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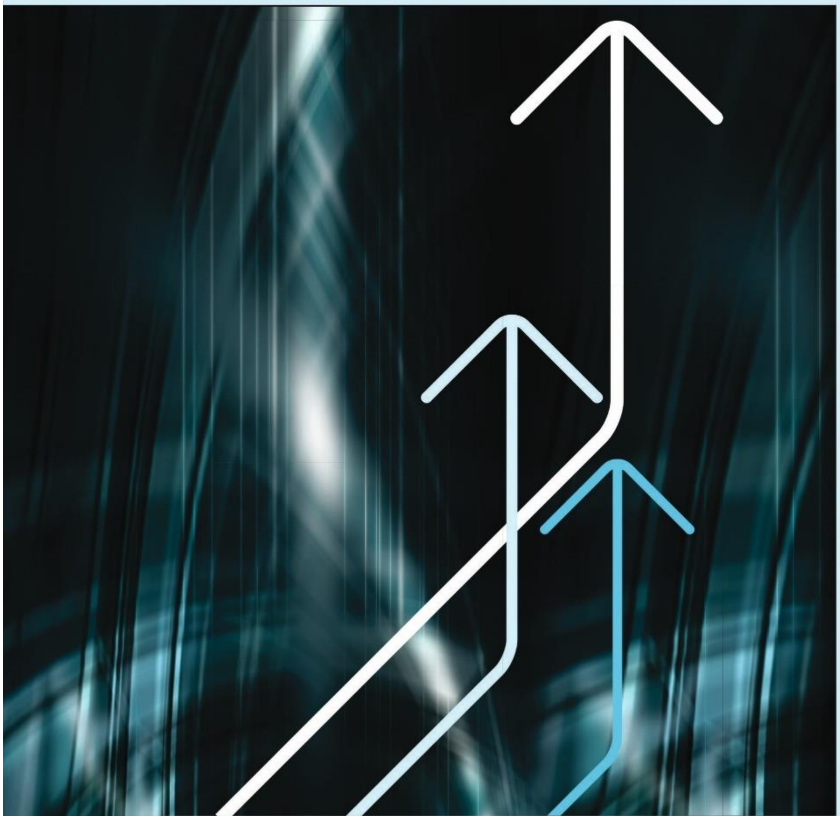

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“VICTOR SLĂVESCU” CENTRE FOR FINANCIAL
AND MONETARY RESEARCH

FINANCIAL STUDIES

ROMANIAN ACADEMY
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Contents

MEASURING SYSTEMIC RISK OF CHINA'S LISTED BANKS[1]

Ping ZHANG*

Yiru WANG**

Min ZHAO***

Tzu-Yi YANG****

Abstract

After the financial crisis in 2008, the world became more aware of the importance of the systemic risk. Within China's financial system, commercial banks have a dominant position. Therefore, the study of systemic risk of the banking industry in China has an important and real meaning. The present paper was based on the weekly return of 16 listed banks in China from 2010 to 2018. The quantile regression method and the GARCH model were applied to measure the systemic risk of banks in China. The VaR and CoVaR showed that the risk of large commercial banks in China was generally low but was usually higher than the medium and small banks. Comparing the quantile regression method and the GARCH model method indicated that both approaches could effectively measure the systemic risk of listed banks

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* *Assistant Professor, Department of Financial Engineering, School of Finance, Capital University of Economics and Business, Beijing, China.*

** *School of Finance, Capital University of Economics and Business, Beijing, China.*

*** *Department of Financial Engineering, School of Finance, Capital University of Economics and Business, Beijing, China.*

**** *Department of Foreign Languages and Literature National Ilan University, Taiwan.*

in China. The %CoVAR calculated by the GARCH model was significantly smaller than the result from the quantile regression method. Compared with the DCC-GARCH model, a simple GARCH model might underestimate the systemic risk of banks.

Keywords: systemic risk; CoVaR; quantile regression method; GARCH model method; DCC-GARCH

JEL Classification: D81; G32; G00

1. Introduction

In 2008, it was the break-out of the subprime crisis in the US. The bankruptcy of the world-famous investment bank Lehman Brothers Holdings Inc., Merrill Lynch was acquired by Bank of America, then there was a huge of Dow Jones as well as severe fluctuation in the world's stock market. Subsequently, the crisis shifted to the real economy, leading to the bankruptcy of many companies and a huge drop in the real economy. Consequently, the global economy's growth was slowed down, and finally, the subprime crisis turned into a worldwide financial crisis. After the financial crisis in 2008, the world was aware of the importance of the systemic risk. Therefore, lots of supervisory standards appeared to prevent and avoid the eruption of systemic risk. In 2010, the supervisory committee of Basel Bank launched Basel Capital Accord III, added the content of systemic risk. From the macro prudence perspective, the spillover effect on the entire financial system should be concerned with effectively preventing the banking industry's systemic risk.

As a globally recognized key factor that seriously affects financial stability, the systemic risk is a major concern for authorities and specialized departments in many countries. To prevent the systemic risk burst, it was needed to strengthen research and classify its features, influential factors, measurement, and prevention methods. Therefore, in this paper, China's banking industry will be used as the research object, and CoVaR method will be adopted for measurement; hopefully, China's systemic important banks can be distinguished, and therefore, reference opinions can be provided for future supervision.

Within China’s financial system, commercial banks have a dominant position. With the outbreak of the crisis in the banking system, the entire financial market was affected. Therefore, the study of systemic risk of the banking industry in China has an important and real meaning. Besides, compared to mature overseas research domain, in China, the research studies on the systemic risk are less advanced. In this paper, the CoVaR of commercial banks in China was calculated, using two methods, then associated with the newest data. The research will be expanded in multiple ways. Hopefully, this could bring beneficial supplement to the systemic risk research in China.

In this paper, the weekly return from September 2010 to December 2018 of 16 listed banks in China and the China Securities Index was applied. Two modelling methods were used, respectively, quantile regression method and GARCH model method, to calculate VaR and CoVaR and sort them; this was to identify systemic important bank and compare both methods. Hopefully, the difference in the results of the two methods could be analysed.

The main contributions of this paper are as follows. First, we calculate the VaR, CoVaR, ΔCoVaR, and %CoVaR from three different models: quantile regression, GARCH model method, and DCC-GARCH model. Second, we find that quantile regression method and the GARCH model could effectively measure the systemic risk of listed banks in China. Third, compared with the DCC-GARCH model, a simple GARCH model might underestimate the systemic risk of banks.

The rest of this paper is structured as follows: the literature on systemic risk measurement is presented in the second section, and the main content of this paper was derived based on this fact; in the third section is presented the measurement of systemic risk; the fourth section is dedicated to empirical analysis, followed by the conclusions section.

2. Literature review

2.1. Definition and measurement of systemic risk

There is no common definition of systemic risk from the academic field, but there are two ways for defining it. One way is from the point of view of contagion. According to this, the systemic risk is considered as the probability that certain events will affect a certain financial institution and then spill over to many financial institutions, or even to the whole financial system. Specifically, in the banking industry, the systemic risk is considered when a crisis of a certain bank led to breaches of contract in the case of other banks and to the risk faced by the entire banking system. The second point of view refers to the negative influence generated on the real economy. According to the definition proposed by international organizations, namely, International Monetary Fund (IMF), Bank for International Settlements (BIS), and Financial Stability Board (FSB), "a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system and has the potential to have serious negative consequences for the real economy." (FSB-FMI-BIS, 2009, p.2).

The studies on the measurement of the systemic risk can be mainly divided into two types. One was to study the internal correlation between systemic risk and financial vulnerability to select a specific index to construct a prediction model or stress index to measure the probability for the break-out of systemic risk. Kaminsky, Lizondo, and Reinhart (1998) proposed a method by which the macro economy's related variable are used as the prediction index. Historical data for those countries with financial crises were collected to determine the threshold value to be applied to other countries. Through this, the probability for that country to have a financial crisis was judged. Another type was to study the systemic risk contribution of the financial institutions. Specifically, this paper investigates the contribution of a financial institution to systemic risk during the crisis, analyses systemically important institutions, and strengthens their supervision, to reduce the probability and destructiveness of systemic risk. The commonly used methods are included marginal expected shortfall (MES) and Conditional Value at Risk (CoVaR).

Brownlees & Engle (2017) had proposed the marginal expected shortfall (MES) method. They used it to measure when extreme situations appeared in the financial market, the expected loss appeared in the rate of return of the stock in a single financial market, and it was a bottom-down method for measuring systemic risk. Acharya et al. (2017) had further defined MES, and under the premise of share capital loss and institution leverage, index SRISK related to systemic risk was set up. It was thought that in a financial crisis, the higher the SRISK value of a company, the larger that systemic risk.

CoVaR method was expanded by Adrian and Brunnermeier (2016) based on VaR method. VaR meant the maximal loss that the financial institution or financial system might face under a certain confidence level. CoVaR meant the risk faced by other financial institutions or the financial system when extreme situations occurred in a certain financial institution. Both had adopted a linear quantile regression method to calculate the contributions to systemic risk from 1226 financial banks in the US during the period from 1986 to 2010. It was found that the risk propagated outwards from the financial institution showed a positive correlation to the stock price of that institution.

The latest literature on systemic risk falls into two categories: tail dependence model and network model. Tail dependence model measures the systemic risk with the high-frequency data, especially with the stock return. Tail dependence model for systemic risk is CoVaR (Adrian & Brunnermeier, 2016), ES (Du & Escanciano, 2016; Kratz et al., 2018), MES and SES (Acharya et al., 2017), SRISK (Brownlees & Engle, 2017), CCA (Gray et al., 2008, 2010). The network model has gradually become an important method to study systemic risk contagion. Billio et al. (2012) constructed a return correlation network to investigate the systemic risk contagion among financial institutions by the linear Granger causality test. Subsequently, many scholars carried out relevant research on this basis. Brunetti et al. (2019) constructed the inter-bank market return correlation network before and after the financial crisis in 2008. It was found that the risk contagion between US and European banks increased during the crisis, while the linkage of the return network increased significantly. Corsi et al. (2018) conducted a network analysis of tail risk contagion between 33 systemically important banks and 36 sovereign bonds in the world from 2006 to 2014. It was found that when the European sovereign debt crisis broke out, the market risk contagion intensified, resulting in the instability of the financial system. Ghulam & Doering (2018) examined the tail Risk Spillover Effects of banks, insurance, hedge funds, and commodity market indexes in the UK and Germany from 2007 to 2015 and found that hedge funds in both countries were the main risk sources. Diebold and Yilmaz (2012, 2014) constructed a risk spillover network analysis method to investigate the volatility spillover effect of financial markets. Maghyereh, Awartani & Bouri (2016) found that with the framework of risk contagion analysis, we can describe the degree of risk contagion in different financial sectors and identify the central source of risk contagion to provide a reference for improving risk prevention system. Recently, the framework of Risk contagion Analysis has also received extensive attention, among which representative studies include Lundgren et al. (2018), Berisha, Meszaros & Olson (2018), and Nishimura & Sun (2018).

2.2. CoVaR method

There are three methods to calculate CoVaR, respectively, quantile regression method, GARCH model method, and Copula function method. Based on quantile regression, Wang, Chen, and Zhang (2014) have introduced extreme value theory and used extreme quantile regression to calculate, under 0.5% and 1% level, the risk spillover of the financial institution, and the result showed that, under extreme conditions, the spillover effect of the bank to the system was high. Kong (2016) showed that a single VaR model might lead to underestimating the overall level of the banking industry. Deng (2017) used a static and dynamic CoVaR method to calculate a single bank's risk and the spillover to the overall banking industry. The result showed a certain positive correlation between bank risk and its received spillover from the banking system. Based on ARMA-GARCH model Sun (2016) made fitting on the rates of return of 14 listed banks in China, and the one with the best effect was used for calculation. The result shows that large scale bank had an important position to the banking system; SPD Bank had stronger competence to resist the risk than VaR, and it was recommended that other banks could adopt its method. Wang, Zhang, and Wang (2018) used GARCH model to calculate VaR, %CoVaR series of 14 listed banks in China, and observed no necessary correlation between VaR series and %CoVaR. Among 14 banks, Construction Bank had the highest systemic spillover effect.

At the level of in-depth research, the Copula function method appears to be more frequently used regarding CoVaR. Copula-CoVaR-based research is usually associated with the GARCH model. GARCH model was required to fit its edge distribution. The parametric estimation on Copula function can be conducted, then substituted into it for calculation. Based on the Copula-CoVaR method, Shan (2018) calculated the systemic risk contribution from 16 listed banks in China. The result showed that the value of the unconditional risk of national and large-scale bank was lower, but the systemic risk contribution was large.

3. Systemic risk measurement

3.1. VaR method

Value at Risk (VaR) meant, within a certain holding period and given confidence level (generally 95% or 99%), the maximal possible loss encountered by a certain financial institution or asset portfolio i when there was a change in market factors such as stock price and interest rate, and its mathematical expression is as follows:

$$\mathrm{Prob}\left(\Delta P^{i} \leq VaR_{q}^{i}\right) = \mathrm{q} \quad (1)$$

where Prob meant the probability, q is the significance level, $\Delta P^{i} = \mathrm{P}_{t+\Delta t}^{i} - P_{t}^{i}$ represents the loss encountered by a certain financial institution or asset portfolio i within holding period $\Delta \mathrm{t}$, VaR_{q}^{i} is, under confidence level(1-q), the value of a certain financial institution or asset portfolio i when staying in the risk. In other words, within the future time section $\Delta \mathrm{t}$, the probability for the occurrence of loss larger than VaR_{q}^{i} in that financial institution or asset portfolio was q.

The VaR method is a simple and easy method to understand, and the result of risk measurement can be represented by a specific value. Therefore, since its first promotion in the 1990s, it has gradually become a mainstream risk measurement tool. However, the traditional VaR method is limited to a single institution's risk, and the correlation among institutions is neglected. The risk spillover effect among financial institutions cannot be caught. Besides, under continuous implementation, it was gradually found that the use of that model is only limited to the situation when the market is normal. Once the model is used in an extreme environment (such as a financial crisis), serious deviations will appear. In 2016, Adrian and Brunnermeier, based on risk spillover, have introduced tail correlation analysis into VaR and proposed the CoVaR method.

