks caused by the health crisis, which is associated with an increase in market volatility of around 7% (Del Lo *et al*., 2021). The results show similar outcomes to other financial markets worldwide. Delis *et al.* (2021) explore the effects of the COVID-19 crisis and the associated skewness on the market price of risk and their results indicate that during COVID-19, there is an obvious negative reaction in the skewness and market price of risk, and this negative effect is more obvious than in the 1987 crisis. Furthermore, Elnahass *et al.* (2021) examine the impact of the COVID-19 pandemic on global

banking stability and assess any potential recovery signals. The results provide evidence that the COVID-19 outbreak has an influential impact on financial performance across various indicators of financial performance and financial stability (i.e., high-risk indicators including default risk, liquidity risk and asset risk).

All the literature mentioned above reveal negative effects of the COVID-19 on either stock price volatility or economic stability. Hence, based on the literature's indication, I assume that the real effects of COVID-19 will harm bank stability and increase volatility.

H2: The real effects of COVID-19 have a negative effect on bank stability

As it is indicated in *H1* and *H2*, real COVID effects could affect bank liquidity and stability. For media coverage effect, it is also illustrated by some literature. When only the media coverage is considered, Kölbel *et al.* (2017) believe that media coverage of corporate social irresponsibility generates risk by providing conditions that increase the potential for stakeholder sanctions. They find that firms receiving higher corporate social irresponsibility coverage face higher financial risk. Similarly, Byun and Oh (2018) also investigate media coverage effects of Corporate Social Responsibility (CSR) and the results indicate that publicized CSR activities are positively associated with shareholder value and improve the future operating performance of the firm. In addition, they show that the media coverage on CSR engagements with local impact on companies' communities and employees, is the main factor of a higher performance of shareholder's value and operating profit. From the mentioned two studies, it can be concluded that the media coverage of CSR can affect firm value and performance (operating profit). From this point of view, it may affect liquidity as well. The effects of media coverage also be revealed from different aspect, Dang *et al.* (2019) examine the impact of the media coverage from the leverage adjustments of firms, and he results reveal find that a higher level of news coverage and more positive news sentiment are associated with

greater leverage adjustment speeds. In addition, Frijns and Huynh (2018) indicate the impact of media coverage on the herding behaviour.

For studies mention health disease and recent COVID-19, Perotti (2020) and Demirgüç-Kunt *et al.* (2021) believe that COVID-19 firstly affect firm liquidity and then infects the banking side. Furthermore, Perotti (2020) believes that the major issue for the banking system especially the shadow banks is the systematic illiquidity shock under the COVID pressure. In addition, as the regulations and controlling actions be carried out by the government, the first issue facing the financial system is the liquidity problem due to the interruption of cash flows. For media coverage of COVID-19, Demirgüç-Kunt *et al.* (2021) confirm that the policy announcements on liquidity support reduce the adverse impact of the COVID crisis, which means media coverage of news related to COVID-19 support affect the liquidity issue. From this point of view, it indicates a relationship exists between liquidity and the COVID crisis. Ftiti *et al.* (2021) show that the non-fundamental news related to COVID-19 reduces the level of stock market liquidity. Different from the real effect, here the question is regarding the effects from the aspect of the information attention/media coverage of COVID-19. Based on the above discussion, I assume that with higher attention to COVID-19 (here assumes the negative figure or news), which means the government may act and the awareness of its outcome is noticed among the public, the liquidity problem will be much more severe.

H3: The media coverage of COVID-19 has a negative effect on bank liquidity.

As previous literature shows that the worse outcome of an unexpected pandemic could be an instability of whole financial system (Leoni, 2013), it may be asked if the media coverage of COVID-19 has the similar effects on banking stability. Some studies provide evidence with us such as Pagnottoni *et al.* (2021), who investigate the SARS-CoV-2 epidemics outbreak effects on global financial markets, which examines the financial volatility of the selected stocks and

bond markets related to the epidemic effects. Their results indicate that news announcements/news coverage of the epidemic affect financial market behaviours, as the announcement of lockdowns and any actions from the government related to COVID-19 hit the market and make it experience high volatility during a time wave. Similar to Ftiti *et al.* (2021), who show that the news related to the COVID-19 increase the stock market volatility. In addition, Elnahass *et al.* (2021) also illustrate strong empirical evidence that the COVID-19 pandemic has detrimental effects on both financial performance and financial stability. Based on the above studies, this chapter hereby assumes that the attention to COVID-19 could negatively affect banking stability. In addition, the COVID-19-related news has also been indicated as a significant factor on the volatility of the financial market (Haroon and Rizvi 2020). From the above discussion, I hereby assume that the media coverage of COVID-19 hits bank stability.

H4: The media coverage of COVID-19 has a negative effect on bank stability.

4. Methodology

4.1 Data description

This section includes all data used in Chapter 3 to analyse the hypotheses and questions, consisting of the sample countries, time waves covered, variables used and economic model for analysing the data.

4.1.1 Sample

I intend to analyse the most developed and developing economies as these countries have already built relative stable policies and financial systems, and they have influential power to

the world economy. Analysing the most developed and developing economies of the COVID-19 effects is more convincing for the worldwide financial system and it can help other economies reference the results. For the country selection, six countries will be included in the data analysis, which consists of three of the most developed economies and three developing countries. For three most developed countries, U.S., UK and Germany will be analysed as sample countries that were infected severely by COVID-19 based on the statistics of the total infected number by the end of 2021 by the World Health Organization (WHO). At the same time, I will also include the three most developing economies, which have also been severely infected by COVID-19, including Brazil, India and Argentina. For including bank liquidity and bank stability indicators, I will use bank stock data from all publicly trading banks included in all selected six countries.

4.1.2 Time-period & waves

I intend to analyse if the financial market has already adjusted to the pandemic and does not seem to be sensitive to the COVID-19 media coverage. For analysing the separate time waves, it can compare the results of different countries to see if any different effects among them.

As COVID-19 was firstly noticed in China at the end of December 2019, till March 2020, the virus has been spreading among the U.S and European countries even all around the world. After that, the U.S. and European governments started to make the policy of national lockdown. This period is the third wave of COVID-19. Up to now, COVID-19 is still spreading, and the governments encourage the public to get the vaccination. Hence, this study intends to select all four specific waves to analyse the relationship for a more concrete result.

For selecting each time wave carefully, I will firstly introduce some literature indicating the COVID waves and the policy announcement of the UK (it will be quite similar with countries being infected severely among the world). Bontempi (2021) indicates the first wave

of COVID-19 is from December 2019 as the firstly reported and announced outbreak in China till the end of February 2020, when COVID-19 appeared in Italy and then fast infected Europe till September 2020. For the UK, the government makes several announcements to handle COVID-19. The influential policy announcements include the first national lockdown on 23rd March 2020; lifting of the national lockdown on 10 May 2020; lockdown restrictions eased on 14th August; new lockdown rule announced on 22nd September 2020; second national lockdown on 5th November 2020; easing off the second lockdown on 2nd December 2020; the third lockdown on 6th January 2021; following the 4-step lifting lockdown from March to July 2021; requiring for face mask rule on 8th December 2021, removing all COVID rules on 24th February 2022. From the COVID policies in the UK, it can be distinguished into three different time waves, the first is from March 2020 to August 2020; the second is from September 2020 to December 2020, the third is from January 2021 to February 2022. In addition, according to the World Health Organization (WHO) data, COVID-19 has several different variants including Alpha, Beta, Gamma, Delta and Omicron. As the UK is infected by three variants of COVID-19, the time wave of the UK hereby includes mainly three stages.

Based on the discussion above, the COVID can be summarised into four time-waves in total. The first time-wave is from the December 2019 to the end of February 2020. During this period, the COVID-19 just started to spread in China, the U.S and other European countries are about to infect the virus. The second time wave is from the beginning of March 2020 to the end of July 2020. During this period, the U.S and European have been through huge increased number of infected people, and some countries experienced a lockdown policy from strict to easy gradually. The third time wave is from Aug 2020 to Dec 2020. During this time wave, COVID-19 has been spreading and controlling all around the U.S. and European. This period could be seen as a post-pandemic period. The final stage is from January 2021 to January 2022). As all countries in this study are European and American countries, the first-time wave from

the end of December 2019 to February 2020 will be removed.

In conclusion, the whole-time period is from the 1st March 2020 to the 1st March 2022, and it is divided into 3 sub-time waves for indicating a more comparative and accurate result. The specific date for each wave is stated as follows: first wave: 1st March 2020 to 31st July 2020; second wave: 1st August 2020 to 31st December 2020; third wave: 1st January 2021 to 1st March 2022.

