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SYSTEMIC RISK IN VIETNAM STOCK MARKET

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ABSTRACT

Systemic risk is one of the issues currently being paid attention to in ensuring the stability and sustainability of the global financial system in general and the securities market of countries in particular. The paper studied the systemic risk of enterprises listed on Ho Chi Minh City Stock Exchange in the period from the first quarter of 2010 to the second quarter of 2017. The authors have applied the VaR and ΔCoVaR method to compare the loss level of businesses to the systemic risk of the whole market upon an unstable event. The study also found a disadvantage of using VaR in measuring systemic risk in that it was still "individual" and "single" and didn't consider the spread among various entities in the market. In addition, the sensitivity of listed companies varied under normal and volatile conditions. The results showed that ΔCoVaR is a more suitable measure in considering the contribution level of companies to the systemic risk of the whole market. Calculated results were proposed as an indicator for investors and market managers in order to limit systemic risks in the future.

Contribution/ Originality: This study is one of very few studies which have applied VaR and ΔCoVaR methods to measure and rank system risks of listed companies in Vietnam. Based on the quantile regression, the study also found that the disadvantage of using VaR in measuring systemic risk was that it was still "individual" and "single" and didn't consider the spread among various entities in the market. In addition, the sensitivity of listed companies varies under normal and volatile conditions. ΔCoVaR is a more appropriate method of assessing the contribution to systemic risks of the whole market.

1. INTRODUCTION

The world financial crisis in 2008 has shown that confidence in the stability of the financial system is no longer sustainable. After the crisis, researchers around the world focused their efforts on explaining its causes and assessing the impacts of crises. The diversity of post-crisis research shows that financial instability imposes a great challenge for researchers. The events that took place during the crisis in 2008 have shown that the risk of contagion can continue to pose a threat to the stability of the financial system in general and the stock market in particular. The potential impact of the crisis has left important financial institutions vulnerable (2008 started with the collapse of Lehman Brothers).

The common features of crises derive from systemic risk which has a great impact on the stability of the financial system, including the stock market. It can be assumed that the stock market plays an important role in the financial system, being a sensitive indicator of market reactions. Systemic risk on the stock market can be considered a warning signal to investors and policy makers about the risk of market failure. Therefore, the study of systemic risk on this market is of great necessity.

In Vietnam, through nearly twenty years of establishment and development, the stock market has experienced strong growth, becoming a channel for medium and long term capital to the economy. However, from 2008 to the current day, the market fluctuations have been quite complex and potentially possessed much more risk. This situation is most clearly reflected through the low accumulation of capital, the high cost of capital and the risks of the market system. According to preliminary statistics of systematic risk on the market, more than 50% of sectors have shown signs of increasing system risk. In recent years particularly, Vietnam's stock market is increasingly showing signs of reaction to changes in the world economy as it integrates into it. Therefore, the study and evaluation of systemic risk on the stock market as well as the consideration of the level of listed enterprises' systemic risk in the market is a current pressing issue.

The use of risk measurement methods has been studied recently by Acharya *et al.* (2017); Adrian and Brunnermeier (2008); Jonghe (2010); Staum *et al.* (2016). Authors often use stock data because this is an easily accessible source of information on the market.

The research also focused on the relationship between institutions (Hattori *et al.*, 2014; Avkiran, 2018). The authors used a variety of systemic risk measurement methods such as CoVaR, MES, SES, DIM, from 1997 to 2012 to examine the stability of the Japanese financial system. Some results showed the interdependence between the financial system and the economy, between the financial system and the public sector.

The research on systemic risk is relatively rich and diverse. However, according to the overview analysis of the current research, the following gaps still exist.

Firstly, there has been no research or publication domestically and abroad that is directly related to the systemic risk ranking of the listed sectors on the Vietnam stock market.

Secondly, there has been no clear definition of the concept of systemic risk in Vietnamese studies. Domestic research primarily focuses on systemic risk that cannot be ruled out by diversification (systematic risk) (Nguyen, 2010) while the concept of systemic risk is disruptive, widespread and rarely mentioned.

Thirdly, the selection of a measuring instrument that is appropriate to the current situation of the stock market in Vietnam is still improper. IGlobally, researchers have come up with tools to measure systemic risk such as VaR, CoVaR, MES, SES, etc. However, the application of VaR to risk studies has not been widespread despite some initial studies on VaR on the stock market (Vo and Nguyen, 2011).

Therefore, proposing a method of measuring systemic risk and evaluating the systemic risk of the listed enterprises on the stock market in Vietnam is of great necessity. The application of appropriate measurement methods will be an important indicator for investors as well as market policymakers in controlling systemic risk.

2. STUDY OVERVIEW

2.1. Definition of Systemic Risk

There are two concepts of systemic risk that are addressed in the "systematic risk" and "systemic risk" studies. "Systematic risk" is the market risk due to the weakness of market structure stemming from fluctuations of interest rates, war, politics, etc., and cannot be ruled out by diversification (Amit and Livnat, 1988) Meanwhile, "systemic risk" is understood to be a risk as financial instability becomes widespread and weakens the functions of the financial system to the extent that material damages are caused to economic growth and welfare. Systemic risk reflects the direct failure of microprudential monitoring and also raises the need to enhance the role of macroprudential monitoring.