3.2. CoVaR method

CoVaR method, which was Conditional Value at Risk, is a derivation method from the VaR method, and its nature is a conditional VaR method. It meant that under the certain period and a given confidence level, the maximum and possible losses encountered by other financial institutions or the entire financial system when the extreme situation (the loss was VaR) occurred in a single financial institution, the mathematical expression is:

$$\mathrm{Prob}\left(\Delta P^{j} \leq \mathrm{Co}VaR_{q}^{j|i} | \Delta P^{i} = VaR_{q}^{i}\right) = \mathrm{q} \quad (2)$$

where, Prob meant the probability, q is a significance level, $\Delta P^{j} = \mathrm{P}_{t+\Delta t}^{j} - P_{t}^{j}$ is the loss of financial institution j within holding period $\Delta \mathrm{t}$, $\Delta P^{i} = VaR_{q}^{i}$, when the extreme situation occurred in institution i (in period Δt, the loss is equal to Value at Risk) and $\mathrm{Co}VaR_q^{j|i}$ is under confidence level(1-q), Value at Risk of certain financial institution j.

CoVaR method has encountered two disadvantages of the VaR method in the previous description. It was commonly used to evaluate when one financial institution or market is under crisis, the risk faced by other institutions or markets. It is different than the traditional VaR method, which only focused on a single financial institution. Therefore, the CoVaR method paid more attention to the spillover effect among institutions. This was usually used to judge the systemic importance of certain financial institutions (the stronger the spillover effect, the stronger the systemic importance).

3.3. Risk spillover value

Adrian and Brunnermeier (2016) had pointed out that the risk spillover effect of financial institution i to j can be described through both $\mathrm{Co}VaR_q^{j|i}$ and VaR_q^j. The former means Value at Risk of institution j when institution i is under crisis, and represents the overall risk faced by institution j, and the latter is unconditional Value at Risk of institution j and represents the risk of institution j itself. The risk spillover effect $\Delta\mathrm{Co}VaR_q^{j|i}$ of institution i on j can be represented by the difference value of both, and the calculation formula is:

$$\Delta\mathrm{Co}VaR_q^{j|i} = \mathrm{Co}VaR_q^{j|i} - VaR_q^j \quad (3)$$

The risk spillover effect of institution i on institution j was the added risk value faced by institution j when institution i was under crisis. The larger the value, the more significant the risk spillover effect of institution i on institution j, and the larger the risk contribution level.

In calculation, since different institution j had different scale, the difference of calculated VaR was larger. Therefore, a direct comparison cannot be conducted. Usually, standardization will be conducted on $\Delta\mathrm{Co}VaR_q^{j|i}$ to calculate risk spillover percentage $\%\mathrm{Co}VaR_q^{j|i}$ of institution i on institution j, and the calculation formula is:

$$\%\mathrm{Co}VaR_q^{j|i} = \frac{\Delta\mathrm{Co}VaR_q^{j|i}}{VaR_q^j} \times 100\% \quad (4)$$

Standardized $\%\mathrm{Co}VaR_q^{j|i}$ did not have dimension. Therefore, it can facilitate pair comparison. Consequently, the spillover effect

among institutions can be fully reflected, and based on this, the systemic importance of different institutions can be analysed.
In this paper, quantile regression and GARCH model methods were selected to calculate CoVaR, as in references (Adrian & Brunnermeier, 2016; Brownlees & Engle, 2017).

4. Empirical result analysis

4.1. Sample selection and initial analysis of data

4.1.1 Sample selection

In this paper, the weekly rates of return of 16 listed banks in China were selected as sample data, and the sample period was from September 01, 2010, to December 31, 2018, and observed values of 429 weeks were obtained. Besides, the weekly rates of return of SSE Composite Index were selected to represent R_{mt}, and the weekly rates of return of CSI Bank Index were selected to represent the overall situation of the banking system. And all the data came from the China Stock Market & Accounting Research Database.

Until December 31, 2018, there were 28 listed banks in China, wherein 8 of them was listed in 2016, 1 was listed in 2017, 3 was listed in 2018. Therefore, the listed time was short, and the sample was not sufficient; the 16 listed banks before January 1, 2016, were selected as research objects. In addition, China Everbright Bank was listed on August 18, 2010, Agricultural Bank of China was listed on July 15, 2010. The starting time of the data was selected as September 01, 2010 to guarantee the data's consistency. The final selected 16 banks were: Ping An Bank (PAB), SPD Bank (SPD BANK), China Minsheng Bank (CMBC), China Merchants Bank (CMB), HuaXia Bank (HUAXIA BANK), Bank of China (BANK OF CHINA), Industrial and Commercial Bank of China (ICBC), China Industrial Bank (INDUSTRIAL BANK), China CITIC Bank (CNCB), Bank of Communications (BANKCOMM), Bank of Nanjing (NJCB), Bank of Ningbo (BANK OF NINGBO), Bank of Beijing (BOB), Construction Bank (CCB), Agricultural Bank of China (AGRICULTURAL BANK OF CHINA), China Everbright Bank (CEB BANK).

4.1.2 Descriptive statistics of rate of return

Descriptive statistics for returns are shown in Table 1, in the Appendix.

From Table 1, the mean of the returns of banks in China is 0, the standard deviations is maintained in the range of 0.03-0.05. The Kurtosis values of 16 listed banks of China are all larger than 3 and show that the data have the features of "High Kurtosis and Fat Tail." The Skewness values of 16 banks are all non-zero. It describes the asymmetrical distribution feature of the data, and some skewed to the left and some to the right. From JB Statistic, all 16 banks have passed 5% significance level tests. It describes that the P values were all smaller than 0.05 and rejects the hypothesis that the series returns follow a normal distribution. Bank Index and data of 16 banks show similar features: mean is almost 0, the standard deviation is in the range of 0.03-0.05, Kurtosis value is larger than 3, Skewness value is larger than 0, and it shows the features of "High Kurtosis and Fat Tail" and "distribution skewed to the right". JB Statistic pass the significance test, and it doesn't have a normal distribution. When the series of return of SSE Composite Index was compared to the rest of the 17 sets of data, the volatility was smaller, and the rest of the situations were consistent.

4.2. Empirical analysis based on quantile regression method

We need to expand the state variable when using the quantile regression method to calculate CoVaR. To make the state variables fully reflect the system's situation, they can represent the market return, volatility, interest rate risk, fluidity risk, and credit risk.

4.2.1 Selection of state variable

By referring to past researches and the real situation of China's market, 6 state variables were selected in this paper to conduct regression, and they were respectively: (1) Weekly rate of return of SSE Composite Index; (2) Weekly volatility of SSE Composite Index: Using weekly return to construct GARCH model to calculate market volatility; (3) Term spread: Yield to maturity of 10 years national debt - yield to maturity of 3 months national debt; (4) Credit spread: Yield to maturity of 10 years AAA rank corporate bond – yield to maturity of 10 years national debt; (5) Fluidity spread: 3 months Shanghai Interbank Offered Rate(SHIBOR)- yield to maturity of 3 months national debt; (6) Interest rate change: Change of yield of 3 months national debt (Yield of the last transaction day of t+1 week – yield of the last transaction day of t week). Next, the Agricultural Bank of China will be used as an example for detailed expansion and specific calculation.

4.2.2 Calculating VaR

First, using quantile regression to calculate VaR, q=0.05 to get the following equation:

$$R_t^{\text{Agricultural Bank}} = -0.0437 + 0.5914 yield - 0.7099 VIX - 0.7341 maturity + 1.5225 credit - 0.0858 liquidity - 0.5277 interest + \mu_{0.05,t}^{\text{Agricultural Bank}} \quad (5)$$

We use the same methods to construct models for the rest of the 16 sets of data (including Bank Index). To calculate the VaR series of each bank and Bank Index, taking Agricultural Bank of China as the example:

$$VaR_{0.05,t}^{\text{Agricultural bank}} = -0.0437 + 05914 yield - 0.7099 VIX - 0.7341 maturity + 1.5225 credit - 0.0858 liquidity - 0.5277 interest \quad (6)$$

A set of VaR with a quantile of 0.05 of the Agricultural Bank of China is obtained. The remaining 16 sets of data have processed with the same method, and a total of 17 sets of VaR have been obtained (for comparison, the median series of 17 sets s of VaR and the Covar were listed in Table 3, in the Appendix).

4.2.3 Calculating CoVaR

First, using Agricultural Bank of China as the example, with q = 0.05, the equation obtained will be as follows:

$$R_t^{\text{Bank index|Agricultural Bank}} = -0.0062 + 0.7283 R_t^{\text{Agricultural Bank}} + 0.2722 yield - 0.5228 VI + 0.4683 maturity - 1.1291 credit + 0.2991 liquidity + 0.5782 interest + \mu_{0.05,t}^{\text{Bank index|Agricultural Bank}} \quad (7)$$

We use the same method to set up the quantile regression equation for the rest of the 15 banks.

Next, calculate the CoVaR of Bank Index for each bank, and taking the Agricultural Bank of China as an example:

$$CoVaR_{0.05,t}^{\text{Bank index|Agricultural bank}} = -0.0062 + 0.7283VaR_{0.05,t}^{\text{Agricultural bank}} + 0.2722yield - 0.5228VIX + 0.4683maturity - 1.1291credit + 0.2991liquidit + 0.5782interest \quad (8)$$

Then CoVaR series of the quantile of 0.05 of Bank Index to Agricultural Bank of China can be obtained. Using the same method to treat the remaining 15 sets of data to obtain 16 sets of CoVaR series (results are shown in Table 2, in the Appendix).

4.2.4 Calculating ΔCoVaR and %CoVaR

Next, we use equations (3) and (4) to calculate ΔCoVaR and %CoVaR, a total of 16 sets of the series, then we take the median on the calculated VaR series, CoVaR series, ΔCoVaR series and %CoVaR series, as it is listed as in Table 2, in the Appendix.

4.2.5 Results

According to Table 2, the top five ranks in terms of VaR are: Ping An Bank, SPD Bank, China Minsheng Bank, China Everbright Bank, Bank of Communications, and the last five ranks are: Industrial and Commercial Bank Of China, Bank of China, Construction Bank, China Industrial Bank, and Bank of Nanjing. Based on the bank scale, for the top 8 ranks of banks, except Bank of Communications, the others all did not have market values over 300 billion yuan; banks in the last eight ranks, five of them have ranked over 600 billion yuan. Taking the mean on VaR, it was found that China Industrial Bank ranked in sixth place, Bank of Nanjing ranked in seventh place, and those five large scale national banks ranked out of 10th. Therefore, it can be seen the return of commercial banks of larger scale was more stable, and the risk level was lower.

From %CoVaR, banks of top five ranks are: Bank of Ningbo, Industrial and Commercial Bank of China, Agricultural Bank of China, Construction Bank, China Merchants Bank, and banks of last five ranks are, respectively: SPD Bank, Bank of Communications, China Industrial Bank, China Everbright Bank, and Ping An Bank. Banks in the top five ranks, except Bank of Ningbo, have the total market values not lower than 600 billion yuan. This shows that when large scale commercial banks are compared with small scale commercial banks, their risk spillover to the system is stronger, and they have more systemic importance.

4.3. Empirical analysis based on GARCH model

Taking Agricultural Bank of China as an example to conduct CoVaR calculation based on GARCH model, the specific process is as follows.

4.3.1 Stationary test of rate of return

In Table 1 (Appendix) data has been conducive to descriptive statistics to avoid the occurrence of the "pseudo-regression" phenomenon (there was no real connection between data, the high correlation between them is because they change up or down with time simultaneously). Next, we conducted a stationary test on the data listed in Table 3, in the Appendix. By the ADF test method, we observe that 18 sets of series of return are all stationary, and the direct modelling and studying can be done. Next, taking Agricultural Bank of China as an example, the modelling process will be introduced.

4.3.2 GARCH model

Conducting the ARCH Effect test on the 17 sets of data (including series of return of Bank Index), the result shows that all 17 sets of data have ARCH Effect, and this explained that using GARCH model to make fitting was effective.

We use three common GARCH model to make fitting on series of return of bank, then follow MSE, RMSE, MAE values, and fitting optimization R^2 to select the best model. If there is an auto-regression phenomenon, it will be introduced ARMA term to make a correction to get the final ARMA-GARCH model.

According to Table 1 (see the Appendix), all 17 sets series do not have the normal distribution. Therefore, in this paper, it was hypothesized that random variable series ε_t follow t distribution.

4.3.3 Calculating VaR

Using the following formula (9), we calculate the VaR of each bank. $\hat{R}_t^i$ and $\hat{\sigma}_t^i$ are predicted through model set up in 4.3.2, and $Q(q)$ is quantile of t distribution of 0.05 quantile point.

$$VaR_{q,t}^i = \hat{R}_t^i - Q(q)\hat{\sigma}_t^i \quad (9)$$

Calculating the returns and the standard deviation series of 17 set of data (including Bank Index), then substituted into formula (9) for a calculation to get 17 sets of VaR series (the result was merged with the rest of the three sets of series and listed in Table 3, in the Appendix).

4.3.4 Calculating CoVaR

Then using formula (10):

$$R_t^{j|i} = \alpha^j + \beta^j VaR_{q,t}^i + A(L)R_t^j + B(L)\mu_t^j \quad (10)$$

To make fitting on Bank Index return, wherein VaR in the formula was VaR series calculated for 16 banks as in 4.3.3. Then conducted ARCH Effect test on the residual of the fitted mean equation, if ARCH Effect existed, then used the same steps as in 4.3.2 to set up GARCH model to select the best model to estimate $\hat{R}_t^{j|i}, \hat{\sigma}_t^j$, then referred to steps in 4.3.3 to calculate $CoVaR_{q,t}^{j|i}$.

4.3.5 Calculating ∆CoVaR and %CoVaR

Next, we use formula (3) and (4) to calculate risk spillover value and risk spillover ratio for 16 sets of series. Then took median on the calculated VaR series, CoVaR series, ∆CoVaR series, and %CoVaR series. They are listed in Table 4, in the Appendix.

4.3.6 Results

According to Table 4, from VaR, the banks of top five ranks are, respectively: Ping An Bank, Bank of Nanjing, Bank of Ningbo, China Industrial Bank, China CITIC Bank; the banks of last five ranks are, respectively: China Everbright Bank, Bank of Communications, Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China. That is consistent with the conclusion obtained from quantile method. As compared to small scale banks, the risk of large-scale banks was even lower.