For doing the empirical analysis for three different time waves, I will run the baseline model provided in section 5 based on data of three different time waves. Specifically, the first wave will include data from 1st March 2020 to 31st July 2020; the second wave will include data from 1st August 2020 to 31st December 2020; the third wave will include data from 1st January 2021 to 1st March 2022. A whole-time analysis will be also included to compare with the results.

4.2 Variable description

The data and variables in this chapter come from various databases (BankFocus; Refinitiv) and official websites (Google trend; Worldmeter, WHO, Yahoo Finance) and include the author's own calculations. All data and variables used in this study will be weekly frequency.

For analysing the COVID-19 effects on banking liquidity and stability, there are some existing studies indicating how the COVID-19 and banking liquidity, as well as banking stability, could be reflected by using reliable variables and indexes. All the detailed information on data and variable description will be provided at the end of this section in Table 1.

Based on current literature, three main methods are used to indicate the COVID-19 effects when studying its impact on the financial system. The first is to assess the impact of COVID-19 public policy responses on financial markets (Zaremba *et al.* 2020). The second is to use health statistic data (cases or deaths) to estimate the COVID-19 impact on financial markets

(Albulescu 2020; Ali *et al.* 2020; Zhang *et al.* 2020; Del Lo *et al.* 2021; Xu 2021). The third is to illustrate the COVID-19 effects using Google Trend related to the COVID-19 pandemic (Costola *et al.* 2020; Brodeur *et al.* 2021; Del Lo *et al.* 2021; Nikolopoulos *et al.* 2021).

As I intend to investigate and compare the real effects and media coverage effects of COVID-19 on bank liquidity as well as bank stability, based on previous literature and the data availability situation, this paper is going to use health statistic data (i.e. the real number of COVID-19 cases) as the real effects of COVID-19 indicator, which is consistent with Ali *et al.* (2020), Del Lo *et al.* (2021) and Xu (2021) use the Google trends as the media coverage effects of COVID-19, which is supported by Costola *et al.* (2020); Brodeur *et al.* (2021) and Del Lo *et al.* (2021).

For indicating bank liquidity and bank stability, previous studies show different approaches. For the most commonly used accounting-based method to reveal liquidity, Imbierowicz and Rauch (2014); Alali (2019) and Ftiti *et al.* (2021) use the bank liquidity ratio as the indicator of bank liquidity. As I intend to use weekly data, the accounting-based liquidity ratio is, therefore, cannot satisfied. In this regard, the market-based method should be more appropriate as it could provide weekly or even daily frequency data. For the market-based method, the most widely used measures of stock market liquidity are the quoted bid-ask spread and the effective bid-ask spread (Hameed *et al*., 2010; Koutmos, 2018). These measures can be estimated from stock transaction data. However, they both have some bias as Hagströmer (2021) mentions that the average bias is 13%–18% for S&P 500 stocks overall, and up to 97% for low-priced stocks. From this point of view, I will use the proportional bid-ask spread to identify bank liquidity.

For indicating bank stability, the most common accounting-based method is the bank *Z-SCORE* (e.g., Beck *et al.*, 2013; Fiordelisi and Mare, 2014; Fu *et al.*, 2014; Goetz, 2018 and Leroy and Lucotte, 2017; Nguyen, 2021), which considers banks' buffers (profits and capital)

and risk and measured through standard deviation of returns on assets and based on information on asset returns, volatility and leverage and mainly captures the microeconomic dimensions of financial stability. Usually, the bank Z-score is used to reveal bank individual risk yet some studies (e.g., Amidu and Wolfe, 2013), reveal that Z-score can potentially measure the accounting distance-to-default, which implies that the Z-score could also be used as a bank systemic risk measurement using accounting data.

As this is accounting-based and cannot obtain weekly data, the bank stock volatility will hereby to be introduced in this chapter, which is also used in studies by Aouadi *et al*., 2013; Baumöhl *et al.*, 2018; and Azrak *et al*., 2021).

4.2.1 Dependent variables

- The weekly proportional bid-ask spread

For analysing the relationship between COVID-19-related news and financial stability, two dependent variables will be used in the main regression analysis. Following the measurements of bank liquidity provided by Cao and Petrasek (2014) and Belkhir *et al.* (2020), the proportional bid-ask spread will be used to indicate bank liquidity risk. The formula is provided below:

$$\text{Bid-ask Spread}_{i,t} = \frac{2|P_{i,t} - M_{i,t}|}{M_{i,t}} * \frac{1}{N} \quad (1)$$

where Pi,t is the trade price for bank i at time t; Mi,t is the corresponding quote midpoint, and N stands for the number of trading days in a week

- Weekly Bank stock volatility

For capturing bank stability, I am going to use the stock price volatility, which is also used by Aouadi *et al*. (2013); Baumöhl *et al.* (2018) and Azrak *et al.* (2021), rather than using the common so-called Z-score method. The most important reason is that I utilise weekly data

throughout this chapter in the analysis progress, and the Z-score is an accounting-based method, which indicates the highest frequency is quarterly and may remain the same among the analysis time periods. From this point of view, I hereby will choose to use weekly banking stock price volatility to indicate banking stability. As Minsky's (1982) hypothesis ('economic agents observing low financial risk are induced to increase risk-taking, which in turn may lead to a crisis') reveals that financial market volatility may have a direct impact on the likelihood of a financial crisis. If the economic conditions deteriorate and result in bad investment decisions, volatility then will increase, signalling a pending crisis. In addition, the famous stock market crash in the history of 1929 could reveal the importance of the security market to the whole economy. This 1929 stock market crash finally led to the great depression in the 1930s.

Based on the discussion above, rather than use daily stock price volatility, weekly stock price volatility will be used to indicate bank stability, Usually, we prefer a more stable stock price overtime period, and a higher stock price volatility indicates higher risk and therefore, lower stock market stability.

Following the approach provided by Chen and Hsu (2012) and Geng *et al.* (2021), the formula of weekly bank stock volatility is shown below:

$$VOL_{it} = SD_{it} = \sqrt{\frac{1}{N-1}\sum_{t-1}^{N}\left(R_{it} - \frac{1}{N}\sum_{t=1}^{N} R_{it}\right)^2} \quad (2)$$

where R_t is the daily return; $R_t = \log(CL_t^N) - \log(CL_{t-1}^N)$; $CL_t$is the closing price of bank i on day t; $CL_{t-1}$is the closing price of bank i on day t-1; N is the number of trading days in a week.

4.2.2 Independent variables

- Total infected number (*TOTALINF*) (Capturing real effects of COVID-19)

Apart from the keyword search index from Google trend, the total infected number provided by the Worldmeter will be another indicator of the COVID-19 measurement. This method is

consistent with Del Lo *et al.* 2021.

- Google trends index (*GTI*) (capturing media coverage of COVID-19)

Google Trends data provides an unfiltered sample of search requests made to Google, and it has been used in plenty of research works (e.g., Nuti *et al.*, 2014; Hamid and Heiden, 2015; Brodeur *et al.*, 2021 Costola *et al.*, 2020; Del Lo *et al.,* 2021). It supplies an index for search intensity by topic over a time-period requested in a geographical area. This is the number of daily searches for the specified topic divided by the maximum number of daily searches for this topic over the time waves in question in that geographical area. This is scaled from zero to 100, where 100 is the day with the most searches for that topic and zero indicates that a given day did not have sufficient search volume for the specific term. A search-term query on Google Trends returns searches for an exact search term, while a topic query includes related search terms (in any language). According to the study examined by Nuti *et al.* (2014), Google Trends provide deep insights into health-related phenomena. From 2009 to 2013, Google Trends publications increased seven-fold, of which around 27% of articles utilised it for investigating infection diseases. Overall, 67% of articles provided a rationale for their search input. From the discussion above, it is believed that the Google trend is a suitable index used in this chapter as a COVID-19 trace variable.

For this project, the search keyword related to COVID-19 including 'COVID-19'; 'COVID'; 'coronavirus'; 'Covid vaccine' will be used in each sample country during each time wave to indicate the media coverage and search attention of the COVID-19. The search index of each and every keyword will be collected in six different countries.

4.2.3 Control variables

As this chapter analyses the relationship between COVID-19 and financial concept, there are

some common factors it needs to be controlled for the potential influence. It divides the control variables into three categories, which are COVID-19 related, bank related and macro-economic related.

- COVID-19 related

I include COVID-related controls of the weekly increased new case/infected number (*NUMINF*) and the weekly increased death number (*NUMDEA*), which are expected to have impacts on the financial market. These weekly data is collected directly from the WorldMeter and WHO databases.

- Bank related

For the bank-related factors that may affect bank stock performance, I include the weekly stock price movement. As Philippas *et al.* (2019) indicate, the closing price could be an effector for the stock price movement, Hence, here introduces the *MOVE* as a control variable to catch the possible effects of the price change on bank stock price movement.