Initially, examining systemic risk did not achieve a general consensus among researchers. In fact, systemic risk and systemic financial crises had not been fully integrated into existing macroeconomic models. Therefore, systemic risk was not explicitly mentioned in models of economic trends and the instructions of policy decision making.

Explanation of systemic risk varies from one type to another, depending on the area of research and risk management organizations. Systemic risk can stem from any element of the economy. This means that a financial instrument, institution, market, market infrastructure or segments of financial system can be the source of systemic risk, spreading systemic risk, as well as being affected by it. It is not easy to determine whether the size of an event can become systemic, as during a volatile market, the assessment of the influential extent on components of market can be inaccurate and deviant. Systemic risk may originate from within or outside the financial system or as result of a connection between specific financial intermediaries and financial markets as well as their exposure to the real economy.

Thus, the concept of systemic risk can be seen in a wide range of organizations and sectors. In the securities sector, systemic risk is defined as the probability of an triggering event, through a propagation mechanism that has negative impacts on other components or owners in the stock market, causing serious consequences for the entire financial system in particular and the economy in general.

2.2. Measurement of Systemic Risk

The development of systemic risk measurement methods can vary based on the specific objectives of financial institutions or economic sectors. The measurement methods are based on such criteria as the level of interconnection between market segments, individual risk factors or financial health indicators, models based om macro variables, models based on the market and hybrid structural models.

Measuring the level of interconnection between market segments uses measurement methods built on dividing the linkages in the market structure such as:

(1) risk measurement methods that derive from the linkage among financial institutions;

(2) risk measurement methods that derive from interdependence among financial sectors and the real economy;

(3) risk measurement methods that are realized from the interdependence of the financial and public sectors; and,

(4) risk measurement methods that stem from fluctuations in the financial markets.

Individual risk indicators or financial health indicators are based on balance sheet data, such as financial soundness indicators (FSIS). These indicators are often widespread and include a variety of risks. However, these indicators tend to look back to the past and do not account for the probability of bankruptcy or the correlation between the components. Additionally, only a few indicators can be considered as early warning tools (eg, indicators for funding structures). Market data can be used to develop additional indicators for risk management at a higher frequency.

Models based on macro variables are based on market volatility and data from the balance sheet to examine macroeconomic relationships but do require long-term data.

Models based on the market detect risk information from market data of high frequency and therefore are suitable for tracking the changing conditions of a certain company or industry (Reichert, 2017).

Hybrid, structural models calculate the impact of shocks on financial variables and actual data (eg, probability of bankruptcy, or credit growth) by combining the data from balance sheets and market prices.

After the 2007-2008 crisis, the theory of complex systems (or networks) was rediscovered and applied to the financial markets for analyzing the interconnection among markets. One of the earliest risk measurement methods that still presents many of the advantages of current financial management is the Value at Risk (VaR) model. VaR tells you how much the maximum loss in a given period is, with low probability of the actual loss exceeding this value. VaR methods have been applied in risk management in many countries (Vo and Nguyen, 2011). However, VaR does not indicate the loss estimation in the event of an extremely negative market fluctuation and wherever

the event , however improbable, has actually occurred. Investors should be aware if losses are real, how much they can lose on average or how much the maximum losses can be.

Overcoming VaR's weakness in measuring systemic risk, the Conditional Value at Risk (CoVaR) model has been developed based on calculating VaR under various conditions. CoVaR can be calculated via several methods depending on the conditions utilized in the model. In addition, using CoVaR, it is possible to calculate ΔCoVaR to examine the effect of typical factors (sectoral factors) on systemic risk. A number of well-known studies by Adrian and Brunnermeier (2008) or Artzner *et al.* (1999) have demonstrated that CoVaR and ΔCoVaR are effective tools for measuring systemic risk. For that reason, CoVaR has been used as an effective measure in the systemic risk ranking of the system (Karaś and Szczepaniak, 2017). The typical case study by Sheu and Cheng (2012) has shown that CoVaR can look at the systemic risk impact of the industry on the overall market risk. In addition, the authors added the marginal CoVaR (ΔCoVaR) to analyze the extent of losses of eighteen industries in the Taiwan market.

In addition, studies of Sedunov (2016) and Wang *et al.* (2018) showed that CoVaR was an useful measurement method in considering the relationship between institutions in stock market.

3. RESEARCH MODEL

To assess the impacts of stocks upon risk events, the authors used the CoVaR method by Brunnermeier and Adrian proposed in 2008 in NY Fed Staff Reports. This report was then revised in 2009, 2010, 2014 and 2016. CoVaR is a method of measuring the level of adverse impact on the financial system upon insolvency. CoVaR is built on the basis of VaR method., The content of such a model is based on two assumptions:

(i)That the distribution function of the value of a company's asset depends on the financial health of that company itself and is subject to the fluctuation of asset value of other companies, and

(ii)   That when a company is in a state of insolvency, or in a situation where the value of the debt is greater than that of the market price of the assets, this situation will lead to the changes of asset value according to the market price of the whole stock market. When the company's asset market value is lower than that of the debt, the company will fall into insolvency.