From %CoVaR, the banks of top five ranks are, respectively: China CITIC Bank, Agricultural Bank of China, Bank of China, HuaXia Bank, Construction Bank; the banks of last five ranks are, respectively: China Minsheng Bank, Bank of Communications, China Merchants Bank, Bank of Ningbo and China Everbright Bank. In five national banks, three of them were in the top five, for another large scale Industrial and Commercial Bank of China ranked in the sixth place, totally speaking, the risk spillover of large-scale banks was higher.

Comparing the risk spillover value calculated from both methods, it is found that the value calculated based on GARCH model method is significantly lower than that obtained using the quantile regression method. Next, it is considered the correlation of two sets of returns, and then it is calculated the risk spillover value based on the DCC-GARCH model.

4.3.7 Calculation results based on DCC-GARCH model

First, it is used the GARCH model to construct a model for single series of rate of return and to get standardized residual for the model, and then it is set up the DCC model for standardized residual. After setting up a single variable GARCH model of series of return, it follows the generated standardized residual series to set up the DCC model, then it is found out dynamic-related coefficient series. The results are summarized in Table 5 (see the Appendix).

According to Table 5, the following analysis was made: From VaR, the rank was consistent with the calculation of GARCH model, and this shows that large scale bank had relatively lower risk level. From %CoVaR, the top five ranks are, respectively: China Merchants Bank, Construction Bank, Agricultural Bank of China, Bank of Ningbo and Industrial and Commercial Bank of China; the last five ranks are, respectively: China Minsheng Bank, China Everbright Bank, Bank of Nanjing, Bank of Beijing and Ping An Bank. As compared to medium and small-scale banks, the risk spillover of large-scale national bank was stronger. The risk spillover is significantly enhanced, and it is consistent with the value calculated from the quantile regression method.

4.4. Validity test of empirical results

It is used the failure frequency test method to conduct a validity test on the calculation result. CoVaR evaluates the Value at Risk of another institution when there is a crisis on other institution (return equal to Value at Risk). Therefore, the calculated value will be lower than the value when the market, in a normal situation. It was not reasonable to test CoVaR using the value when the market is at the normal level. In other words, when there is larger variation in the market, institutions in the market that could have crises easily should be selected. For the real situation of China's market, the period from June 2014 to June 2016 was chosen as the test period with specific reasons as follows:

(1) From June 2014 to June 2015, the A-share market of China encountered a "policy bull market" lasting for 12 months, and a sky-high daily trading volume of 800 billion, 900 billion, and 1 trillion were

created. The total market values of the two markets rose from 23.6 trillion to 71.0 trillion, and the circulation market value increased from 19.7 trillion to 57.2 trillion. The price of the market index broke its record high one after another. After the end of the bull market, SSE Composite Index rose as high as 158%.

(2) From June of 2015 to the beginning of 2016, the bubble of the stock market broke, and "limit down for thousand stocks" was what you saw at that moment, and the number of trade suspension company had reached its peak. As high as 1200 companies were at trade suspension, and the percentage was almost half of Shanghai and Shenzhen stock markets. On June 19, 2015, the Shanghai composite index dropped by about 6.42%. SZSE COMPONENT INDEX dropped by about 6.03%, 20.5 trillion was evaporated for market value in both stock markets, 17.5 thousand yuan was the loss per capita. On July 27, 2015, SSE Composite Index dropped abruptly by 8.48%, which was the largest drop in nearly eight years. On August 18, 2015, A-share had its third round of fall, and in that day, the accumulated sale was 171.4-billion-yuan, A-share had a drop of 6.15%. In 2016, China started its implementation of a circuit-breaker mechanism. Two days after the market opening, 4 circuit-breaking occurred in the market, which led to earlier market rest two times. On January 07, there were only 15 minutes of transactions in the entire day, and it had created the lowest record of A-share in China for the past 20 years.

During this period, the market encountered abrupt rise and abrupt drop. The systemic risk could easily break out. Therefore, it was more appropriate to use this sample region to test the validity of CoVaR. Then using formula:

$$\mathrm{LR} = -2\ln\left[(p^*)^N (1-p^*)^{T-N}\right] + 2\ln\left[\left(\frac{N}{T}\right)^N \left(1-\frac{N}{T}\right)^{T-N}\right] \qquad (11)$$

we calculate LR test values of each set of data. The results are shown in Table 6, in the Appendix.

At 5% significance level, the critical value of $c^2(1)$ is 3.84 (see Table 6). It can be noticed that the LR test values of each set of data are all smaller than 3.84. Therefore, the original hypothesis could not be refused. Hence, the CoVaR values calculated by both methods are all effective.

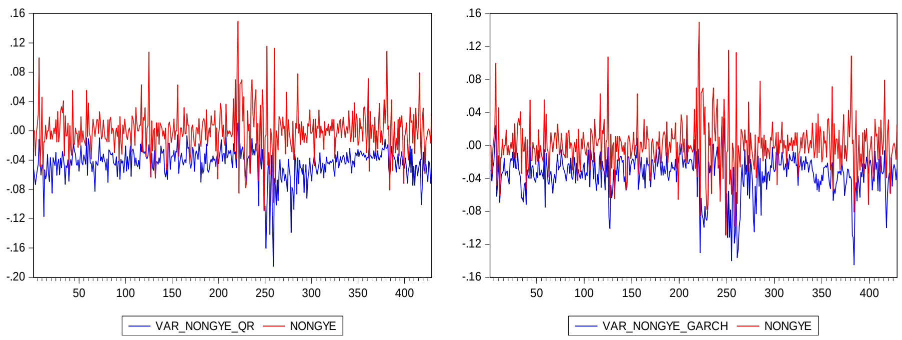
4.5. Results: comparison of two methods

4.5.1 Comparison between VaR and %CoVaR values

VaR calculated based on the quantile regression method is generally larger than that calculated based on GARCH model method.

Figure 1

Trend chart of VaR series of Agricultural Bank of China calculated from both methods



According to Figure 1, the VaR series calculated based on the GARCH model is closer to the trend of return, and both sets of VaR series is underneath the return, and the values are all effective.

From the rank of the median of VaR series, it can be seen that VaR calculated from both methods all have a common characteristic: the risk of large-scale bank is generally lower than that of small and medium banks.

From %CoVaR series, %CoVaR calculated based on the quantile regression method is higher. After introducing the DCC model, which considers the correlation between series, the risk spillover is consistent with the quantile method. This shows that simple GARCH model method might generally underestimate the bank's risk spillover effect. Regardless of the method used, either the quantile regression or the GARCH model (including DCC-GARCH), the rank of %CoVaR has one common feature: the risk spillover of large-scale national bank is high.

4.5.2 Comparison of validity of CoVaR values

In Table 6, in the Appendix, it is displayed the validity test result of CoVaR calculated by both methods. Comparing the three rows of data, it can be seen that the values are close.

5. Conclusion

In this paper, the weekly rates of return of 16 listed banks in China were used as research objects, and the modelling was conducted through the quantile regression and GARCH model method, and it was calculated the risk spillover of an individual bank to the entire bank industry. A conclusion of the analysis refers to the fact that the VaR calculated by both methods were effective. Compared to small and medium banks, the risk of large-scale banks in China was usually lower. Another important observation deriving from analysis is that the CoVaR calculated by both methods were effective. However, the risk spillover value calculated based on GARCH model was generally smaller. When studying risk spillover, the effect of the DCC-GARCH model was better than simple GARCH model. Compared to small and medium scale banks, the risk spillover effect of large-scale commercial banks in China was stronger.

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APPENDIX

Table 1

Descriptive statistical analysis of series of rates of return of 16 listed banks of China and Bank Index

Name of Bank	Mean	Maximum	Minimum	Standard deviation	Skewness	Kurtosis	JB Statistic
PAB	-0.0017	0.2225	-0.5246	0.0549	-1.6816	23.2576	7537.5380**
SPD BANK	-0.0008	0.2188	-0.3051	0.0415	-0.5120	12.0354	1478.0280**
CMBC	0.0001	0.2152	-0.2196	0.0411	-0.0380	9.6176	782.8959**
CMB	0.0014	0.1382	-0.1207	0.0378	0.3653	4.1189	31.9197**
HUAXIA BANK	-0.0011	0.1514	-0.3365	0.0443	-0.8495	11.6666	1394.2040**
BANK OF CHINA	0.0002	0.2150	-0.1185	0.0323	0.7011	9.6091	815.9334**
ICBC	0.0006	0.1572	-0.1462	0.0311	0.2770	8.2903	505.7635**
INDUSTRIAL BANK	-0.0013	0.1979	-0.6575	0.0557	-4.8739	57.6220	55029.6900**
CNCB	-0.0001	0.2891	-0.1921	0.0458	1.0313	9.6315	862.1295**
BANKCOMM	-0.0001	0.1868	-0.1594	0.0374	0.8855	8.7015	637.1223**
NJCB	-0.0013	0.1750	-0.6295	0.0547	-4.1282	48.4549	38150.9400**
BANK OF NINGBO	0.0006	0.2171	-0.2905	0.0470	-0.2422	9.2082	693.1291**
BOB	-0.0019	0.1440	-0.2705	0.0422	-1.1690	10.8741	1205.9890**
CCB	0.0007	0.1929	-0.1393	0.0353	0.5284	7.2785	347.1777**
AGRICULTURAL BANK OF CHINA	0.0007	0.1496	-0.1090	0.0302	0.5625	6.5607	249.2479**
CEB BANK	0.0001	0.2639	-0.1582	0.0413	1.4790	12.0309	1614.2270**
Bank Index	0.0008	0.1370	-0.1287	0.0328	0.6089	5.4488	133.7062**
SSE Composite Index	-0.0001	0.0907	-0.1429	0.02935	-0.7512	6.4846	257.395**

***It meant that it has passed 5% significance level test*

Source: Stock return of 16 listed banks, Bank Index, and SSE Composite Index in China from 2010 to 2018. All the data came from the China Stock Market & Accounting Research Database.

Table 2

Systemic risk measured results of 16 listed banks In China and Bank Index based on quantile regression method

Name of Bank	VaR	Rank	CoVaR	Rank	ΔCoVaR	Rank	%CoVaR	Rank
PAB	-0.0609	1	-0.0473	14	-0.0083	15	19.16	16
SPD BANK	-0.0562	2	-0.0491	11	-0.0113	12	28.69	12
CMBC	-0.0534	3	-0.0505	10	-0.0123	10	33.23	10
CMB	-0.0464	9	-0.0523	8	-0.0156	6	38.30	5
HUAXIA BANK	-0.0491	6	-0.0517	9	-0.0142	8	36.10	8
BANK OF CHINA	-0.0418	13	-0.0524	7	-0.0146	9	37.71	7
ICBC	-0.0424	12	-0.0555	1	-0.0171	2	45.31	2
INDUSTRIAL BANK	-0.0409	15	-0.0475	13	-0.0088	14	21.47	14
CNCB	-0.0483	7	-0.0530	6	-0.0152	7	35.59	9
BANKCOMM	-0.0492	5	-0.0473	15	-0.0099	13	24.00	13
NJCB	-0.0389	16	-0.0489	12	-0.0121	11	30.89	11
BANK OF NINGBO	-0.0453	11	-0.0550	2	-0.0189	1	47.26	1
BOB	-0.0476	8	-0.0541	3	-0.0160	5	37.92	6
CCB	-0.0410	14	-0.0539	4	-0.0165	3	42.27	4
AGRICULTURAL BANK OF CHINA	-0.0453	10	-0.0532	5	-0.0165	4	42.90	3
CEB BANK	-0.0505	4	-0.0460	16	-0.0080	16	20.40	15
Bank Index	-0.0383	17	—	—	—	—	—	—

Source: The VaR, CoVaR, ΔCoVaR, and %CoVaR are calculated from the quantile regression method.

Table 3

Stationary test of each series of return

Name of Bank	ADF value	Test result	Name of Bank	ADF value	Test result
PAB	-21.1530	stationary	CNCB	-20.3738	stationary
SPD BANK	-20.0654	stationary	BANKCOMM	-21.6844	stationary
CMBC	-21.7393	stationary	NJCB	-22.0590	stationary
CMB	-21.6661	stationary	NINGBO	-23.2732	stationary
BOB	-21.8808	stationary	CCB	-21.8048	stationary
ICBC	-23.9933	stationary	CEB BANK	-21.9216	stationary
HUAXIA BANK	-20.7471	stationary	BANK OF CHINA	-22.1743	stationary
INDUSTRIAL BANK	-20.6917	stationary	AGRICULTURAL BANK OF CHINA	-23.1600	stationary
Bank Index	-21.1378	stationary	SSE Composite Index	-18.7903	stationary

Source: Stock return of 16 listed banks, Bank Index, and SSE Composite Index in China from 2010 to 2018 . All the data came from the China Stock Market & Accounting Research Database.

Table 4

Systemic risk measured result of 16 listed banks in China and Bank Index based on GARCH Model Method

Name of Bank	VaR	Rank	CoVaR	Rank	ΔCoVaR	Rank	%CoVaR	Rank
PAB	-0.0505	1	-0.0340	7	-0.0022	8	5.71%	7
SPD BANK	-0.0438	8	-0.0331	12	-0.0014	11	3.22%	10
CMBC	-0.0439	7	-0.0343	5	-0.0014	10	2.84%	12
CMB	-0.0442	6	-0.0328	14	-0.0006	15	2.36%	14
HUAXIA BANK	-0.0432	9	-0.0337	9	-0.0026	6	7.10%	4
BANK OF CHINA	-0.0297	17	-0.0348	4	-0.0033	2	7.20%	3
ICBC	-0.0327	14	-0.0371	1	-0.0027	4	6.27%	6
INDUSTRIAL BANK	-0.0446	4	-0.0362	2	-0.0027	5	5.10%	8
CNCB	-0.0445	5	-0.0353	3	-0.0035	1	8.14%	1
BANKCOMM	-0.0359	13	-0.0333	10	-0.0012	12	2.44%	13
NJCB	-0.0469	2	-0.0326	15	-0.0015	9	4.61%	9
BANK OF NINGBO	-0.0469	3	-0.0332	11	-0.0007	14	1.36%	15
BOB	-0.0412	10	-0.0331	13	-0.0012	13	2.96%	11
CCB	-0.0376	11	-0.0343	6	-0.0023	7	6.32%	5
AGRICULTURAL BANK OF CHINA	-0.0303	16	-0.0339	8	-0.0028	3	7.81%	2
CEB BANK	-0.0361	12	-0.0324	16	-0.0005	16	1.28%	16
Bank Index	-0.0306	15	—	—	—	—	—	—

Source: The VaR, CoVaR, ΔCoVaR, and %CoVaR are calculated from the GARCH model method.