MOVE can be expressed as the formula below:

$$MOVE_{it} = \frac{CLOSE_t - CLOSE_{t-1}}{CLOSE_{t-1}} * \frac{1}{N} \quad (3)$$

where *CLOSEt* is the closing price for day t, *CLOSEt-1* is the close price for day t-1; i stands for the i^{th} bank; t is for t^{th} trading day in the sample and N stands for the number of trading days in a week.

- Macro-economic related

As this chapter is to analyse bank liquidity and bank stability, some macroeconomic factors will affect them as well. For the data frequency and availability issue, two control variables will be included for controlling the poetical GDP effects and the economic developments,

which are the weekly GDP growth rate and one dummy variable to capture whether the country is a developed or developing economy. For the weekly GDP growth rate, it is collected directly from the OECD database.

Table 1 below provides all variables used in this study, including the variable name, symbol, definition and the data source where it is collected.

Table 1

Variable description

Variable	Symbol	Definition	Data Source
Dependent Variables			
Proportional bid-ask spread	*SPREAD*	The weekly bid-ask spread indicating bank liquidity risk; a larger value implies higher bank liquidity risk	Refinitiv, Yahoo Finance Authors' calculation
Bank stock volatility	*VOL*	The weekly bank stock volatility indicates bank stability; a larger value means higher bank risk and lower bank stability	Refinitiv, Yahoo Finance Authors' calculation
Independent Variables			
Google trend index	*GTI*	The index from keyword search values from 0 (lowest attention) to 100 (highest attention)	Google trend
Total death number	*TOTALDEA*	The country-level number of total death population by COVID-19	Worldmeter, WHO
Total vaccine number	*TOTALVAC*	The country-level total vaccine population by COVID-19	Worldmeter, WHO
Total infected number (removed as highly correlated to total death number)	*TOTALINF*	The country-level total population infected by COVID-19	Worldmeter, WHO
Control Variables			

Increased infected number	*NUMINF*	The country-level number of the total weekly increased population infected by COVID-19	Worldmeter, WHO
Increased death number	*NUMDE*	The country-level number of total weekly increased death population to COVID-19	Worldmeter, WHO
Stock price movement	*MOVE*	Weekly stock price movement	Refinitiv, Yahoo Finance Authors' calculation
GDP growth	*GDPg*	Weekly GDP relative to the same week in the previous year.	OECD Database - Economic Outlook
Economic development	*ECONO*	The dummy variable to reveal the economic development of each country, which 1 implies a developed country and 0 implies a developing country	World Bank

5. Econometric modelling

For analysing the data, Demirgüç-Kunt *et al.* (2021), examine the impact of financial sector policy announcements on bank stocks during the onset of the COVID-19 crisis based on data from all publicly traded banks across 52 countries via applying the OLS model. Compared with the OLS, Fu *et al.* (2014) and Noman *et al*. (2018), which all study the cross-country relationship regarding the bank stability effects, indicate that the GMM model could be regarded as a better approach to obtain a more accurate result and deal with the possible problem of endogeneity due to the omitted variables

Based on the indications above, this study will follow both the method applied by Noman *et al*. (2018) and Demirgüç-Kunt *et al.* (2021), which apply the OLS for checking the basic relationship between COVID-19 and bank liquidity and stability as the baseline model and GMM model for dealing with the potential endogeneity and omitted variable issue, as well as in the robustness check.

Two models are provided below as the baseline analysis approach, which uses the bid-ask spread as the bank liquidity indicator and bank stock volatility as the bank stability indicator.

$$SPREAD_{i,t} = \alpha + \beta_0 GTI1_{c,t} + \beta_1 GTI2_{c,t} + \beta_2 GTI3_{c,t} + \beta_3 GTI4_{c,t} + \beta_4 TOTALDEA_{c,t} +$$

$$+\beta_5 TOTALVAC_{c,t} + C_{i,t} + D_{i,t} + \epsilon_{it} \quad (3)$$

Where the *SPREAD* is the weekly bank proportional bid-ask spread; α is the intercept, β_0 is the coefficient of the $GTI1_{it}$ (Google trends index of the first keyword searched-"COVID-19"); β_1 is the coefficient of $GTI2_{it}$ (Google trends index of the second keyword searched-"COVID"); β_2 is the coefficient of $GTI3_{it}$ (Google trends index of the third keyword searched-"Coronavirus") ;β_3 is the coefficient of $GTI4_{it}$ (Google trends index of the fourth keyword searched-"Covid vaccine"); β_4 is the coefficient of total death number; β_5 is the coefficient of total vaccine number; *C* is the control variable; *ε* is a random error term; *D* is the dummy variables; c, *i, t* denote country, bank and time

$$VOL_{i,t} = \alpha + \beta_0 GTI1_{c,t} + \beta_1 GTI2_{c,t} + \beta_2 GTI3_{c,t} + \beta_3 GTI4_{c,t} + \beta_4 TOTALDEA_{c,t} +$$

$$+\beta_5 TOTALVAC_{c,t} + C_{i,t} + D_{i,t} + \epsilon_{it} \quad (4)$$

Where the VOL_{it} is the bank stability indicator (bank stock volatility); β_0 is the coefficient of the $GTI1_{it}$ (Google trends index of the first keyword searched-"COVID-19"); β_1 is the coefficient of $GTI2_{it}$ (Google trends index of the second keyword searched-"COVID"); β_2 is the coefficient of $GTI3_{it}$ (Google trends index of the third keyword searched-"Coronavirus") ;β_3 is the coefficient of $GTI4_{it}$ (Google trends index of the fourth keyword searched-"Covid vaccine"); β_4 is the coefficient of total death number; β_5 is the coefficient of total vaccine number; *C* is the control variable; *ε* is a random error term; *D* is the dummy variables; c, *i, t* denote country, bank and time

6. Results

6.1 Descriptive statistics

Table 2 below provides the descriptive statistics (including the mean, standard deviation, minimum and maximum value) for all dependent and independent variables used in the baseline model.

Table 2

Variable	*N*	Mean	Std. Dev.	Min	Max
SPREAD	35,824	2.89	3.76	0	123.67
VOL	35,854	1.40	7.98	0	397.35
GTI1	35,880	21.16	18.39	1	100
GTI2	35,880	41.66	17.50	8	100
GTI3	35,880	7.15	14.48	1	100
GTI4	35,880	24.92	24.25	2	100

TOTALINF	35,880	2.48e+07	2.01e+07	102	7.82e+07
TOTALDEA	35,880	420963.10	271492.5	8	941868
TOTALVAC	22,938	3.25e+08	2.54e+08	0	1.77e+09

N.B. SPREAD is the weekly proportional bid-ask spread; *VOL* is the weekly stock price volatility; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of the weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case.

Table 2 above provides summarised statistics for all dependent and independent variables. For two dependent variables, the bid-ask spread (*SPREAD*) is more stable than stock price volatility (*VOL*) as the standard deviation of *SPREAD* (3.76) is lower than *VOL* (7.98). This indicates that during the whole time-period, the stock price experienced some high volatility time and unstable stages, yet the bid-ask spread behaved slightly fluctuate but better than the stock price. The minimum value of both *SPREAD* and *VOL* are zero. This may be because the large sample in this study includes some banks that do not have any exchange behaviours during a specific time-period, which may lead to an unchanged stock price and so a zero bid-ask spread. The maximum value of the two dependent variables is 123.67 and 397.35, respectively. The relatively large value can be caused by the high stock price as some stock prices may reach $1,000 and even $10,000. Hence, the bid-ask spread could be high and the volatility. Overall, from the summarised statistic, each category of two dependent variables is reasonable and acceptable to analyse in the regression model.

For independent variables, all four Google trend indexes reached a maximum searching index of 100 in the whole time-period, which indicates that each selected word related to COVID-19 has been searched by a large number of individuals and under a high density. When looking more carefully, it can be seen that the search of "coronavirus" is relative, not popular with the other three, as the mean (7.15) and standard deviation (14.48) are both the lowest among the other three keywords. On the contrary, the most popular searching word should be

"COVID" as it holds the highest mean and a standard deviation of 17.5 also indicates that there is not much fluctuation from its mean value. A minimum value of 8 also testifies that. Compared with "COVID-19", "Covid vaccine" should be more volatile as its standard deviation is the highest one among the others. This could be because "Covid vaccine" is searched by a high density during a specific time-period, and it is highly possible to be around the announcement of starting the vaccination program. After the familiarity with vaccination, the searching density could start to drop. Compared with the search for a vaccine, "COVID-19" could keep a more stable trend throughout the whole time-period.

For the rest three independent variables indicating the real effects, the observation of total vaccine number (*TOTALVAC*) is smaller than the others. It is because the vaccination starts from around 2021, and the whole time-period in this study starts from early 2020. Hence, there is no data regarding vaccination before 2021. From the maximum value of each variable, the *TOTALVAC* is higher than the total infected number (*TOTALINF*), which indicates that there are a large number of individuals who get the vaccine without being infected with COVID. From Table 2, all the figures regarding the three real effect variables are reasonable.

For checking the potential multicollinearity, the VIF test is also applied, and the results indicate a high level of collinearity between the *TOTOALINF* and *TOTALDEA*. Hence, as these two variables have a high correlation, the *TOTALINF* will be removed for the multicollinearity issue. After removing the TOTALINF, the VIF shows no concerns regarding the multicollinearity issue as the highest value is 3.5 and the average value is 2.1, and no significant correlation among variables.

6.2 Baseline model results

The main results of the bank liquidity and bank stability are stated below in Table 3 and Table 4, which include different time specifications (whole time period, first-wave, second-wave and third-wave).

Table 3

Dependent variable: *SPREAD*

Independent variables	Whole-time	First-wave	Second-wave	Third-wave
GTI1-COVID-19	0.07***	0.02*	0.01**	0.01***
GTI2-COVID	-0.05***	-0.01*	-0.01**	-0.01***
GTI3-coronavirus	0.02*	0.03	0.01	0.01
GTI4-COVID vaccine	-0.01	-0.01	0.01	0.01*
TOTALDEA	2.76e-07*	1.02e-06*	4.07e-09	1.08e-07
TOTALVAC	-5.81e-11	-4.30e-10	-2.36e-10	-1.31e-11
NUMINF	5.59e-08*	1.70e-07*	6.76e-08	5.04e-08*
NUMDEA	2.85e-06	-8.97e-07	-1.14e-05	4.28e-06
MOVE	0.01	0.04	0.02	0.01
GDPg	-0.11***	-0.12***	-0.26***	-0.02***
ECONO	-4.50***	-6.25***	-4.54***	-3.66***
cons	7.16***	8.89***	6.63***	5.70***
Adj. R²	0.03	0.02	0.04	0.03

N.B. SPREAD is the weekly proportional bid-ask spread; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of the weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country. Whole-time is from 1st March 2020 to 1st March 2022; First-wave is from 1st March 2020 to 31st July 2020; Second-wave is from 1st August 2020 to 31st December 2020; Third-wave is from 1st January 2021 to 1st March 2022.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table 3 shows the results of the bid-ask spread as the dependent variable. For the bid-ask spread, it is commonly accepted that a tight spread would suggest better liquidity and a wider spread would be less liquidity and may arise some liquidity issues (Attig *et al.*, 2006; Zhang

and Wong, 2022). From this regard, when checking the four Google trend indexes, which indicate the media coverage impacts, Table 3 reveals significant effects on bank liquidity, especially for the trends of "COVID-19" and "COVID", which show high significant influence for the whole-time view and the third-wave time specifications. Although the significant level is not as high as the whole-time and third-wave, it still indicates significant influence among the second and third waves. In addition, the coefficients of these two trend indexes ("COVID-19" and "COVID") are also similar among all time stages. From this regard, it can be revealed that media coverage is related to bank liquidity, which this result is also supported by Perotti (2020) and Demirgüç-Kunt *et al.* (2021). When turns to the value of each coefficient, it shows around 0.02 for the search of "COVID-19" for three time stages, and a highest 0.07 during the whole-time view. For the sign of each Google trend index, overall, it shows a positive sign to bid-ask spread (except "COVID"), which indicates a negative correlation to bank liquidity. This is consistent with the hypotheses and also with previous studies carried out by Perotti (2020), Demirgüç-Kunt *et al.* (2021) and Ftiti *et al.* (2021). However, the sign of the search for "COVID" shows a positive relationship (negative to bid-ask spread) with bank liquidity among all time stages. This result is important as it indicates a beneficial relationship between the attention of "COVID" and bank liquidity. The possible reason here is that compared to other keywords related to COVID-19, the "COVID" can be demonstrated all issues with this virus, including "COVID-19", "coronavirus" and "Covid vaccine". When an individual desires to know information regarding COVID-19 but with no specific direction, it is highly possible that the "COVID" would be typed in the searching bar. As Google trend does not include the specific number of how many times one keyword is searched, the number cannot be sure, but it can be illustrated by the searching index score. It is mentioned before that "COVID" is the most popular searching word among the other three the whole time. Hence, the searching index score could be kept at a relatively high (around 40-50) level throughout the whole time, and it

shows a positive correlation to bank liquidity. Based on the study of Ashraf (2020), who also finds a positive relationship between media announcements and economic growth, this finding is similar to Ashraf (2020) and indicates that under high searching attention to "COVID", it is possible that the bank liquidity would be better with more searching.

For the searching of "coronavirus" and "Covid vaccine", these two behave less significant to "COVID-19" and "COVID". However, the "coronavirus" shows a significant and negative relationship (positive correlation with bid-ask spread) with bank liquidity when seeing the time period as a whole and then indicates a non-important factor during the three time waives. This may be because the "coronavirus" is not a popular search key words compared with the other three during specific time waves. However, when the time period is seen as a whole, the search word "coronavirus" shows its importance. For the "Covid vaccine", it only shows as a significant factor during the Third-wave and a positive to bank liquidity (negative to bid-ask spread) during the First-wave. As Bontempi (2021) indicates in the study that during the time of First-wave, the government starts to announce the information regarding the vaccine but no practice in the public, the media coverage of the "Covid vaccine" in First-wave may result in a recovery of the bank liquidity but then it bounces back.

For the real effects of COVID-19, this study includes two main factors to indicate the death and vaccine cases. Compared with the media coverage effects on bank liquidity, the real effects of COVID-19 show a less significant level, as only the *TOTALDEA* (total death number) behaves significantly affects bank liquidity under the First-wave and when only focused on the whole time period. The real effects of the death number of the COVIC-19 indicate a negative impact on bank liquidity, which is consistent with the hypotheses and is supported by Boot *et al.* (2020) and Goodell (2020). For the *TOTALVAC* (total vaccine number), it reveals a positive but non-significant effect on bank liquidity. The results indicate that compared with the vaccine number, the death case is indeed harmful to the bank liquidity. As time passes by and the

number of vaccines increases, the financial system will recover and the liquidity issue may not be a server problem, the bank liquidity will show a better situation as the vaccine case increases. This is also mentioned by previous studies by Ashraf (2020) and Correia *et al.* (2020), who suggest that with the infected cases increase, the economic situation could behave better. Hence, the results here indicate that the real effects of COVID-19 indeed affect bank liquidity, and it harms the bank liquidity with more death cases.

This study also includes both developed and developing economies to check if there are any differences between them. From the results, the economic development situation indicates as a highly significant factor throughout all time specifications, which reveals that compared with a developed economy, a developing country is more easily to be affected by a pandemic, as it would have a higher bid-ask spread under the same situation.

Table 4

Dependent variable: *VOL*

Independent variables	Whole-time	First-wave	Second-wave	Third-wave
GTI1-COVID-19	-0.07	-0.01	-0.02	-0.02
GTI2-COVID	0.01***	0.02**	0.01**	0.01***
GTI3-coronavirus	0.02	0.01	0.01	0.02
GTI4-COVID vaccine	-0.01***	-0.02***	-0.01**	-0.02***
TOTALDEA	2.43e-06***	5.85e-06***	3.31e-06***	3.45e-06***
TOTALVAC	1.01e-09***	-2.29e-10	6.03e-10	1.48e-09***
NUMINF	-4.66e-07***	-6.77e-07***	-4.31e-07***	-3.41e-07***
NUMDEA	2.12e-06	1.19e-05	-5.94e-06	1.41e-05
MOVE	0.02	0.01	-0.01	0.02
GDPg	-0.03***	-0.39***	-0.98***	0.03***
ECONO	1.17***	4.05***	0.05	1.23***
cons	-0.83***	-8.20***	-3.08***	-0.52**
Adj. R²	0.03	0.04	0.04	0.03

N.B. VOL is the weekly stock price volatility; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of the weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is

the economic development, which 1 implies a developed country and 0 implies a developing country. Whole-time is from 1st March 2020 to 1st March 2022; First-wave is from 1st March 2020 to 31st July 2020; Second-wave is from 1st August 2020 to 31st December 2020; Third-wave is from 1st January 2021 to 1st March 2022.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table 4 shows the results of stock price volatility as a dependent variable. It is commonly believed that a higher volatility indicates an instability situation, and a lower volatility indicates a relatively stable situation. According to that, from the table, when referring to the Whole-time, media coverage effects are significant to bank stability, as both searching indexes of "COVID" and "Covid vaccine" show significant impact on bank stability throughout all time specifications. There is also evidence supported by the results of Elnahass *et al.* (2021) and Ftiti *et al.* (2021), who reveal that the news announcements and media coverage related to COVID-19 affect stock price volatility. Similar to the effects on bank liquidity, the Google trend index also shows positive and negative effects on bank stability. For the searching keyword of "COVID", it indicates a significant negative effect on bank stability (positive to stock price volatility), which is consistent with Ftiti *et al.* (2021) and Pagnottoni *et al*. (2021) and supports the hypothesis. In addition, the effect behaves highly significant when counts for the Whole-time and during the Third-wave, but less significant during the First and Second waves. The possible reason behind this could be the relatively short time period of both the First and Second waves. As it mentioned before, when COVID-19 starts to spread, the first issue facing the financial system could be liquidity problems. The results here also indicate that, as almost four searching indexes of media coverage shows high significance among Third-wave but less or non-significant through First or Second waves. Similar to "COVID", searching for "coronavirus" also indicates a negative relationship with bank stability, yet it shows not significant. For the media coverage of "COVID-19" and "Covid vaccine", they both show a

positive relationship with bank stability (negative to stock price volatility), which indicates a benefit for bank stability. For the coverage of "Covid vaccine", it also demonstrates a positive effect on bank liquidity in Table 3. Hence, the coverage of "Covid vaccine" could be a benefit for the financial system in recovery from the virus hits.