Table 5

Systemic risk measured results of 16 listed banks in China based on DCC-GARCH model

Name of Bank	VaR	Rank	CoVaR	Rank	ΔCoVaR	Rank	%CoVaR	Rank
Ping An Bank	-0.0505	1	-0.0385	16	-0.0094	16	23.76%	16
SPD Bank	-0.0439	7	-0.0405	11	-0.0110	12	29.52%	11
China Minsheng Bank	-0.0428	9	-0.0415	2	-0.0125	3	29.27%	12
China Merchants Bank	-0.0434	8	-0.0425	1	-0.0135	1	36.45%	1
HuaXia Bank	-0.0440	6	-0.0412	4	-0.0123	4	30.50%	7
Bank of China	-0.0296	16	-0.0410	7	-0.0117	9	29.65%	10
Industrial and Commercial Bank of China	-0.0318	14	-0.0405	10	-0.0118	8	31.85%	5
China Industrial Bank	-0.0446	5	-0.0396	14	-0.0107	14	29.82%	9
China CITIC Bank	-0.0446	4	-0.0407	9	-0.0121	7	30.81%	6
Bank of Communications	-0.0357	13	-0.0404	12	-0.0116	10	30.04%	8
Bank of Nanjing	-0.0462	3	-0.0399	13	-0.0108	13	27.35%	14

Name of Bank	VaR	Rank	CoVaR	Rank	ΔCoVaR	Rank	%CoVaR	Rank
Bank of Ningbo	-0.0468	2	-0.0412	3	-0.0128	2	32.89%	4
Bank of Beijing	-0.0412	10	-0.0390	15	-0.0102	15	25.68%	15
Construction Bank	-0.0377	11	-0.0411	5	-0.0122	5	33.09%	2
Agricultural Bank of China	-0.0315	15	-0.0409	8	-0.0121	6	33.03%	3
China Everbright Bank	-0.0361	12	-0.0410	6	-0.0112	11	27.95%	13

Source: The VaR, CoVaR, ΔCoVaR, and %CoVaR are calculated from the DCC-GARCH model.

Table 6

Validity test result of CoVaR

Name of Bank	LR statistic			Name of Bank	LR statistic		
	QR	GARCH	DCC-GARCH		QR	GARCH	DCC-GARCH
PAB	0.0246	0.3914	0.0246	CNCB	1.2830	2.8734	1.2830
SPD BANK	1.2830	0.0246	0.0246	BANKCOMM	0.0246	0.0246	1.2830
CMBC	1.2830	0.0246	0.3914	NJCB	0.3914	0.0246	0.0246
CMB	2.8734	2.8734	2.8734	BANK OF NINGBO	2.8734	0.0246	1.2830
HUAXIA BANK	2.8734	1.2830	2.8734	BOB	1.2830	0.0246	0.0801
BANK OF CHINA	1.2830	2.8734	2.8734	CCB	0.0801	0.3914	1.2830
ICBC	0.0246	1.2830	2.8734	AGRICULTURAL BANK OF CHINA	0.3914	0.0801	1.2830
INDUSTRIAL BANK	0.0801	2.8734	0.3914	CEB BANK	0.0801	1.2830	1.2830

THE AUDIT OPINION IN THE ROLE OF STOCK PRICES FLUCTUATIONS ON THE MACEDONIAN STOCK EXCHANGE

Ivan DIONISIJEV, Msc*

Zorica BOZHINOVSKA LAZAREVSKA, PhD**

Abstract

In the modern literature, the audit opinion is defined as a certificate that accompanies the financial statements of companies. The audit opinion is important because it provides an answer as to whether companies' financial statements are free from material misstatement. Although in the Republic of North Macedonia the research studies related to the influence of the audit opinions on the stock prices of the companies listed on the Macedonian Stock Exchange are almost non-existent, in the world numerous papers have researched the impact between these two variables. The purpose of this paper is to study the impact of audit opinions contained in the audit reports on the stock prices of companies in the Republic of North Macedonia. The model also includes two control variables: the net profit and the size of the companies. The sample included in the research are companies listed on the Macedonian Stock Exchange. The results of this research show that the impact of the audit opinion on the stock price is not significant, i.e., that investors in the decision-making process do not take into account the audit opinion.

Keywords: auditor's opinion; net profit; company size; stock price

JEL Classification: M42; G11

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* *Research and Teaching Assistant, Ss. Cyril and Methodius University in Skopje, Faculty of Economics – Skopje, Republic of North Macedonia.*

** *Full time Professor, Ss. Cyril and Methodius University in Skopje, Faculty of Economics – Skopje, Republic of North Macedonia.*

1. Introduction

The opinion given by the auditor on the objectivity and truth of the expressed circumstance and the aftereffect of the activity is an expert assessment of the presented financial condition and the consequence of the activity. In essence, the auditor evaluates whether the financial statements have been prepared following the applicable balancing regulations and accounting standards, truthfully and honestly. Based on the performed audit procedures and the collected evidence, the auditor forms an opinion on the financial statements, which he communicates to the interested users - stakeholders. The auditor's opinion is his reasoned impression of the financial statements and their correspondence with professional and legal regulations.

There are many studies on the effect, i.e., the impact of the audit opinion on the stock price of listed companies. From their results, it can be concluded that there are still different conclusions about the impact of the audit opinion on the stock price. Some studies have proven the relationship between these two variables to be significant, while other studies have concluded that audit opinion does not significantly affect the stock price.

The purpose of this research is to study the impact of audit opinions contained in audit reports on the stock prices of companies in the Republic of North Macedonia. The realized net profit of the companies, as well as their size, will also be added to the model as control variables. The sample includes fifteen companies listed on the Macedonian Stock Exchange. Normality data testing, multicollinearity and autocorrelation testing, ANOVA, linear regression, and other statistical methods are used to analyse the collected data. The analysis is done with the SPSS program. All the obtained results of the research are summarized in a conclusion which indicates whether the audit opinion and the other control variables have an impact on the stock price fluctuations on the Macedonian Stock Exchange.

The paper is conceived in the following sections: Introduction, Literature Review, Research Methodology, Results and Discussion, Conclusion.

2. Literature review

Tom Lee (1984) gives one of the most comprehensive definitions of auditing as far back as 1984 and that "An audit is a tool by which a person is assured by another person of the quality, condition or status of a matter in question, which this other person has examined. The need for an audit arises because the first-mentioned person is in doubt or has doubts about the quality, condition or status of the relevant issue in question, and is unable to remove such doubt (Lee, 1984)".

Rezaei and Shahroodi (2014) briefly defined the audit as a reassurance to stakeholders who have a business relationship with the company (Rezaei & Shahroodi, 2014). In the domestic audit practice, according to the Law on Audit (2010), the audit is defined as "independent examination of financial statements or consolidated reports and financial information, in order to express an opinion on their authenticity and impartiality" (Official Gazette of RNM, 2010)

The structure of the independent auditor's audit report is strictly defined by the auditing standards, and a key element of the report is the paragraph with the expressed opinion. For the readers and users of the audit report, it is of particular importance what message the auditor wants to convey to them through the form of the audit opinion. The nature of the audit opinion, with which a more objective and accurate diagnosis of the economic-financial condition of the audit services user and with the evaluation of his achievements, inevitably, by the nature of the works, indicates what should be done to eliminate and overcome the shortcomings and for strengthening the positives manifested during the client's operation (Bozhinovska, 2011). Basically, there are 4 types of audit opinion: unqualified opinion, qualified opinion, disclaimer of opinion, and adverse opinion (Kong, 2020).

Several studies examined the impact of audit opinion on financial statements on the stock price of companies. Thus, Anvarkhatibi, et al. (2012) have concluded from their research that at 95% confidence interval there is no significant relationship between audit opinion and stock price (Anvarkhatibi, et al., 2012). Furthermore, Moradi et al. (2011) have come to a similar conclusion that qualified audit opinion does not affect stock prices (Moradi, et al., 2011). A year earlier, Tahinakis et al. (2010) conclude from their results that audit reports contain limited information about investors and that they are not part of the decision-making process of the investors themselves, de facto, the audit opinion does not influence the decision of investors (Tahinakis, et al., 2010). An interesting fact is that Tanui in 2010 have concluded from their research that there is still a small but very weak relationship between audit opinion and company stock price and that audit opinion is only a small part of the change in the stock price (Tanui, 2010). Recent and more detailed research with good data processing is done by Muslih and Amin (2018) which get a similar result as previous researchers, namely that the impact of audit opinion on stock price movements is not significant (Muslih & Amin, 2018).

Although the studies that have defined a connection between the audit opinion and the movement of the stock price are rare, they still exist. One of those studies was done in 2012. Hoti et al. (2012) point out that the opinion of independent auditors influences stock price movements (Hoti, et al., 2012).

The company's net profit also attracts a lot of attention from investors to invest in a particular company. It describes the financial gain realized when the income generated by the business activity exceeds the expenses and taxes involved in maintaining the business in question (Kenton, 2020). Purnamawati (2016) with his research on the impact of capital structure and profitability on the stock price in manufacturing companies concludes that there is a positive effect between them (Purnamawati, 2016). Also in 2018, Muslih and Amin (2018) confirm the hypothesis that there is a significant relationship between the company's net profit and stock price movements. This indicates the fact that the net profit is very important information for potential investors in the process of deciding on investments in certain shares.

Companies vary in their size as small companies, medium and large companies. In the literature for measurement of a certain company to which size group belongs, several measurement categories are used, such as: according to the size of the capital, the net worth of the company, the total assets of the company, the number of employees in the company, etc. (iEduNote, 2020).

In this part, also, the researchers have differing views and conclusions. Thus, Kurshev and Strebulaev (2015) in their research conclude a positive relationship between company size and capital structure (Kurshev & Strebulaev, 2015). Dogan (2013) conducted a detailed study of 200 listed companies on the Istanbul Stock Exchange between 2008 and 2011. He concludes that there is a positive relationship between the size of companies and their profitability (Dogan, 2013). Cheung and Lilian (1992) in their research point out that the relationship between firm size and stock price is current and variable from time to time (Cheung & Lilian, 1992).

3. Methodology

3.1. Population, sample, method of data collection, measurement of variables

The population in the research is all companies listed on the Macedonian Stock Exchange. The sample used in the research are companies from the population, i.e., listed companies on the Macedonian Stock Exchange, and the data collection was done through several data sources, such as the website of the Macedonian Stock Exchange: *www.mse.mk*, the website of the system for electronic information for listed joint-stock companies: *www.seinet.com.mk*, as well as the individual websites of the joint-stock companies that are included in the sample.

Table 1

Description of the variables

Variables	Abbreviation	Measurement
Stock Price	STOCK_PRICE	The average stock price in the second quarter of the year after the publication of the audit report on the financial statements
Audit Opinion	AUD_OPINION	The measurement of the audit opinion is done with values from 1 to 5
Net Profit	PROFIT	The company's net worth (Income Statement)
Company Size	SIZE	Total assets in the Balance Sheet

Source: Authors' text

Table 1 provides an overview of the dependent variable and the independent variables together with their abbreviations and the measurement of the variables. The measurement of the identified variables in the model is as follows: the stock price of the companies is the sample taken from the website of the Macedonian Stock Exchange and represents the average stock price in the second quarter of the year after the publication of the audit report on the financial statements. The measurement of the audit opinion was done with values from 1 to 5 in the SPSS program: '5' for Unqualified opinion, '4' for Unqualified opinion with emphasis on question, '3' Qualified opinion, '2' for Disclaimer of opinion and '1' for Adverse opinion. The measurement of the net profit of the company is the de-facto absolute amount of the net profit of the company, which is stated in the Income Statement of the company itself. The value of the company in this research uses the value of the total assets presented in the Balance Sheet of the companies themselves.

3.2. Empirical specification

This research uses a quantitative research method. The processing of the collected data was done through several statistical methods and tests, using SPSS software. The model is formulated as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon \quad (1)$$

where: Y = Stock Price; X_1 = Audit Opinion; X_2 = Net profit; X_3 = Company Size; ε = random error.

3.3. Data analysis

The analysis of the collected data includes several statistical tests, as follows: *Data normality testing* to determine if data is normally distributed for decision making and conclusions. This test involves preparing a histogram of the dependent variable to see if the residual is skewed, and a simple Kolmogorov-Smirnov test is performed. If the significance value is greater than 0.05 then it means that the data is normally distributed. *Multicollinearity test* to determine the relationship between the independent variables. Multicollinearity can be detected by the Variance Inflation Factor (VIF). If the value of Centred VIF is less than 10, then it means that there is no multicollinearity. *Data heteroskedasticity test*, performed with Spearman's heteroscedasticity test. If the value is above 0.05 it means that there is no heteroskedasticity. Next, to determine if there is a problem with autocorrelation in the research model, a *Watson Durbin test (DW*) was performed, with the following conditions: a positive autocorrelation if the DW value is below -2 (DW <2); no autocorrelation if the DW value is between -2 and +2, a negative autocorrelation occurs if the DW value is above +2 or DW> +2. The last statistical test is the *regression test* to see if the change in the variable Y can be explained by variable X. In this test, we use the coefficient R^2 (R square).

4. Results and discussion

4.1. Sample review

As previously mentioned in the paper, the population of this research are the companies in the Republic of North Macedonia that are listed on the Macedonian Stock Exchange. Fifteen companies listed on the stock exchange are taken in the research sample. The data used are panel data from fifteen companies and a time series of six years (2014-2019). From here, there are ninety observations in the research.

4.2. Research results

Furthermore, the results obtained from statistical data processing using SPSS software are followed.

- *Residual Normality Test*

This test is done to determine if the data is normally distributed or not, by testing the normality of the residual. The first test is shown in histogram 1 and table 2 below.

Histogram 1

Data distribution

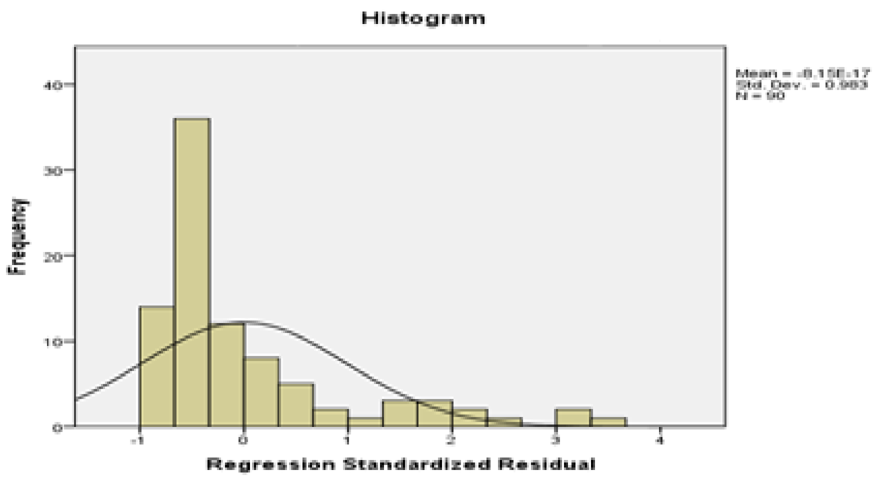

Table 2

One-Sample Kolmogorov-Smirnov Test

		STOCK_PRICE
N		90
Normal Parameters[a,b]	Mean	13049.13
	Std. Deviation	19347.000
Most Extreme Differences	Absolute	.263
	Positive	.263
	Negative	-.252
Asymp. Sig. (2-tailed)		**.000**

a. Test distribution is Normal; b. Calculated from data
Source: Authors' calculations

Histogram 1 shows that the residual is skewed to the left. Also, from the Kolmogorov-Smirnov test, it can be concluded that the value of 0.00 is less than 0.05. This means that the residues are not normally distributed. When the curve of the histogram is skewed, then the transformation of the data by making a square root is required. Thus, the data is transformed in the SPSS program using the square root. After the transformation is done, the following results are obtained**:**

Histogram 2

Data distribution

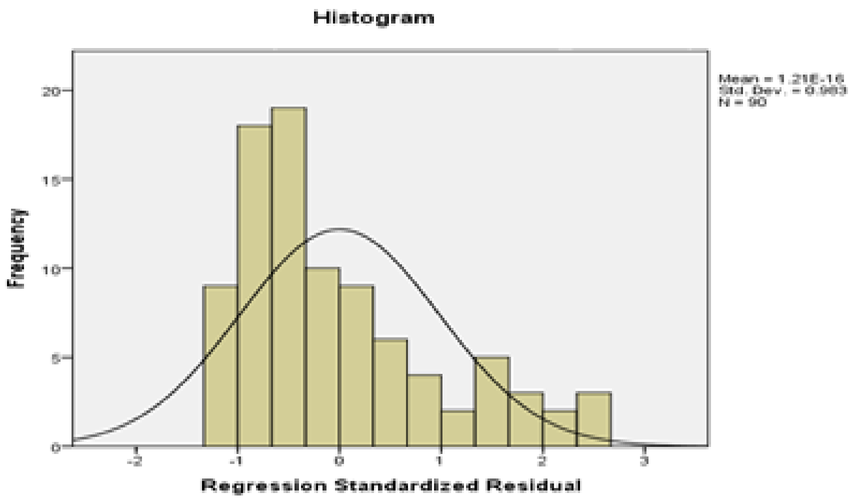

Table 3

One-Sample Kolmogorov-Smirnov Test

		STOCK_PRICE
N		90
Normal Parameters[a,b]	Mean	86.6906
	Std. Deviation	74.80675
Most Extreme Differences	Absolute	.200
	Positive	.200
	Negative	-.153
Kolmogorov-Smirnov Z		1.898
Asymp. Sig. (2-tailed)		**.001**

a. Test distribution is Normal; b. Calculated from data
Source: Authors' calculations

Histogram 2 shows that the curve looks better but is still slightly skewed. In table 3, with the Kolmogorov-Smirnov test, it can be seen that the value of 0.01 is less than 0.05. This means that the residues are not normally distributed. The data is transformed again using the square root. The obtained results are shown in the following histogram and table.

Histogram 3

Data distribution

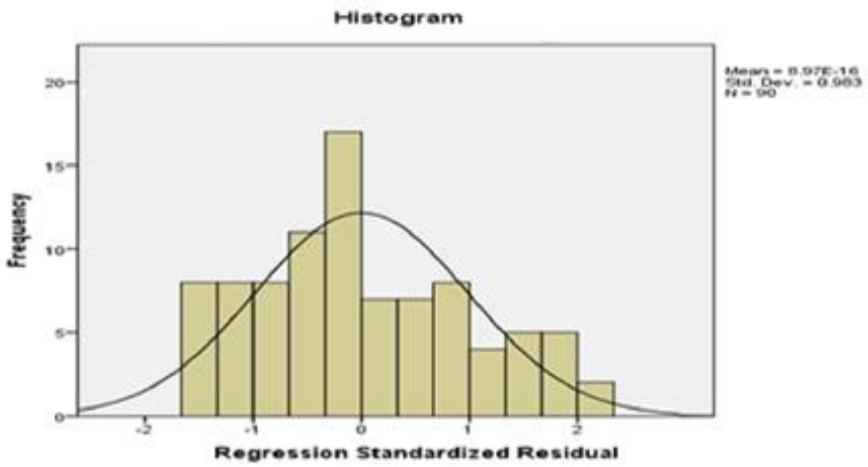

Table 4

One-Sample Kolmogorov-Smirnov Test

		STOCK_PRICE
N		90
Normal Parameters[a,b]	Mean	8.4613
	Std. Deviation	3.90715
Most Extreme Differences	Absolute	.129
	Positive	.129
	Negative	-.088
Kolmogorov-Smirnov Z		1.220
Asymp. Sig. (2-tailed)		**.102**

a. Test distribution is Normal; b. Calculated from data
Source: Authors' calculations

It can already be seen on the histogram that the residual is normally distributed. Table 4 also shows that the value obtained from

0.102 is greater than 0.05, which means that the residual now has a normal distribution. These transformed data can be used in the further research process.

- ***Multicollinearity test***

The next statistical test is the multicollinearity test. Table 5 shows the Variance Inflation Factor (VIF) values for the three independent variables (audit opinion, net profit, and company size) and all values are less than 10.

Table 5

Multicollinearity test

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	Collinearity Statistics	
		B	Std. Error	Beta	Tolerance	**VIF**
1	(Constant)	2.406	.635			
	AUD_OPINION	.137	.330	.049	.805	**1.242**
	SIZE	-1.301E-11	.000	-.445	.564	**1.773**
	PROFIT	.003	.002	.218	.487	**2.055**

a. Dependent Variable: STOCK_PRICE
Source: Authors' calculations

The result means that there is no multicollinearity between the three variables.

- ***Autocorrelation test***

To determine if there is a problem with autocorrelation in the research model, the Watson Durbin test (DW) was performed with the conditions listed above in the paper.

Table 6

Autocorrelation test

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.344[a]	.118	.084	.63977	**.630**

a. Predictors: (Constant), AUD_OPINION, SIZE, PROFIT; b. Dependent Variable: STOCK_PRICE
Source: Authors' calculations

Table 6 shows the result obtained for the value of DW, which is 0.630 which means that there is no autocorrelation.

- ***Heteroskedasticity test***

Spearman heteroskedasticity test was performed for heteroskedasticity and the results are presented in Table 7.

Table 7

Spearman heteroskedasticity test

Correlations

			PROFIT	AUD_OPINION	SIZE	STOCK_PRICE
Spearman's rho	PROFIT	Correlation Coefficient	1.000	.454**	.866**	.067
		Sig. (2-tailed)		.000	.000	**.549**
		N	82	82	82	82
	AUD_OPINION	Correlation Coefficient	.454**	1.000	.294**	-.012
		Sig. (2-tailed)	.000		.005	**.909**
		N	82	90	90	90
	SIZE	Correlation Coefficient	.866**	.294**	1.000	.171
		Sig. (2-tailed)	.000	.005		**.108**
		N	82	90	90	90
	STOCK_PRICE	Correlation Coefficient	.067	-.012	.171	1.000
		Sig. (2-tailed)	.549	.909	.108	
		N	82	90	90	90

***. Correlation is significant at the 0.01 level (2-tailed).*
Source: Authors' calculations

From Table 7, it can be concluded that the significance of the variables: audit opinion, company size, and net profit are 0.909, 0.108, and 0.549. The results indicate that there is no heteroskedasticity.

- ***Regression Tests***
  - ***Simultaneous Test (F test)***

To see if the independent variables simultaneously affect the dependent variable, the following hypotheses are set:

"H_0: Audit opinion, net profit, and company size do not have a simultaneous effect on the stock price."

"H_1: Audit opinion, net profit, and company size have a simultaneous effect on the stock price."

Table 8

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.287	3	1.429	3.492	**.020[b]**
	Residual	31.925	78	.409		
	Total	36.213	81			

a. Dependent Variable: STOCK_PRICE; b. Predictors: (Constant), SIZE, AUD_OPINION, PROFIT

The ANOVA table shows that the significance value is 0.020 and it is less than 0.05 which means that H_0 is rejected, i.e. that the audit opinion, net profit, and size of the company simultaneously affect the stock price. Thus, a regression can be continued by analysing the relationship between independent variables and the dependent variable.

- ***Multiple regression***

In Table 9 the results of the multiple regression are given. The effects of independent variables on the dependent variable will be elaborated separately.

- Audit Opinion

"H_0: The audit opinion does not affect the stock price."

"H_1: The audit opinion affects the stock price."

Table 9

Multiple regression (t test)

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.406	.635		3.790	.000
	AUD_OPINION	.137	.330	.049	.413	**.681**
	SIZE	-1.301E-11	.000	-.445	-3.144	**.002**
	PROFIT	.003	.002	.218	1.428	**.157**

From Table 9, it can be concluded that the value of the significance of the variable "audit opinion" is 0.681> 0.05. This means that H_0 is accepted and H_1 is rejected, ie that the audit opinion does not affect the share price. According to the results obtained, it can be concluded that the audit opinion is not an important part of the decisions made by investors, in fact investors make their decisions based on other factors, and most investors probably do not understand the audit and the significance of the audit report.

- Net Profit

"H_0: Net profit does not affect the stock price."

"H_1: Net profit affects the stock price."

Table 9 shows that the value of significance for the net profit is 0.157> 0.05. Also, in this case, it can be concluded that the net profit does not affect the stock prices on the stock exchange and that the net profit is also not taken into account in the decisions of investors.

- Company Size

"H_0: The company size does not affect the stock price."

"H_1: The company size affects the stock price."

And last but not least, the value of the size of the company is 0.002 <0.05 which means that H_0 is rejected and H_1 is accepted, i.e. the size of the company has an impact on the stock price. Given that the size of the company is measured by the size of the assets on the balance sheet, it is important to investors whether the company in which they invest is characterized as small or large, concerning the total assets owned by the company.

- ***Determination test (R Square)***

The purpose of this test is to determine how much the independent variables can explain the changes in the dependent variable.

Table 10

Determination test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.344[a]	**.118**	.084	.63977

a. Predictors: (Constant), SIZE, AUD_OPINION, PROFIT; b. Dependent Variable: STOCK_PRICE

The coefficient of determination (R square) is 0.118 which means that the audit opinion, net profit, and size of the company explain 11.8% of the share price. The remaining 88.2% are explained by other variables that are not covered by this research. The value of the coefficient of determination, R square, is considered large if it exceeds 50%, but even a small value of this coefficient is not a bad indicator. "The small value of R square indicates that the ability of the independent variables to explain the change in the dependent variable is very limited. If R square is close to 1 it means that the independent variables predict almost all the information needed to predict the changes in the dependent variable, which is very rare (Achmad & Witiastuti, 2018)".

5. Conclusion

From the literature, it can be stated that researchers in the past have come to inconsistent results when it comes to the impact of audit opinion on the stock price of companies. Although the main purpose of the audit report, especially the audit opinion is to assist in the decision-making process of investors, in the Republic of North Macedonia it has no impact on them, i.e., investors' decisions are based on some other factors. As added variables in the research are the net profit and the size of the companies. Although the audit opinion is not significant for the movement of the stock price, the results show that the size of the company still has a significant effect on the change in the stock price in the Republic of North Macedonia, i.e., potential investors take into account the size of the company before investing in it. The net profit of the companies as an absolute amount, on the other hand, has no significant effect on the share price.

As a limitation in the research can be mentioned the small sample that is included at random from the companies listed on the Macedonian Stock Exchange, as well as the lack of similar research in the Republic of North Macedonia to compare the results obtained.

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ANALYZING THE TECHNICAL EFFICIENCY USING DATA ENVELOPMENT ANALYSIS METHOD: THE CASE OF GULF COOPERATION COUNCIL COUNTRIES

Ala' BASHAYREH, PhD*

Samer A. ABDELHADI, PhD**

Mohammad W. ALOMARI, PhD***

Abstract

Given the importance of technical efficiency for production process, the current study is measuring the technical efficiency in the Gulf Cooperation Council countries over the period 2009-2016. For this purpose, the study will employ the nonparametric model uses the linear programming by Data Envelopment Analysis (DEA) to calculate technical efficiency. Results revealed that Kuwait is operating by optimal size production in both frontiers, constant returns to scale (CRS), and variable returns to scale (VRS) and so it is considered as the benchmark for the rest of the Gulf Cooperation Council countries. On the other hand, the results showed that Bahrain, UAE, Oman and KSA do not operate within optimal size, which restrain them to perform the overall technical efficiency and scale efficiency.

Keywords: scale efficiency, economic growth, Gulf Cooperation Council

JEL Classification: C33; G14; L16; O11

* *Assistant Professor, Faculty of Economics and Administrative Sciences, The Hashemite University, Zarqa, Jordan.*

** *Associate Professor, Chairman of the Department of Economics, Faculty of Economic and Administration Sciences, Hashemite University, Zarqa, Jordan.*

*** *Associate Professor, Faculty of Economics and Administrative Sciences, The Hashemite University, Zarqa, Jordan.*

1. Introduction

The world nowadays facing liberalization of foreign trade and economic openness within the concept of globalization, while the framework of economic competition was expanding in production between countries. Competition is no longer restricted to the local markets of a single country, but rather to the level of international markets among countries. Thus, the achievement of economic competition between countries requires an efficient management of resources with the ability to introduce a new product and achieving a larger volume of exports. This can be carried out through maximizing the benefit of available modern technology and reducing the cost of production, in addition to learn from international experiences in the field of production, especially in the industrial sector as an engine of economic growth that can create sufficient value added to productive units.