Compared with the media coverage effects, for the real effects of COVID-19, both of the two variables indicate highly significant effects among almost all different time stages (except the vaccine on first and second waves), which is consistent with studies of Haroon and Rizvi (2020), Del Lo *et al.* (2021) and Delis *et al.* (2021). Specifically, both death and vaccine cases are negatively related to bank stability (positive to stock price volatility), which is also supported by Del Lo *et al.* (2021). This finding also supports the hypothesis. From the results, it illustrates that as the total death number increases, it is highly possible to affect the bank stock price volatility to a higher volatility situation, thus leading to instability among bank stock markets. For the real effects of vaccine number, it indicates a benefit for bank stability, yet the effects are not significant. However, compared with the effects of death, the coefficient of vaccine number is largely smaller than the death number. Hence, in this regard, it would be more important to control the death cases.

Overall, the results indicate that both media coverage and real effects of COVID-19 are significant to bank stability under different time waves. The real effect of COVID-19 shows a more influential factor on bank stability compared with the media coverage effects. Both media coverage and real effects indicate negative influences on bank stability, yet the media coverage effects are different depending on the searching index. For the economic development effects, it shows the opposite effects on bank liquidity, as the bank liquidity would be worse if it is a developed economy.

7. Robustness check

7.1 checking with the GMM model

This section includes the results of the GMM model for checking the robustness of the results indicated in section 6. Table 5 and Table 6 provide the results of bid-ask spread and stock price volatility as two dependent variables. I also include the comparison of results from the OLS and system GMM model under each time wave. All the results and tables are provided in the Appendix. In this section, only the summarised results will be discussed.

Table 5

Dependent variable: *SPREAD*

Independent variables	Whole-time	First-wave	Second-wave	Third-wave
GTI1-COVID-19	0.01	0.01	0.03	0.03*
GTI2-COVID	-0.01***	-0.01***	-0.01***	-0.03***
GTI3-coronavirus	0.02**	0.02***	0.03	0.01
GTI4-COVID vaccine	0.001	-0.001	0.001*	-0.01***
TOTALDEA	4.49e-07**	3.54e-07	4.70e-06*	4.47e-06*
TOTALVAC	-1.96e-10	5.65e-10	-6.36e-10*	2.36e-09*
NUMINF	1.22e-07**	7.59e-08	8.65e-07***	7.50e-07***
NUMDEA	-5.80e-06	3.54e-07	3.12e-06	-8.20e-06
MOVE	0.01	0.02	0.01	0.01
GDPg	-0.11***	-0.12***	-0.27***	-0.02***
ECONO	-4.51***	-6.18***	-4.39***	-3.62***
cons	7.18***	8.69***	6.40***	5.71***
Adj. R²	0.05	0.04	0.04	0.03

SPREAD is the weekly proportional bid-ask spread; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of the weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement. *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, in which 1 implies a developed country and 0 implies a developing country. Whole-time is from 1st March 2020 to 1st March 2022; First-wave is from 1st March 2020 to 31st July 2020; Second-wave is from 1st August 2020 to 31st December 2020; Third-wave is from 1st January 2021 to 1st March 2022.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From Table 5, most of the results of the GMM model of the media coverage effects are consistent with the results in OLS, as the search of "COVID" remains high significant level throughout the four-time specifications and the same sign with the baseline results. The results of the search index of "COVID-19" and "coronavirus" also remain the same sign with OLS, as they both show a negative correlation with bank liquidity, which is also consistent with previous studies by Perotti (2020), Demirgüç-Kunt *et al.* (2021) and Ftiti *et al.* (2021). The difference is regarding the significant level of the search keyword of "COVID-19" and "coronavirus". From the GMM, it indicates that the media coverage of "COVID-19" is not significantly related to bank liquidity, and the media coverage of "coronavirus" shows high negative impacts on bank liquidity (positive related to bid-ask spread) in the Whole-time wave and First-wave. However, in the baseline model, the results show that the media coverage of "coronavirus" is less or not significant among all time specifications. Hence, in this regard, if the media coverage effect of "coronavirus" is significant cannot be confirmed under this sample. However, the negative relationship can be confirmed as the sign remains the same in GMM as well as the media coverage effects of "COVID".

For the real factors of COVID-19, the sign of effects for total death cases stays consistent with OLS, yet the total vaccine number reveals some different effects (i.e., a significant positive effects on bank liquidity under Second-wave and a significant negative effect on bank liquidity under the Third-wave) in GMM model. From this regard, the effects of the total vaccine number cannot be confirmed throughout the Whole-time period as it indicates different influences in both baseline and GMM mode. For the significant level, similar to the results in the baseline model, the media coverage shows a higher important impact on bank liquidity compared with the real effects as the media coverage behaves more significance than the effects from total death numbers and total vaccine numbers.

For the effects of developed economies, the results in GMM indicate the same outcomes as the baseline. Hence, it can be concluded that compared with developing countries, the bank liquidity of developed economies may benefit from their economic development during the COVID pandemic.

In conclusion, based on the results from both baseline and GMM, it is revealed that the media coverage of COVID-19 and the real factors of COVID-19 indeed affect bank liquidity, and at a significant level. However, whether the media coverage or real factors of COVID-19 could significantly benefit or harm bank liquidity, it should be decided by the specific searching keyword of COVID-19 (i.e., "COVID", "COVID-19", "coronavirus" or "Covid vaccine) and the specific aspect of COVID-19 (i.e. death number or vaccine number).

Table 6

Dependent variable: *VOL*

Independent variables	Whole-time	First-wave	Second-wave	Third-wave
GTI1-COVID-19	-0.01***	-0.03	-0.03**	-0.03***
GTI2-COVID	-0.02	-0.01	-0.02	-0.01***
GTI3-coronavirus	0.04***	0.04***	0.04**	0.04***
GTI4-COVID vaccine	-0.01***	-0.03	-0.01	-0.01**
TOTALDEA	1.96e-06***	2.01e-06***	1.04e-06**	1.60e-06**
TOTALVAC	8.91e-10***	6.25e-09	3.74e-10	6.35e-09***
NUMINF	-6.24e-08	9.25e-08	2.17e-07**	8.28e-07
NUMDEA	-2.44e-05***	3.06e-05*	1.15e-05***	2.79e-05***
MOVE	0.001	0.02	0.05	0.08
GDPg	-0.01	-0.12***	-0.54***	0.02*
ECONO	1.12***	1.79***	0.32***	1.35***
cons	-0.98***	-2.56***	-1.32***	-1.18***
Adj. R²	0.08	0.10	0.09	0.09

N.B. VOL is the weekly stock price volatility; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of the weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country. Whole-

time is from 1st March 2020 to 1st March 2022; First-wave is from 1st March 2020 to 31st July 2020; Second-wave is from 1st August 2020 to 31st December 2020; Third-wave is from 1st January 2021 to 1st March 2022.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From Table 6, except the *GTI2-COVID*, the results (the sign of effects) of the GMM model of the rest three Google trend indexes (i.e., COVID", "coronavirus" and "Covid vaccine") remain consistent with the results in OLS, yet the significant level behaves differently with the results in OLS. For the significant level, the results in GMM show a higher level of significance among the four different time periods, which confirms that the media coverage of COVID-19 significantly affects bank stability, and these results are also supported by Elnahass *et al.* (2021) and Pagnottoni *et al*. (2021). Compared with the baseline results, the GMM indicates that the media coverage of "COVID" is also positively related to bank stability, which is similar to the effects of "COVID-19" and "Covid vaccine". From this regard, it reveals a benefit for the bank stability when there is large media coverage of the specific COVID-19 information, or higher attention to information related to COVID-19, as indicated by Ashraf (2020) and Correia *et al*. (2020). For the specific time waves, the results of media coverage of "Covid vaccine" keeps consistent with the results in the baseline model, which shows a significant negative relationship with bank stability at a 1% level for the Whole-time period. During the Third-wave, unlike the results in the OLS model, the GMM demonstrates both a 1% significance level of media coverage of "COVID-19" and "coronavirus".