The concept of technical competence is one of the economic concepts that have received the attention of many economic sectors such as agriculture, industry, the banking system, transportation, and others. Measuring the technical efficiency of the economy is one of the indicators upon which it based to determine the methods of achieving economic growth.

A low level of technical efficiency for an individual country would imply that a higher level of economic development could achieved by efficiently producing more output with the same level of inputs. In contrast, a highly efficient country should lie more on technical progress and innovative activity in order to achieve higher economic growth. It seems, therefore, that identifying the sources of technical inefficiency is of particular importance to promote economic growth (Dimelis & Papaioannou, 2011).

Therefore, technical efficiency considered necessary condition for building a more sustainable modern economy. The purpose of this study is to explore and analyze the technical efficiency in the Gulf Cooperation Council (GCC) countries during the period (2009 - 2016).

2. Theoretical background and literature review

The concept of efficiency established in 1951 in the study of Koopmans (1951), which noted that "the product is technically efficient if the increase in production of a particular product requires a reduce production of another product at least or adding one more input at least.

The study of Farrell (1957) is the first attempt to measure economic efficiency. His study indicates that economic efficiency consists of two parts. **First:** *technical efficiency* (TE), means the ability to achieve the best level of production using the available inputs. It is the ratio of actual production to optimal production, or the ratio of actual inputs to the level of optimal inputs. If this ratio is less than one, this indicates a decrease in technical efficiency. **Second:** *allocative Efficiency*, means the ability to use the optimal mix "Optimal Combination" of production inputs to achieve production at the lowest cost.

Stigler (1960) defines technical efficiency as the relationship between inputs and outputs, measured as follows: actual outputs / maximum outputs from available resources. Optimal efficiency is achieved when this ratio is equal to one, and this is achieved when the marginal output of the factors of production is equal to the cost of each factor. According to Carlsson (1972), technical efficiency is defined as producing the maximum amount of output because of using a given amount of input or maximizing the production of available inputs.

The concept of efficiency has remained unchanged since its inception, and there has been no modification to this concept. In the study of Porcelli (2009), efficiency is defined as: **First**, *technical efficiency* measures the actual output ratio to the potential output by assuming a given input or measuring the proportion of inputs used in production to the optimum level to be used of those inputs, assuming a given output. **Second**, *allocative efficiency* refers to the ability to combine inputs and outputs using optimal ratios in the light of prevailing prices. For example, testing actual costs versus optimal production costs, or the optimum profit for an enterprise. In the definition of Amornkitvikai (2011), efficiency means the production of a given output with the lowest possible level of inputs, or the ability of an enterprise to use the optimal mix of inputs, considering production technology and input prices.

The importance of studying and improving efficiency has been highlighted in industrial countries in general and developing countries in particular in their close relationship to the exploitation of economic resources. Economic progress in any country depends on two main factors: First, technical efficiency in the employment of inputs. Second, capital investment efficiency represented in machinery, equipment and raw materials. The well-being of society is based on maximizing outputs with minimal inputs, where high productivity in the production of any commodity expresses the possibility of producing the same amount of the commodity using less resource, thereby diversifying production from other commodities (Coelli et al, 2005).

Alomari and Saqfalhait (2016) used panel data to study the impact of technical efficiency on the performance of listed Jordanian pharmaceutical companies for the period (2007-2012). They found that there is a positive relation between technical efficiency and profitability, while profit margins are low in low-efficiency companies.

Margono et al (2011) found that economic growth in Indonesia is low and not sustained due to low technical efficiency. Lau and Brada (1990) concluded that technical efficiency had positive effect on industrial performance and hence economic growth in China. Ali and Hamid (1996) found that technological progress and technical efficiency contribute significantly and positively to economic growth.

3. Methods of measuring technical efficiency

Technical efficiency can be measured using the two most common forms of applied economics*: parametric* and *nonparametric* model. The *parametric model* is used in the regression analysis of the production function in the traditional way. Greene (2002) points out that the "Frontier Production Function" is an extension of the regression model that best represents the production function, through which the production level is estimated using available inputs. One of the most important features of the parametric model is that it is used in the Returns to Scale test and helps to determine the impact of the change in efficiency at the production level (Sena, 2003). The disadvantages of this model are its inability to identify sources of low efficiency, and regression results give a general indicator of efficiency by comparing the actual output with potential output level (Ogundari, 2008).

The *nonparametric model* uses the linear programming by Data Envelopment Analysis (DEA). In practice, this analysis evaluates each decision-making unit (DMU) compared with the best DMUs or the so-called "Best Practice for each DMU. Where inefficient DMUs are evaluated against the efficient DMUs, and therefore efficient DMUs will enveloped the inefficient DMUs (Soares et. al, 2017). The objective of this model is to estimate the production frontier of DMUs that use the same inputs to achieve output, where production frontier estimated based on efficient DMUs - the comparison of each DMU with the benchmark in terms of production scale. The main advantages of this analysis are to determine the best performance among different DMUs;

to defining the worst performance among different DMUs; to assist in the process of redistributing inputs needed to raise efficiency levels; to assist in determining the degree of inefficiency in performance; and to determine the level of change in efficiency over time. Given the advantages of this method in the analysis, it will be used in this study to calculate technical efficiency.

The DEA method has been applied since 1978 (Charnes et al., 1978), which has its roots from Farrell (1957). The DEA concedes as the best method to determine benchmark, because it is distinguished by identifying the best counterpart units for inefficient units, based on multiple inputs and outputs. Efficiency measurement in this method does not require availability of inputs or output prices, nor does it require input and output from the same unit of measurement, as there are no restrictions on the use of a particular form of production function (Sena, 2003). This method of measurement can be used when the size of data is relatively small (Coelli et al., 2005).

The DEA method assuming that the production frontiers either constant returns to scale CRS, or variable returns to scale VRS. The CRS was formulated in the study of Charnes et al. (1978), it's known as CCR and called the *Overall Technical Efficiency*, where the production frontier can be determined based on this assumption. The VRS was formulated in a study of Banker et al. (1984), it's known as BCC and called *Pure Technical Efficiency*, indicating the ability of the DMU to achieve the best production using available inputs.

The CRS hypothesis is appropriate in the DEA only when all DMUs are operating by optimal scale (Coelli et al., 2005). However, in fact, there are many barriers that prevent some DMUs from achieving optimal scale such as imperfect competition (Pannu et al. (2011); Alemdar and Oren (2006)), because the operating size of the DMUs response to the input's productivity, which can be increasing, decreasing, or maximum. Using either CRS or VRS, technical efficiency scores can be calculated either in Input Oriented or Output Oriented. The results of the CRS and VRS models can be used to calculate the *relative technical efficiency* scores which known as the Scale efficiency (SE).

If the DMU is operating optimally (optimal size), the TE^{VRS} will be equal or close to the TE^{CRS}. Means, the TE scores can be determined by the CRS assumption. If the DMU is not operating optimally, the TE^{VRS} will exceeds the TE^{CRS}, and the DMU will be inefficient if TE^{VRS} equals (one). That's why the SE has been calculated, where the SE is defined as the capacity of the enterprise to produce within its size (Kao & Lu, 2011).

The relative technical efficiency (SE) is calculated by dividing the TE^{CRS} on TE^{VRS}. If the DMU operates by the optimal size (operating on the production frontier), the TE^{CRS} will be equal to TE^{VRS}, this also indicates that the degree of scale efficiency (SE) equals (one). If the DMU does not operate optimally, the TE^{VRS} will be greater than the TE^{CRS}, which makes the degree of (SE) less than one, and here are two possibilities: **First,** the DMU operates by increasing returns to scale (IRS). Therefore, the level of production must increase by increasing inputs and operate at a larger scale until technical efficiency is achieved. **Second,** the DMU operates by decreasing returns to scale (DRS) and therefore reduce the production level and operate in a smaller size and fewer inputs to achieve technical efficiency.

The inefficiency can be explained by the production elasticity, calculated by dividing Marginal Production (MP), on the average production (AP). If the AP at its maximum, the production elasticity will equal (one), so the DMU operates by CRS and achieves overall and relative technical efficiency. If the AP was increasing, the production elasticity will exceed one, and the MP in this case will exceed the AP, indicating that the DMU operates by increasing returns to scale (IRS). If the AP is decreasing, the production elasticity will be (smaller than one), and the MP in this case will be smaller than the AP, meaning that the DMU operates by decreasing returns to scale (DRS). (Erbetta & Rappuoli, 2003). In both cases (IRS and DRS), the DMU may be inefficient, where the degree of efficiency depends on the difference between TE^{CRS} and TE^{VRS}.

4. Methodology

4.1. Data

The study used a panel data for the six GCC countries over the period (2009-2016). The following inputs were included for the analysis: total number of labors in each country, dollar value of total capital in each country measured by 2010 prices, and total production of crude oil per year for each country as a natural resource. The output is real value of Gross Domestic Product GDP measured by 2010 prices. These data were obtained from the World Bank database.

4.2. Measuring the technical efficiency of the GCC countries using DEA analysis

After applying the DEA model, the results are shown in Table 1. The TE scores of using the output-oriented approach of each country in each year, applying the two models (CRS, VRS).

Table 1

Technical Efficiency Scores in GCC Countries Using Output Oriented Approach

CRS Model

Year	*Bahrain*	*Kuwait*	*Oman*	*Qatar*	*KSA*	*UAE*
2009	0.734	1.000	0.657	0.980	0.614	0.730
2010	0.736	1.000	0.657	0.990	0.612	0.729
2011	0.735	1.000	0.654	1.000	0.629	0.728
2012	0.740	1.000	0.657	0.999	0.618	0.729
2013	0.737	1.000	0.657	0.998	0.608	0.729
2014	0.737	1.000	0.658	0.998	0.606	0.730
2015	0.738	1.000	0.659	1.000	0.604	0.729
2016	0.739	1.000	0.659	1.000	0.600	0.729
Average	***0.737***	***1.000***	***0.657***	***0.996***	***0.611***	***0.729***
Max.	***0.740***	***1.000***	***0.659***	***1.000***	***0.629***	***0.730***
Min.	***0.734***	***1.000***	***0.654***	***0.980***	***0.600***	***0.728***
St.d	***0.001***	***0.000***	***0.001***	***0.006***	***0.009***	***0.001***

VRS Model

Year	*Bahrain*	*RTS*	*Kuwait*	*RTS*	*Oman*	*RTS*	*Qatar*	*RTS*	*KSA*	*RTS*	*UAE*	*RTS*
2009	1.000	IR	1.000	CR	0.701	IR	1.000	IR	0.969	DR	0.947	DR
2010	0.993	IR	1.000	IR	0.691	IR	0.999	IR	0.973	DR	0.950	DR
2011	0.975	IR	1.000	DR	0.689	IR	1.000	CR	1.000	DR	0.962	DR
2012	1.000	IR	1.000	DR	0.684	IR	0.999	CR	1.000	DR	0.972	DR
2013	0.949	IR	1.000	DR	0.681	IR	0.999	CR	0.994	DR	0.982	DR
2014	0.931	IR	1.000	DR	0.680	IR	0.999	CR	1.000	DR	1.000	DR
2015	0.934	IR	1.000	DR	0.677	IR	1.000	IR	1.000	DR	0.995	DR
2016	0.927	IR	1.000	DR	0.676	IR	1.000	CR	1.000	DR	1.000	DR
Average	***0.964***		***1.000***		***0.685***		***0.999***		***0.992***		***0.976***	
Max.	***1.000***		***1.000***		***0.701***		***1.000***		***1.000***		***1.000***	
Min.	***0.927***		***1.000***		***0.676***		***0.999***		***0.969***		***0.947***	
St.d	***0.031***		***0.000***		***0.008***		***0.001***		***0.013***		***0.021***	

Scale Efficiency (SE)

Year	*Bahrain*	*Kuwait*	*Oman*	*Qatar*	*KSA*	*UAE*
2009	0.734	1.000	0.938	0.980	0.633	0.771
2010	0.741	1.000	0.951	0.991	0.629	0.768
2011	0.754	1.000	0.950	1.000	0.629	0.757
2012	0.740	1.000	0.960	1.000	0.618	0.750
2013	0.776	1.000	0.965	0.999	0.612	0.742
2014	0.791	1.000	0.967	0.999	0.606	0.730
2015	0.791	1.000	0.973	1.000	0.604	0.733
2016	0.797	1.000	0.976	1.000	0.600	0.729
Average	***0.765***	***1.000***	***0.960***	***0.996***	***0.616***	***0.747***
Max.	***0.797***	***1.000***	***0.976***	***1.000***	***0.633***	***0.771***
Min.	***0.734***	***1.000***	***0.938***	***0.980***	***0.600***	***0.729***
St.d	***0.026***	***0.000***	***0.012***	***0.007***	***0.012***	***0.016***

Note: RTS denotes to Returns to scale; IR is increasing returns to scale, CR is constant returns to scale and DR is decreasing returns to scale. KSA denotes for Saudi Arabia and UAE is United Arab Emirates.

Source: World Bank Database

Based on Table 1, the scores of TE in the two models CRS and VRS show that Kuwait is operating by optimal size, because the scores of TECRS equals TEVRS. Thus, Kuwait achieves the Overall TE and Pure TE within the CRS and VRS assumptions, and it is considered as the benchmark for the rest of the GCC countries.

The rest of the GCC countries distributed according to its allocation from Kuwait, it can be ranking according to the average technical efficiency as shown in Table 2.

Table 2

Ranking of GCC countries by average technical efficiency

Country	Pure Technical Efficiency (TE^{VRS})	Order	Relative Technical Efficiency (SE)	Order
Bahrain	0.964	Fifth	0.765	Fourth
Kuwait	1	First	1	First
Oman	0.685	Sixth	0.960	Third
Qatar	0.999	Second	0.996	Second
KSA	0.992	Third	0.616	Sixth
UAE	0.976	Fourth	0.747	Fifth

Source: World Bank Database

Qatar is the nearest country for Kuwait in the two models CRS and VRS, meaning that Qatar approximately achieves the Overall TE and Pure TE. Thus, it operates by optimal size since there are no significant differences in technical efficiency between the two models (CRS, VRS).