For the real factor effects of COVID-19, the results in GMM are all consistent (i.e. both the sign of effects and the significant level) with the results in OLS, as both the number of total death cases and the number of vaccine cases indicate a negative correlation with bank stability. For the economic effects, the GMM also demonstrates the same results as the baseline model,

which indicates that for bank stability, a highly developed country would suffer from its developed economy compared with a developing country.

From the above discussion, it can be concluded that the media coverage of COVID-19 has significant effects on bank stability, yet it may not keep a highly significant factor throughout each different time wave. In addition, there is much evidence showing that the media coverage of COVID-19 could be a benefit for bank stability. For the effects of the real factors of COVID-19 on bank stability, there is evidence to show that a relationship exists between the real factors of COVID-19 and bank stability and the effects behave at a high significant level.

7.2 checking with two time-wave dummy variables

Under this section, I further check the robustness by introducing two additional dummy variables to distinguish the different time waves and compare the results with the Whole-time results in Table 3 and Table 4.

The two dummy variables are *FIRST-WAVE* and *SECOND-WAVE*, respectively. The *FIRST-WAVE* is the dummy variable to capture the First-wave, which 1 implies the date from 1st March 2020 to31st July, and 0 otherwise. *SECOND-WAVE* is the dummy variable to capture the Second-wave, in which 1 implies the date from 1st August 2020 to 31st December 2020, and 0 otherwise. The results are shown in Table 7.

Table 7

Independent variables	(a)	(b)
GTI1-COVID-19	0.01**	-0.01
GTI2-COVID	-0.01***	0.01***
GTI3-coronavirus	0.02*	0.02
GTI4-COVID vaccine	-0.001	-0.01***
TOTALDEA	2.76e-07*	2.43e-06***

TOTALVAC	-9.95e-11	1.01e-09***
NUMINF	5.98e-08**	-4.65e-07***
NUMDEA	1.84e-06	1.78e-06
MOVE	0.01	0.01
GDPg	-0.05***	-0.05***
ECONO	-4.49***	1.17***
FIRST-WAVE	1.61***	-0.41**
SECOND-WAVE	0.17**	-0.67***
cons	6.70***	-0.57*
Adj. R²	0.04	0.08

N.B. (a) is the regression results for *SPREAD*, which is the weekly proportional bid-ask spread; (b) is the regression results for *VOL*, which is the weekly stock price volatility; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country; *FIRST-WAVE* is the dummy variable with captures the time-wave from 1st March 2020 to 31st July 2020, where 1 is the First-wave time period and 0 otherwise; *SECOND-WAVE* is the dummy variable with captures the time-wave from 1st August 2020 to 31st July December 2020, where 1 is the Second-wave time period and 0 otherwise.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

From the results of Table 7, it reveals a highly significant relationship between the different time wave variables and bank liquidity as well as bank stability, which indicates that during different time waves, the effects and the extent of the effects would be different. Compared with the Third-wave, the bank liquidity issue in the First and Second waves may be impacted deeper by COVID-19 as the results show a higher value of bid-ask spread in the First-wave. The liquidity issue in the Third-wave would be better and recover from the government support and policies. However, the bank stability issue would be worse in the Third-wave.

For the effects on bank liquidity, the results from Table 7 are consistent with the results shown in Table 3 for the Whole-time, as each factor of four media coverage indicators all behave the same (positive or negative effects and if shows significant impacts) with the results

in Table 3 with slight differences among the coefficient and the level of significance. For the real effects of COVID-19, the results also remain constant, as the total death number shows a significant negative impact on bank liquidity, yet the total vaccine number indicates a positive relationship with bank liquidity but is not significant. For bank stability, the results also remain consistent (including the significant level and sign) in Table 4. In Table 7, both the media coverage effects, and real effects of COVID-19 show highly significant impacts yet the real effects behave more influential to the bank stability compared with media coverage effects.

For the economic development effect, the results also indicate a benefit for the bank liquidity but harm for the bank stability (stock price volatility) of developed economies.

8. Conclusion and policy implication

I investigate and compare the relationship between media coverage and real factors of COVID-19 and bank liquidity as well as bank stability, based on the sample from six countries (three developed economies- U.S., UK, Germany and three developing countries- Argentina, India and Brazil) with over 30,000 observations. In addition, I also compare the COVID-19 effects based on different time waves, including three-time specifications in total, which are 1st March 2020 to 31st July 2020 (when the COVID-19 just starts to spread), 1st August 2020 to 31st December 2020 (when the COVID-19 fast spread around the world and some strict policies are announced to control the spread) and 1st January 2021 to 1st March 2021 (when the COVID-19 lasting for one year and several strict policies start to ease).

For the media coverage of COVID-19, I follow the method provided by Brodeur *et al.* (2021), Costola *et al.* (2020) and Del Lo *et al.* (2021), using the Google trend index to capture four different searching keywords ("COVID", "COVID-19", "coronavirus" and "Covid vaccine") to analyse its effects on bank liquidity and bank stability. The results from both the

baseline model and robustness check confirm that the media coverage of COVID-19 indeed has a significant influence on both bank liquidity and stability, which is consistent with Demirgüç-Kunt *et al.* (2021) and Ftiti *et al.* (2021) and Pagnottoni *et al*. (2021). Most figures from both baseline and robustness results show that the media coverage and real effects (such as the number of death cases) of COVID-19 would harm the bank liquidity and bank stability from the stock market aspect (i.e., wider the bid-ask spread and increase the stock price volatility). However, there is also evidence that shows that the media coverage of COVID-19 could be a benefit for bank liquidity and especially for bank stability. In addition, not only the media coverage of COVID-19, but some real factors such as the vaccine number also show a positive effect on both bank liquidity.

From the above discussion, for bank liquidity, media coverage of COVID-19 and the real factors of COVID-19 indeed affect bank liquidity, and to a significant level. Most of the results indicate a negative impact of media coverage and real effects on bank liquidity and stability. However, there is also evidence showing that the media coverage or real factors of COVID-19 could benefit bank liquidity. Hence, whether it is a benefit or harmful to the financial system, it should be decided by the specific searching keyword of COVID-19 (i.e. “COVID”, “COVID-19”, “coronavirus” or “Covid vaccine”) and the specific aspect of COVID-19 (i.e. death number or vaccine number). In conclusion, the results indicate that both media coverage and real effects of COVID-19 are significant to bank stability under different time waves. The real effect of COVID-19 shows a more influential factor on bank stability compared with the media coverage effects. For the economic development effect, the results also indicate a benefit for the bank liquidity but harm for the bank stability (stock price volatility) of developed economies.

The findings of Chapter 3 have important implications. First, as the study shows that the media coverage and real effects of COVID-19 have a significant impact on bank liquidity and

bank stability, and media coverage could be more influential on bank liquidity and the real effects of COVID-19 could impact bank stability or the bank stock market more directly. Hence, the government may be able to adjust the relevant policies for bank liquidity via monitoring the Google Search Index regarding different search keywords related to COVID-19. At the same time, it can consider the volatility of the bank stock market by checking the actual figure regarding COVID-19 (e.g., the daily increased number, death number etc.). Secondly, the results also find some evidence of the vaccine could be a benefit for bank liquidity. Based on that, it should continue to encourage the public to get vaccinations. Thirdly, as the results indicate that the increase in death numbers could be a threat to not only bank liquidity but bank stability, it should carefully deal with the further infected cases and make policies to control the death cases for restraining its spreading speed.

Conclusion

My thesis investigates the media effects on financial stability based on three different chapters, consisting of traditional media, modern media, social media and three media concepts (media ownership, media concentration and media freedom) as well as the media coverage (Google search index). From the results, it indicates that media has a significant impact on financial stability.

Through this thesis, I find that the traditional and modern media act differently to financial system. It would depend on the financial environment. Overall, traditional media acts more negatively other than modern media. However, in the reality, we should pay more attention on the Newspaper effects, as its circulation is able to change over a short time. For the media concept, the results are quite similar, which is also depends on financial environment. Although media freedom indicates a significant positive effect on financial market, it still harms banking stability. Hence, the results reveal that for different financial environment, we should take different plans to stabilise the financial stability. I believe the results would also benefit for policy makers. As for the social media, Twitter shows its power to manipulate the financial market to both stock price and trading volume. Finally, my thesis also testify the real and media coverage effects from COVID-19 and also compare them. Similar to other studies investigating COVID-19 effects, the results indicate several negative impacts. However, I also find the COVID-19 can actually play a positive role during specific time for the banking liquidity and stability via its vaccine.

Specifically, Chapter 1 focuses on the influence of traditional and modern media areas and media concepts on financial stability, which is indicated by bank Z-score (banking stability) and stock market volatility (financial market stability) based on OECD economies

from 2002 to 2016 of yearly data. The results indicate that these media factors indeed affect financial stability from both banking and financial market stability aspects. Specifically, traditional media formats such as TV significantly harm financial stability. However, this effect may not be a threat to financial stability based on the results, as the TV household ratio is quite high (over 90%). Even if the ratio increases by 1%, the Z-score just drop by 0.08 and stock volatility climbs by 0.03. For other traditional media, the influence of radio and newspaper is different, depending on the market type. For the media concepts, the results show that media freedom, ownership and concentration significantly affect financial stability (either the banking stability or the financial market stability). The finding supports the hypothesis that state-owned ownership would harm financial stability viewing from both the banking and financial market. As for media freedom, it shows that a relatively free media environment is needed for both banking and financial market stability. In conclusion, for both banking stability and stock market stability system, the finding indicates that they may benefit from a relatively strict media environment, less state control and more Internet access. The TV access and contents should be noticed by the government and policymakers as it may have a chance of stimulating financial instability.

Chapter 2 analyses the media effects from another aspect-the social media, Twitter. It investigates the Twitter counts and Twitter sentiment effects on financial stability and stock trading volume based on a one-year time horizon with selected banking stocks trading on NYSE and FTSE100. The results indicate that both Twitter counts, and sentiment can significantly affect stock price volatility and trading volume. Specifically, the results reveal that Twitter count will be beneficial for banking stability when the sentiment does not be considered, and it is also believed to increase stock trading volume with a larger number of Tweets. This finding is supported by Oliveira *et al.* (2017). One explanation for that is Twitter provides an information exchange/sharing platform, with gathers a higher volume of efficient

information, it increases the willingness of investors to trade while controlling massive, biased information and thus decrease the chances of price fluctuation. However, when sentimental information is considered in Tweets, the mood effects are opposite to the counts. It will then show a harmful influence on banking stability. From this point of view, it reveals that much sentimental information may become biased text and hinder a sounding financial system. Hence, it is important to be rational under a social media platform when receiving financial information. Furthermore, it is believed that the U.S market is still a core and potential risk factor when under pressure conditions for the financial market, as U.S banking show a significant positive relationship to stock volatility.

Chapter 3 concentrates on the recent COVID-19 effects from both media sides (media coverage) and actual sides (real figures of COVID-19) on the financial system. This chapter includes six countries (U.S. UK, Germany, Argentina, India and Brazil) to analyse the relationship between media coverage and the real effects of COVID-19 and bank liquidity as well as bank stability. For the time period, this study introduces three time waves of COVID-19 and compares the results to different time specifications, which are 1st March 2020 to 31st July 2020 (when the COVID-19 just starts to spread), 1st August 2020 to 31st December 2020 (when the COVID-19 fast spread around the world and some strict policies are announced to control the spread) and 1st January 2021 to 1st March 2021 (when the COVID-19 lasting for one year and several strict policies start to ease). For investigating the media coverage effects of COVID-19, the study uses the Google trend index to capture four different searching keywords (“COVID”, “COVID-19”, “coronavirus” and “Covid vaccine”), and the results confirm that the media coverage of COVID-19 could indeed significantly affect bank liquidity and stability, Most figures show that the media coverage and real effects (such as the number of death cases) of COVID-19 would harm the bank liquidity and bank stability from the stock market aspect (i.e. wider the bid-ask spread and increase the stock price volatility). However,

there is also evidence that shows that the media coverage of COVID-19 could be a benefit for bank liquidity and especially for bank stability. In addition, not only the media coverage of COVID-19, but some real factors such as the vaccine number also show a positive effect on both bank liquidity. Furthermore, this chapter also investigates if the development situation of one economy could make any difference in the effects. The results indicate a benefit for the bank liquidity but harm to the bank stability (stock price volatility) of developed economies.

The findings of my thesis would have important implications. First, it would be a benefit for the government and banking owners, as well as market players for keeping the whole financial environment stable and sounding via monitoring different types of media platforms (i.e., paying attention to the ownership, and market share of different owner types). In addition, it also benefits for investors who use social media specifically, Twitter, to gather financial information regularly, as well as social media managers to control and manage some biased information. The findings of this thesis could give hints to investors about using Twitter information to analyse market volatility to adjust investment portfolios and infer trading volume based on Twitter counts. From the results of media coverage effects of COVID-19, the government may be able to adjust the relevant policies for bank liquidity via monitoring the Google Trend Index regarding different search keywords related to COVID-19. At the same time, it can consider the volatility of the bank stock market by checking the actual figure regarding COVID-19 (e.g., the daily increased number, death number etc.). In addition, the results also find some evidence of the vaccine could be a benefit for bank liquidity. Based on that, it should continue to encourage the public to get vaccinations, and at the same time, to carefully deal with further infected cases and make policies to control the death cases for restraining its spreading speed.

There are also some limitations in my thesis. First thing is regarding the data. Some databases I used in my thesis are not most recent data, which could result in the results may not

“up-to-date”. The results in my thesis might not be applied to the most recent situation. The second thing is regarding regression analysis. An causality test may be applied here to make further check for the independent and dependent factors. For the future research, it can continue studying the topic regarding media and financial stability aspects based on the background and results of this thesis. Specifically, the future study can focus on a firm-specific aspect such as firm performance, firm profitability and CSR rather than bank-focused. For the media side, the future improvements can be taken from the media data. I use quite sticky data in my thesis to indicate the media ownership and concentration. For the future study, it can find replacement data with higher frequency, or apply different approach to indicate the media concept data. In addition, for investigating the Twitter effects, it can be tested based on an event-study method other than focusing on a long-term period.

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Appendix

Table (a) below states the VIF index of the main independent variables used in Chapter 2

Table (a) VIF Index

Independ Variable	VIF
INTERNET	1.96
FREE	1.83
OWN	1.78
NEWSPAPER	1.58
RADIO	1.52
MCONC	1.42
TV	1.36
TCONC	1.31

Notes: *INTERNET* is Internet user ratio; *FREE* is media freedom; *OWN* is media ownership; *NEWSPAPER* is Newspaper ratio; Radio is Radio ratio; *MCONC* is the Modern media concentration; *TV* is TV household ratio; *TCONC* is the Traditional media concentration;

Table (b) below shows all U.S. banks trading in NYSE used to analyse the Twitter effects on financial stability in Chapter 2

Table (b) U.S. banks trading in NYSE

Bank name	Ticker
Ally Financial Inc.	ALLY
Axos Financial, Inc.	AX
Banc of California, Inc.	BANC
BancorpSouth Bank	BXS
Bank of America Corporation	BAC
Bank of Hawaii Corporation	BOH

Bank Of New York Mellon Corporation (The)	BK
Capital One Financial Corporation	COF
CIT Group Inc (DEL)	CIT
Citigroup Inc.	C
Comerica Incorporated	CMA
Community Bank System, Inc.	CBU
CPB Inc.	CPF
Cullen/Frost Bankers, Inc.	CFR
Customers Bancorp, Inc	CUBI
First Commonwealth Financial Corporation	FCF
Flagstar Bancorp, Inc.	FBC
Hilltop Holdings Inc.	HTH
J P Morgan Chase & Co	JPM
KeyCorp	KEY
M&T Bank Corporation	MTB
National Bank Holdings Corporation	NBHC
New York Community Bancorp, Inc.	NYCB
PNC Financial Services Group, Inc. (The)	PNC
Prosperity Bancshares, Inc.	PB
Provident Financial Services, Inc	PFS
State Street Corporation	STT
Sterling Bancorp	STL
Synovus Financial Corp.	SNV
TCF Financial Corporation	TCF
U.S. Bancorp	USB
Webster Financial Corporation	WBS

Wells Fargo & Company	WFC
Western Alliance Bancorporation	WAL

Table (c) below shows all foreign banks trading in NYSE used to analyse the Twitter effects on financial stability in Chapter 2