KSA, UAE and Bahrain are the third, fourth and fifth respectively, according to its pure TE, but they do not operate by optimal size. Therefore, the SE of KSA falls to 62%, and it was the last country in GCC ranking. SE of UAE falls to 75% as the fifth country, and SE of Bahrain falls to 76.5% having the fourth order. By looking to returns to scale for those three countries (KSA, UAE and Bahrain), it show that KSA and UAE have DRS, meaning these two countries are using inputs more than the desired level, and they should reduce their inputs (L,K and Crude Oil) by a given output (GDP), or increasing the output level by a given inputs, that may increasing the SE. Bahrain has IRS, meaning that its inefficiency results from using input slower than the desirable level, or producing output (GDP) lower than the desired level by a given inputs. Therefore, Bahrain should increase its inputs and output to achieve SE.

The results displayed in Table 1 also indicate that Oman operates by acceptable size since there are a slightly significant differences in technical efficiency between the two models (CRS, VRS). It was the sixth country in pure TE, but it has the third order between the GCC countries according to SE. Moreover, Oman operates by IRS, meaning that its inefficiency results from using input slower than the desirable level, or producing output (GDP) lower than the desired level by a given input. Therefore, Oman should increase its inputs and output to achieve SE.

One of the advantages of DEA analysis calculates the slack or projection of inputs and output that can help us to make recommendations for the DMUs to achieve Overall TE (Size Efficiency). After analysing the TE scores for the GCC countries, the projections of output were as Table 3 shows.

Table 3

The required changes of GDP for GCC countries to achieve SE

Year	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
2009	36%	0	52%	2%	62%	37%
2010	35%	0	52%	1%	63%	37%
2011	36%	0	52%	0	59%	37%
2012	35%	0	52%	0.14%	62%	37%
2013	35%	0	52%	0.19%	64%	37%
2014	35%	0	52%	0.20%	65%	37%
2015	35%	0	51%	0.01%	65%	37%
2016	35%	0	51%	0	67%	37%

Source: DEA analysis

The results of table (3) indicate that most of GCC countries like Bahrain, UAE, Oman and KSA, do not operating within optimal size. That prevent them to achieve Overall TE and SE, but instead they may be achieving Pure TE because their scores of TEVRS exceeds TECRS. That means those countries can be technically efficient independently within their current size.

5. Conclusion

The basics of economic efficiency are based on the fact that resources are scarce. Therefore, the importance of studying and improving efficiency has been highlighted in industrial countries in general and developing countries in particular in their close relationship to the exploitation of economic resources. Such efficiency became more necessary in the production process to maximize the total factor productivity.

In order to minimize inputs, maximize production and economic profitability, this study aims to measure the technical efficiency in the GCC countries over the period (2009-2016). For this purpose, the study employs the nonparametric model (the DEA) to calculate technical efficiency. The DEA method assuming that the production frontiers either constant returns to scale CRS, or variable returns to scale VRS.

Results reveal that Kuwait is operating by optimal size production in both frontiers CRS, VRS and so it is considered as the benchmark for the rest of the GCC countries. On the other hand, the results show that Bahrain, UAE, Oman and KSA do not operate within optimal size which restrain them to perform the overall technical efficiency and scale efficiency. Instead, they may perform pure technical efficiency which means that those countries can be technically efficient independently within their current size.

The study recommends investigating the technical efficiency in other sectors and other countries.

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COMPARING CONNECTION BETWEEN STOCK PRICE & DIVIDEND POLICY IN PUBLIC AND PRIVATE SECTOR: PAKISTAN EVIDENCE

Muhammad AMIN[*]

Jahanzaib ALVI, PhD Scholar [**]

Muhammad REHAN, PhD Scholar [***]

Abstract

The paper establishes if dividend policy is a trustworthy indicator for the investors to predict a company's future growth in value to maximize their returns on their portfolios. The analysis technique used is cross-sectional regression analysis since the research focuses on various companies with numerous variables under a period of ten years. The study was conducted several times, with all companies together. Private companies and then public companies, individually, to see if the dividend policy has the same impact on the stock prices for both types of corporations. The results show that although Dividend Pay-out Ratio itself doesn't have a relationship with the stock price, the Dividend Yield of the company has a significant relationship with Share Price. Mixed results have been witnessed in result of data analysis from control variables. Although Leverage showed a significant relationship with the dependent variable when all companies were assessed altogether, it did not show any significance individually when the connections were analysed separately within public and private companies. On the other hand, Growth did not establish a significant relationship with share price volatility in the complete result; it had a significant one in the private companies' works. The study supports the fact that dividend policy does not necessarily have significance in

[*] *MBA, Shaheed Zulfikar Ali Bhutto Institute of Science and Technology, Karachi, Pakistan.*

[**] *IQRA University, Karachi, Pakistan.*

[***] *Department of Business Administration, Institute of Social Sciences, Gaziosmanpasa University Tokat, Turkey.*

determining share price changes for a sample of firms listed on the Pakistan Stock Exchange.

Keywords: share price volatility; debt-to-equity; pay-out-ratio; public company; private company

JEL Classification: G30; G38; G39; O16

1. Introduction

Dividend policy is one of the critical components for investors looking to invest in a corporation. It is a significant aspect of their investment strategy, especially if they are long-term investors. They would be especially attracted to a firm with a healthy dividend yield (DY) and dividend pay-out (DPR). This paper aims to confirm the link between stock price and dividend policy and establish if it is universal amongst the privately-owned corporations and government entities listed on the Pakistan Stock Exchange. Factors that incorporate dividend policy, DY, and DPR will be used to assess the connection amid the subject variables. Simultaneously, factors known to influence dividend policy itself will be used as control variables to obtain as accurate a result as possible. The sample of the companies would be across all industries, without discrimination on the PSX-100 Index. An equal number of companies would be selected for both private and public entities. The data covers a span of ten years (2009-2019) for the study from the selected companies.

This study will focus on determining if there is a relationship between stock price instability and dividend yield and if that link is common between privately-owned entities and government entities. While sufficient research has been done on the stock price fluctuations and dividend policy across the globe, this topic has yet to be thoroughly examined in Pakistan and on the ever-expanding PSX-100 index. At the same time, the second part of the problem hasn't been researched upon at all. During the background analysis of this topic, no research was available online that examined private companies and public companies independently; thus, a niche was known to be studied upon in this topic.

2. Description of the problem

Dividends are an essential means for investors to gain from their investment in a firm. In addition to dividends, the only way investors earn returns refers to changes in share prices. The dividend policy has significant positive effect on stock prices, and firms make several considerations while developing a dividend policy (Masum, 2014). Historic dividend data, stability in earnings, forecasts of future and current returns and cash flows are the important factors in developing a firms' dividend policy (Ouma, 2012).

While testing the relationship between leverage and dividend in Indonesia, Erkaningrum (2013) found a negative relationship between dividend and debt. This was also tested in Bangladesh by Rashid and Rahman (2008), and they had the same conclusion.

El-Sady et al. (2012) underline that both the management perception of the level of the current and future earnings, and the liquidity constraints are the main factors that influence the dividend policy of listed companies in Kuwait. Other factors also play an essential role in the development of dividend policy, such as firm growth and government policy (Hooi, Albaity, and Ibrahimy, 2015).

In the early 1960s, Miller and Modigliani generated the theory according to which they suggested that the wealth of the investors is not affected by the dividend policy (Miller and Modigliani, 1961). Authors considered that the value of a company lies in its earnings, which has its foundations set up on the organization's investment policy. They pointed out that there are two avenues through which investors yield results for their investment and risks: dividend yield and capital gains yield. They also believed that the decision of a company to pay off the dividends will automatically reduce the price to the amount of dividend per share on the ex-dividend date. However, this situation is valid only in a perfect market (Ojeme, Mamidu and Ojo, 2015).

Various research studies have been done on this matter. Some have borne positive results in confirming the relationship, while others have been negative or indecisive on the subject (Profillet, 2013). Researching the connection between share price and dividend policy registered on FTSE 100, they conducted multiple regression analysis to ascertain the relationship between share price and both dividend pay-out ratio and yields. They discovered a positive relationship between dividend yield and stock price, and a contrary relationship between share price and dividend pay-out ratio.

The study of Ilaboya and Aggreh (2013) found that in their sample of 26 firms in Nigeria, dividend yield had a positive while pay-out had a negative connection with the share price. Hooi, Albaity and

Ibrahimy (2015) reported that the market dividend yield and dividend pay-out have a negative relationship with share price volatility with statistical significance, while earning volatility and long-term debt have a positive relationship statistically to share price volatility.

The share price volatility is defined as the fluctuation in prices of the firms, as the dependent variable in the regression model of this study. By adjusting the returns by the average returns on an annual basis, they would be squared. Then, this would be averaged by the number of given years, and finally, the equation is squarely rooted.

$$The\ volatility\ of\ share\ price = \sqrt{\sum_{i=1}^{n}[(P_i - P_{AVG})^2]/n} \quad (1)$$

Where: P_i = the price for year i; P_{AVG} = the average price of the whole period; n = number of years.

One of the two most significant explanatory variables highlights precisely how much the firm dividend weighs compared to its share price. It is the value of dividend per share divided by price per share.

$$DY = Di/Pi \quad (2)$$

Where: DY= Dividend Yield; Di = Dividend per share; Pi = Price of share.

DPR defines the percentage of net income that the company decides to use to pay off its investors in the form of dividends. The total compensation of a given year (i) is divided by the same year's net income to determine how much the company has allocated towards dividends and how much it has kept as retained earnings.

$$DPR = Di/Ni \quad (3)$$

Where: DPR = Dividend Payout Ratio; Di = Cash Dividend; Ni = Net income.

Growth is calculated by determining the change in earnings between the current and the previous year.

$$G = \Delta E/E_{i-1} \quad (4)$$

Where: G = growth in earnings; ΔE = change in earnings ($E_i - E_{i-1}$); E_i = current earnings (for year i); E_{i-1} = previous earnings (for year $i-1$).

This ratio compares the company's long-term debt to its total equity.

$$Lev = LTD/TE \tag{5}$$

Where: Lev = Leverage; LTD = Long term debt; TE = Total Equity.

The primary model of the research is illustrated below.

$$PV = \beta_1 + \beta_2 DY + \beta_3 DPR + \beta_4 G + \beta_5 Lev + \mu \tag{6}$$

PV is the price volatility, and it is the dependent variable. At the same time, DY and DPR are dividends. Dividend pay-out ratio, which is the primary independent variable while G (Growth) and Lev (Leverage), will be used as a control variable because they are one of the few significant determinants of dividend policy hence can be used to make the function more stable and accurate. With this regression function, we will prove that a connection exists between share price volatility and dividend policy.

3. Method and findings

As per Pakistan Stock Exchange's data portal (dps.psx.com.pk) there are about five-hundred and forty-five companies on the Pakistan Stock Exchange as of December 31, 2020, with a total market with a market capitalization of Rs.8.04 billion as of December 31, 2020, this research will focus on the PSX-100 index. PSX-100 index is a benchmark created by determining the companies with the best market capitalization from each industry, 100 companies on the index.

The attention will not be on a specific industry in the market. Instead, the sample will be divided into two clusters of five companies, each determined whether they are government-owned or private companies. A total of ten companies are going to be chosen from hundred companies on the PSX-100 as a sample. At the same time, the period is going to be from 2009-2019.

A sample size of 10 companies was chosen since very few government entities were listed on the Pakistan Stock Exchange with sufficient data and research purposes. Both the sample pools of public and private companies needed to be the same. So, the sample size was finalized with five companies for each cluster.

Accordingly, the sampling technique that is going to be used in this research is cluster sampling is going to be used for this paper. At the same time, sub-sampling is going to be done based on simple random. Meaning that the companies are going to be grouped based on the cluster sampling technique while the companies that are going to be chosen for the cluster is going to be done through a simple random sampling technique, as in the companies selected for each group are going to be done as if their names are pulled out of a hat.

The instruments used for the data collections were legitimate online sources (scstrade.com) and financial reports of the subject companies from the fiscal year 2009 to the fiscal year 2019. So, the data was collected through secondary sources. SECP regulated the sources, hence the data was reliable and valid for the research.

The analysis technique used is cross-sectional regression analysis since the research focuses on various companies with numerous variables under ten years. The study will be conducted several times, with all companies together. Private companies and then public companies individually see if the dividend policy has the same impact on the stock prices for both types of corporations.

3.1. Pilot test

The pilot test was conducted after data mining and collection on E-Views. The technique used was cross-sectional regression. This was done on three organizations: two private companies, while the other, a public company. Price volatility calculations were done by extracting daily prices from online sources and calculating their standard deviation on excel, while the other variables were collected from financial reports.

3.1.1 Comprehensive result (pilot test)

This analysis conducted by using all the variables together and all the companies together, has led to the results presented in Table 1. The predictor explained 21.9% of the variance (Adjusted R2 =.219, F= 2.40<3.5, p>0.05). It was found that only leverage significantly predicted price volatility (β = 15.28, T= 2.54>2, p<0.05), while growth (β= 0.803, T = 0.2831<2, p>0.05), Dividend pay-out ratio (β= 13.06, T = 1.1369<2, p>0.05) and Dividend yield (β= -59.54, T = -0.63<2, p>0.05) did not significantly impact price volatility.

Table 1

Cumulative Regression Results (public & private)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.33195	10.42098	0.223775	0.8258
DY	-59.54845	94.52005	-0.630009	0.5376
DPR	13.06975	11.49578	1.136918	0.2723
G	0.803198	2.836837	0.283131	0.7807
LEV	15.28668	5.998034	2.548616	0.0215
R-squared	0.375223	Mean dependent var		17.59812
Adjusted R-squared	0.219029	S.D. dependent var		13.5779
S.E. of regression	11.99914	Akaike info criterion		8.011804
Sum squared resid	2303.67	Schwarz criterion		8.2605
Log likelihood	-79.12394	Hannan-Quinn crit.		8.065777
F-statistic	2.402283	Durbin-Watson stat		1.905991

Source: Data extracted from company financials between 2009 and 2019.

- **Comprehensive result excluding dividend pay-out ratio (pilot test)**

Due to a high correlation between dividend yield and pay-out ratio, we excluded the dividend pay-out ratio and reran the analysis, making the model:

$$PV = \beta_1 + \beta_2 DY + \beta_4 G + \beta_5 Lev + \mu \quad (7)$$

The analysis conducted by using all the variables except the dividend pay-out ratio and all the companies together has led to the results presented in Table 2. According to these data, the predictor explained 20.55% of the variance (Adjusted R2 =.205, F= 2.72<3.5, p>0.05); it was found that only leverage significantly predicted price volatility (β = 15.89, T= 2.63>2, p<0.05), while growth (β= 1.09, T = 0.3831<2, p>0.05). Dividend yield (β= 4.72, T = 0.061<2, p>0.05) did not significantly impact price volatility.

Table 2

Cumulative regression results excluding dividend pay-out ratio (pilot test)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.632174	10.31029	0.449277	0.6589
DY	4.723318	76.4001	0.061823	0.9514
G	1.091665	2.849678	0.383084	0.7064
LEV	15.89237	6.02552	2.63751	0.0173
R-squared	0.324749	Mean dependent var		17.59812

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Adjusted R-squared	0.205588	S.D. dependent var		13.5779
S.E. of regression	12.10196	Akaike info criterion		7.994255
Sum squared resid	2489.776	Schwarz criterion		8.193212
Log likelihood	-79.93968	Hannan-Quinn crit.		8.037434
F-statistic	2.72528	Durbin-Watson stat		1.795686
Prob(F-statistic)	0.076473			

Source: Data extracted from company financials between 2009 and 2019.

- **Comprehensive result excluding dividend yield (pilot test)**

Due to a high correlation between dividend yield and payout ratio, we excluded the dividend yield and reran the analysis, making the model:

$$PV = \beta_1 + \beta_3 DPR + \beta_4 G + \beta_5 Lev + \mu \qquad (8)$$

Table 3

Cumulative regression results excluding dividend yield (pilot test)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.256263	8.570666	-0.146577	0.8852
DPR	8.738114	9.048145	0.965735	0.3477
G	0.10541	2.564942	0.041097	0.9677
LEV	16.05811	5.766628	2.784662	0.0127
R-squared	0.359724	Mean dependent var		17.59812
Adjusted R-squared	0.246734	S.D. dependent var		13.5779
S.E. of regression	11.78438	Akaike info criterion		7.94107
Sum squared resid	2360.817	Schwarz criterion		8.140027
Log likelihood	-79.38124	Hannan-Quinn crit.		7.984249
F-statistic	3.183685	Durbin-Watson stat		1.792733
Prob(F-statistic)	0.050581			

Source: Data extracted from company financials between 2009 and 2019.

In contrast, growth (β= 0.105, T = 0.014<2, p>0.05) and Dividend pay-out ratio (β= 8.73, T = 0.965<2, p>0.05 did not significantly impact price volatility.

Since this research aims to see if the relationships are similar in private and public companies, we will run the above analysis on private and public companies individually. The following results represent the characteristics of private companies separately, using the altered equations as above (first using DY and then exchanging it with DPR – equations 7 and 8).

3.1.2 Private companies result

This analysis was performed only for private companies by using all the variables except dividend pay-out ratio. The result described in Table 4 shows that the predictor explained -27.40% of the variance (Adjusted R2 = -0.274, F= 0.0679<3.5, p>0.05), It was found that leverage (β = -0.27, T= -0.022<2, p>0.05), growth (β= 0.455, T = 0.277<2, p>0.05) and Dividend yield (β= 6.12, T = 0.133<2, p>0.05) did not significantly impact price volatility.

Table 4

Private companies result excluding dividend pay-out ratio (pilot test)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.859958	6.24714	1.578316	0.1456
DY	6.12949	45.81235	0.133796	0.8962
G	0.455875	1.644231	0.277257	0.7872
LEV	-0.110649	4.840949	-0.022857	0.9822
R-squared	0.019981	Mean dependent var		10.22823
Adjusted R-squared	-0.274025	S.D. dependent var		6.074708
S.E. of regression	6.856688	Akaike info criterion		6.923283
Sum squared resid	470.1418	Schwarz criterion		7.10587
Log likelihood	-44.46298	Hannan-Quinn crit.		6.906381
F-statistic	0.06796	Durbin-Watson stat		2.141746
Prob(F-statistic)	0.975711			

Source: Data extracted from company financials between 2009 and 2019.

The analysis performed only for private companies and conducted by using all the variables except dividend yield has led to the results presented in Table 5. It shows that the predictor explained -23% of the variance (Adjusted R2 =-0.23, F= 0.189<3.5, p>0.05), It was found that leverage (β = 0.429, T= 0.089<2, p>0.05), growth (β= 0.114, T = 0.074<2, p>0.05) and Dividend pay-out ratio (β= 3.650, T = 0.089<2, p>0.05 did not significantly impact price volatility.

Table 5

Private companies result excluding dividend yield (pilot test)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.649963	5.809214	1.316867	0.2173
DPR	3.651698	5.961588	0.612538	0.5539
G	0.114135	1.529476	0.074624	0.942
LEV	0.42974	4.816825	0.089216	0.9307

Variable	Coefficient	Std. Error	t-Statistic	Prob.
R-squared	0.053731	Mean dependent var		10.22823
Adjusted R-squared	-0.23015	S.D. dependent var		6.074708
S.E. of regression	6.737589	Akaike info criterion		6.888238
Sum squared resid	453.951	Schwarz criterion		7.070825
Log likelihood	-44.21766	Hannan-Quinn crit.		6.871336
F-statistic	0.189272	Durbin-Watson stat		2.153544
Prob(F-statistic)	0.901297			

Source: Data extracted from company financials between 2009 and 2019.

3.1.3 Public companies result

This analysis was conducted only for public companies, and by using all the variables except dividend pay-out ratio. The result in Table 6 shows that the predictor explained -19.26% of the variance (Adjusted R2 = -0.1926, F= 0.0676<3.5, p>0.05), It was found that leverage (β = 18.28, T= 0.526<2, p>0.05), growth (β= 57.30, T = 1.377<2, p>0.05) and Dividend yield (β= -164.32, T = - 0.562<2, p>0.05) did not significantly impact price volatility.

Table 6

Public companies result excluding dividend pay-out ratio (pilot test)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.75185	48.36339	0.470435	0.6701
DY	-164.3223	292.2369	-0.562292	0.6132
G	57.30998	41.59331	1.377865	0.262
LEV	18.28184	34.74722	0.526138	0.6352
R-squared	0.403665	Mean dependent var		32.33789
Adjusted R-squared	-0.192671	S.D. dependent var		12.42457
S.E. of regression	13.56881	Akaike info criterion		8.348984
Sum squared resid	552.3377	Schwarz criterion		8.318075
Log likelihood	-25.22144	Hannan-Quinn crit.		7.966961
F-statistic	0.676909	Durbin-Watson stat		1.312341
Prob(F-statistic)	0.621895			

Source: Data extracted from company financials between 2009 and 2019.

The analysis performed only for public companies and conducted by using all the variables except dividend yield has led to the results presented in Table 7. It shows that the predictor explained 29.3% of the variance (Adjusted R2 =29.3, F= 1.83<3.5, p>0.05), It was found that leverage (β = 4.23, T= 0.154<2, p>0.05), growth (β= 73.9, T

= 2.26>2, p>0.05) and" Dividend pay-out ratio (β= 37.53, T = 1.611<2, p>0.05) did not significantly impact price volatility.

Table 7

Public companies result excluding dividend yield (pilot test)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.516347	34.84147	-0.129626	0.9051
DPR	37.53395	23.28688	1.611807	0.2054
G	73.92446	32.60714	2.267125	0.1082
LEV	4.234918	27.41887	0.154453	0.8871
R-squared	0.646735	Mean dependent var		32.33789
Adjusted R-squared	0.29347	S.D. dependent var		12.42457
S.E. of regression	10.44352	Akaike info criterion		7.825399
Sum squared resid	327.2012	Schwarz criterion		7.794491
Log likelihood	-23.3889	Hannan-Quinn criter.		7.443376
F-statistic	1.830735	Durbin-Watson stat		1.564105
Prob(F-statistic)	0.315889			

Source: Data extracted from company financials between 2009 and 2019.

The correlation matrix analysis reveals that the price variation is directly correlated with dividend pay-out ratio, dividend yield, and growth. At the same time, there is a negative relation between the company's leverage and share price on the stock exchange (Table 8).

Table 8

Correlation between variables

Variables	PV	DPR	DY	G	LEV
PV	1				
DPR	0.031	1			
DY	0.013	0.768	1		
G	0.219	-0.443	0.390	1	
LEV	-0.318	-0.712	0.759	0.311	1

Source: Data extracted from company financials between 2009 and 2019.

3.2. Final results

3.2.1 Final comprehensive results

This analysis was conducted by using all the variables together and all the companies together. The results described in Table 9 shows that the predictor explained 68.69% of the variance (Adjusted R2 =.6869, F= 6.40>3.5, p<0.05), It was found that dividend yield (β = 5.329, T= 2.74>2, p"<0.05) and leverage (β = -5.32, T= 2.97>2, p<0.05) significantly predicted price volatility, while growth (β= -1.50, T = 0.869<2, p>0.05) and Dividend pay-out ratio (β= -5.35, T = 1.24<2, p>0.05), did not significantly impact price volatility.

Table 9

Actual cumulative regression results (public & private)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.66352	6.865505	1.99017	0.0564
DPR	-5.351705	4.303043	-1.243702	0.2239
DY	5.32997	1.942861	2.743361	0.0105
G	-1.502545	1.727767	-0.869646	0.3919
LEV	-5.320341	1.789891	-2.972439	0.006
R-squared	0.81415	Mean dependent var		16.65229
Adjusted R-squared	0.686989	S.D. dependent var		13.2363
S.E. of regression	7.405367			
Sum squared resid	1041.95			
Log likelihood	-103.7886			
F-statistic	6.40252			
Prob(F-statistic)	0.000167			

Source: Data extracted from company financials between 2009 and 2019.

3.2.2 Private companies results

This analysis was conducted by using all the variables together for all the private companies together. The result (see Table 10) shows that the predictor explained 64.34% of the variance (Adjusted R2 =.6434, F= 4.15>3.5, p<0.05). It was found that dividend yield (β = -11.32, T= 3.63>2, p<0.05) and growth (β = 2.70, T= 2.65>2, p<0.05) significantly predicted price volatility, while leverage (β= -1.48, T = 0.70<2, p>0.05) and Dividend pay-out ratio (β= 0.001022, T = 0.00310<2, p>0.05”), did not significantly impact price volatility.

Table 10

Actual private company regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-21.65648	8.466656	-2.557856	0.043
DPR	0.001022	3.294207	0.00031	0.9998
DY	-11.32865	3.114361	-3.637552	0.0109
G	2.700806	1.017992	2.653071	0.0379
LEV	-1.488887	2.109836	-0.705688	0.5068
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.847213	Mean dependent var		7.891181
Adjusted R-squared	0.643497	S.D. dependent var		4.88722
S.E. of regression	2.918054			
Sum squared resid	51.09024			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Log likelihood	-30.47565			
F-statistic	4.158798			
Prob(F-statistic)	0.049681			

Source: Data extracted from company financials between 2009 and 2019.

3.2.3 Public companies results

This analysis was conducted by using all the variables together and all the public companies together. According to data presented in Table 11, the predictor explained 68.55% of the variance (Adjusted R2 =.685, $F= 5.63>3.5$, $p<0.05$), It was found that only Dividend Yield significantly predicted price volatility ($\beta = -39.82$, $T= 3.19>2$, $p<0.05$), while Growth ($\beta=1.32$, $T = 0.5636<2$, $p>0.05$), Dividend pay-out ratio ($\beta= 11.04$, $T = 1.76<2$, $p>0.05$) and Leverage ($\beta= -19.22$, T" = 1.58<2, $p>0.05$) did not significantly impact price volatility.

Table 11

Actual public company regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-51.17739	22.71846	-2.252678	0.0508
DPR	11.04382	6.255401	1.765486	0.1113
DY	-39.82654	12.44965	-3.199008	0.0108
G	1.324186	2.349192	0.563677	0.5867
LEV	-19.22524	12.15135	-1.582149	0.1481
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.833527	Mean dependent var		23.95321
Adjusted R-squared	0.685552	S.D. dependent var		13.63642
S.E. of regression	7.646717			
Sum squared resid	526.2505			
Log likelihood	-55.91954			
F-statistic	5.632865			
Prob(F-statistic)	0.009049			

Source: Data extracted from company financials between 2009 and 2019.

4. Conclusion

The purpose of this research was to ascertain the connection between dividend policy and stock price stability and whether that connection is universal in public and private enterprises individually. With about five hundred and fifty-eight companies on the Pakistan Stock Exchange, ten companies were chosen as a sample with a period of ten years from 2009 to 2019 used for the analysis. The three analyses above show that although DPR itself doesn't have a relationship with the stock price, the DY of the company has a significant relationship with the stock price. Mixed results have been witnessed in result of data analysis from control variables. While Leverage showed a significant relationship with the dependent variable when all companies were assessed altogether, it did not show any significance individually when the relationships were analysed separately within public and private companies. On the other hand, Growth did not show a significant relationship with share price volatility in the complete result; it significantly affected the private companies' results. Although the F-statistics in all three results have been greater than 3.5, which means that even though these variables do not have any relationship with share price volatility individually (except for dividend yield), together, these variables have a significant relationship; with share price volatility.

This shows that the pay-out ratio itself is not a valid predictor to predict the price volatility of a company; even though dividend yield can be used for this matter, dividend policy does not prove to be an accurate model as the predictions are at most only 68.69% accurate, according to the adjusted R-squared, in the above tables.

So, to sum up the findings, there is minimal predictive relationship between dividend policy and share price volatility. However, it is necessary to note that the data used was unable to develop a reliable relationship model as the highest adjusted R-squared observed in the several variations of the equation was only 0.6869. Which means that the model was only able to predict the correct result 68.69% of the time. Moreover, dividend yield ultimately has a stronger relationship with share prices as the dividend yields is more alluring to investors than the general pay-out ratio of the firm. In the end it does not matter how much money a company distributes in Rupee-term to the investors, but the percentage they earned on their initial investment is of more concern to them. Therefore, dividend pay-out ratio does not have a substantial impact on share prices, given that the pay-out ratio is associated with the management discretion.

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"Victor Slăvescu" Centre for Financial and Monetary Research
Casa Academiei 13, Calea 13 Septembrie, Building B, 5th floor
Bucharest, 050711, Romania
Phone: +40 21.318.24.19
Fax: +40 21.318.24.19
E-mail: s.vraciu@icfm.ro