Table (c) Foreign banks trading in NYSE

Bank name	Ticker	Country
Macro Bank Inc.	BMA	Argentina
Westpac Banking Corporation	WBK	Australia
Bank of N.T. Butterfield & Son Limited (The)	NTB	Bermuda
Banco Santander Brasil SA	BSBR	Brazil
Banco Bradesco Sa	BBD	Brazil
Bank of Montreal	BMO	Canada
Canadian Imperial Bank of Commerce	CM	Canada
Royal Bank of Canada	RY	Canada
Toronto Dominion Bank (The)	TD	Canada
Bank of Nova Scotia (The)	BNS	Canada
Banco De Chile	BCH	Chile
Banco Santander Chile	BSAC	Chile
BanColombia S.A.	CIB	Colombia
Grupo Aval Acciones y Valores S.A.	AVAL	Colombia
Deutsche Bank AG	DB	Germany
First BanCorp.	FBP	Puerto Rico
HDFC Bank Limited	HDB	India

ICICI Bank Limited	IBN	India
OFG Bancorp	OFG	Puerto Rico
Sumitomo Mitsui Financial Group Inc	SMFG	Japan
Mizuho Financial Group, Inc.	MFG	Japan
Banco Latinoamericano de Comercio Exterior, S.A.	BLX	Panama
Credicorp Ltd.	BAP	Peru
KB Financial Group Inc	KB	South Korea
Woori Bank	WF	South Korea
Shinhan Financial Group Co Ltd	SHG	South Korea
Banco Bilbao Viscaya Argentaria S.A.	BBVA	Spain
Banco Santander, S.A.	SAN	Spain
Credit Suisse Group AG	CS	Switzerland
UBS AG	UBS	Switzerland
ING Groep NV	ING	Netherlands
Barclays PLC	BCS	UK
Lloyds Banking Group Plc	LYG	UK
HSBC Holdings plc	HSBC	UK

Table (d) below shows banks trading in FTSE100 used to analyse the Twitter effects on financial stability in Chapter 2

Table (d) Banks trading in FTSE100

Bank name	Ticker
Barclays	BARC.L
HSBC Holding UK	HSBA.L

Lloyds Bank	LLOY.L
Royal Bank of Scotland	RBS.L
Standard Chartered	STAN.L

Table (e) below shows the comparison of baseline OLS and GMM results for the First-wave of Bid-ask Spread

First-wave (1st March, 2020 to 31st July, 2020)

Table (e)

Dependent variable: *SPREAD*

Independent variables	(1)	(2)
GTI1-COVID-19	0.02*	0.01
GTI2-COVID	-0.01*	-0.01***
GTI3-coronavirus	0.03	0.02***
GTI4-COVID vaccine	-0.01	-0.001
TOTALDEA	1.02e-06*	3.54e-07
TOTALVAC	-4.30e-10	5.65e-10
NUMINF	1.70e-07*	7.59e-08
NUMDEA	-8.97e-07	3.54e-07
MOVE	0.04	0.02
GDPg	-0.12***	-0.12***
ECONO	-6.25***	-6.18***
cons	8.89***	8.69***
Adj. R²	0.02	0.02

N.B. (1) is the regression results applied in an OLS; (2) is the regression results applied in a GMM; *SPREAD* is the weekly proportional bid-ask spread; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is

the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table (f) below shows the comparison of baseline OLS and GMM results for the First-wave of Stock price volatility

First-wave (1st March, 2020 to 31st July, 2020)

Table (f)

Dependent variable: *VOL*

Independent variables	(1)	(2)
GTI1-COVID-19	-0.01	-0.03
GTI2-COVID	0.02**	-0.01
GTI3-coronavirus	0.01	0.04***
GTI4-COVID vaccine	-0.02***	-0.03
TOTALDEA	5.85e-06***	2.01e-06***
TOTALVAC	-2.29e-10	6.25e-09
NUMINF	-6.77e-07***	9.25e-08
NUMDEA	1.19e-05	3.06e-05*
MOVE	0.01	0.02
GDPg	-0.39***	-0.12***
ECONO	4.05***	1.79***
cons	-8.20***	-2.56***
Adj. R^2	0.06	0.08

N.B. (1) is the regression results applied in an OLS; (2) is the regression results applied in a GMM; *VOL* is the weekly stock price volatility; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table (g) below shows the comparison of baseline OLS and GMM results for the Second-wave of Bid-ask Spread

Second wave (1st August, 2020 to 31st December, 2020)

Table (g)

Dependent variable: *SPREAD*

Independent variables	(1)	(2)
GTI1-COVID-19	0.01**	0.03
GTI2-COVID	-0.01**	-0.01***
GTI3-coronavirus	0.01	0.03
GTI4-COVID vaccine	0.01	0.001*
TOTALDEA	4.07e-09	4.70e-06*
TOTALVAC	-2.36e-10	-6.36e-10*
NUMINF	6.76e-08	8.65e-07***
NUMDEA	-1.14e-05	3.12e-06
MOVE	0.02	0.01
GDPg	-0.26***	-0.27***
ECONO	-4.54***	-4.39***
cons	6.63***	6.40***
Adj. R²	0.02	0.02

N.B. . (1) is the regression results applied in an OLS; (2) is the regression results applied in a GMM; *SPREAD* is the weekly proportional bid-ask spread; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table (h) below shows the comparison of baseline OLS and GMM results for the Second-wave of Stock price volatility

Second wave (1st August, 2020 to 31st December, 2020)

Table (h)

Dependent variable: *VOL*

Independent variables	(1)	(2)
GTI1-COVID-19	-0.02	-0.03**
GTI2-COVID	0.01**	-0.02
GTI3-coronavirus	0.01	0.04**
GTI4-COVID vaccine	-0.01**	-0.01
TOTALDEA	3.31e-06***	1.04e-06**
TOTALVAC	6.03e-10	3.74e-10
NUMINF	-4.31e-07***	2.17e-07**
NUMDEA	-5.94e-06	1.15e-05***
MOVE	-0.01	0.05
GDPg	-0.98***	-0.54***
ECONO	0.05	0.32***
cons	-3.08***	-1.32***
Adj. R²	0.05	0.04

N.B. . (1) is the regression results applied in an OLS; (2) is the regression results applied in a GMM; *VOL* is the weekly stock price volatility; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table (i) below shows the comparison of baseline OLS and GMM results for the Third-wave of Bid-ask Spread

Third wave (1st January, 2021 to 1st March 2022)

Table (i)

Dependent variable: *SPREAD*

Independent variables	(1)	(2)
GTI1-COVID-19	0.01***	0.03*
GTI2-COVID	-0.01***	-0.03***
GTI3-coronavirus	0.01	0.01
GTI4-COVID vaccine	0.01*	0.01***
TOTALDEA	1.08e-07	4.47e-06*
TOTALVAC	-1.31e-11	2.36e-09*
NUMINF	5.04e-08*	7.50e-07***
NUMDEA	4.28e-06	-8.20e-06
MOVE	0.01	0.01
GDPg	-0.02***	-0.02***
ECONO	-3.66***	-3.62***
cons	5.70***	5.71***
Adj. R²	0.03	0.04

N.B. . (1) is the regression results applied in an OLS; (2) is the regression results applied in a GMM; *SPREAD* is the weekly proportional bid-ask spread; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.

Table (j) below shows the comparison of baseline OLS and GMM results for the Third-wave of Stock price volatility

Table (j)

Third wave (1st January, 2021 to 1st March 2022)

Dependent variable: *VOL*

Independent variables	(1)	(2)
GTI1-COVID-19	-0.02	-0.03***
GTI2-COVID	0.01***	-0.01***
GTI3-coronavirus	0.02	0.04***
GTI4-COVID vaccine	-0.02***	-0.01**
TOTALDEA	3.45e-06***	1.60e-06**
TOTALVAC	1.48e-09***	6.35e-09***
NUMINF	-3.41e-07***	8.28e-07
NUMDEA	1.41e-05	2.79e-05***
MOVE	0.02	0.08
GDPg	0.03***	0.02*
ECONO	1.23***	1.35***
cons	-0.52**	-1.18***
Adj. R²	0.07	0.08

N.B. . (1) is the regression results applied in an OLS; (2) is the regression results applied in a GMM; *VOL* is the weekly stock price volatility; *GTI1* weekly google trend index of searching "COVID-19"; *GTI2* weekly google trend index of searching "COVID"; *GTI3* is the weekly google trend index of searching "coronavirus"; *GTI4* is the weekly google trend index of searching "Covid vaccine"; *TOTALINF* is the number of weekly total infected case; *TOTALDEA* is the number of weekly total death case; *TOTALVAC* is the number of weekly total vaccine case; *NUMINF* is the number of weekly increased infected case; *NUMDEA* is the number of weekly increased death case; *MOVE* is the weekly price movement; *GDPg* is the Weekly GDP relative to the same week in the previous year; *ECONO* is the economic development, which 1 implies a developed country and 0 implies a developing country.

* Denote statistical significance at the 10% levels, respectively.

** Denote statistical significance at the 5% levels, respectively.

*** Denote statistical significance at the 1% levels, respectively.