3.1. Research Data

Research data are extracted from the financial statements and historical price data of stocks listed on Ho Chi Minh City Stock Exchange in the period from April, 2009 to September, 2017. However, stocks were screened during the calculation process through testing and post-inspection methods. Stoxplus Financial Communications Joint Stock Company provided the data.

The study used the securities data about listed companies on Vietnam stock market, which were then classified into ten sectors according to the Industry Classification Benchmark (ICB) standards. ICB divides economic sectors into four levels: ten industries (Industries), nineteen super sectors, 41 sectors and 114 sub-sectors. To facilitate the presentation of the research results, groups of industries are denoted from A1 to A10 as set out in Table 1 below:

Table-1. Sector classification according to ICB

Sector	Code
Information Technology	A1
Industry	A2
Petroleum	A3
Consumer service	A4
Medicine and health care	A5
Consumer goods	A6
Banking	A7
Material	A8
Finance	A9
Community utilities	A10

The whole study was done with calculation software and statistics R.

3.2. Measurement Procedure

From the meaning of the CoVaR method and the concept of systemic risk, its measurement and monitoring on the stock market include the following processes:

a.   *Process 1: Systemic Risk at a Time based on the Quantile Regression Method*

The process will measure the VaR of the entire market in the context of listed companies experiencing liquidity difficulties and/or in the context of lower market value of assets than that of the company's own debt. However, the process of measuring VaR of the whole stock market will change in the context of listed companies having lower market value of assets than that of debts and in the situation of insolvency.

Value VaR_q^i determined at %q is described in the equation:

$$P_r\left(X^i < VaR_q^i\right) = q\%$$ (*1)

VaR_q^i indicates the maximum value and likelihood of occurrence within a certain time range.

$CoVaR_q^{j|C(X^i)}$ is defined as the VaR of total assets according to the market value of the stock market j in case company i falls into the status of insolvency. And CoVaR is determined based on the conditional probability equation:

$$P_r\left(X^j|C(X^i) < CoVaR_q^{j|C(X^i)}\right) = q\%$$ (*2)

X^i: is understood as the fluctuation of the asset market value of the company i and of the stock of listed company i.

X is determined as follows:

$X_t^i = (MVA_t^i - MVA_{t-1}^i)/MVA_{t-1}^i$

In which:

- MVA is the market value of asset: MVA = BVA*(MVE/BVE)

- BVA: Book value

- BVE: Equity

- MVE: Capitalization value = Stock price* number of outstanding shares

Based on equation (*1) and (*2), $CoVaR_q^{j|C(X^i)}$ can be expressed as the VaR value of the market volatility at the level of $q\%$ in the event of volatility in the asset market value of the organization i at the level of VaR at $q\%$.

The research data was initially screened and stock codes with a listing period of less than eight years were eliminated to ensure regression theory (the minimum number of observations is 30). Data after screening included 185 stock codes corresponding to 185 monthly MVA value chains in the period from 2010 to 2017.

Process 1 determines that when the company suffers from insolvency, the stock market is affected by the following amount:

$$\Delta CoVaR_q^{j|i} = CoVaR_q^{j|X^i=VaR_q^i} - CoVaR_q^{j|X^i=VaR_{50}^i} \qquad (*3)$$

In the equation (*3), variable $CoVaR_q^{j|X^i=VaR_{50}^i}$ is understood as the market value of the total assets of the stock market under normal conditions, i.e under the condition when no company falls into the situation of a liquidity loss and if statistically understood, $CoVaR_q^{j|X^i=VaR_{50}^i}$ is calculated at the median position of asset market volatility of company i.

The estimation of the variables $CoVaR_q^{j|X^i=VaR_q^i}$ and $\Delta CoVaR_q^{j|i}$ was based on the method of Quantile Regression. The estimation of $CoVaR_q^{j|X^i=VaR_q^i}$ was conducted via the following steps:

- *Step 1:*

(i) Test stationary series Dickey-Fuller to ensure the stationary of the data.

(ii)   Perform the quantile regression of the whole market's asset variation according to the independent variable which is the asset variation of company i at quantiles of 1%, 5% and 25%, we had the following equation:

$$X\hat{}_q^{j|Xi} = \hat{\alpha}\hat{\alpha}_q^i + \hat{\beta}_q^i X^i$$

In which $X\hat{}_q^{j|Xi}$ was the value estimated at the quantiles of 1%, 5% and 25% of the whole stock market under the condition of asset variation X^i of company i.

The result obtained was:

$$X\hat{}_q^{j|Xi} = \hat{\alpha}\hat{\alpha}_q^i + \hat{\beta}_q^i X^i <=> CoVaR_q^{j|X^i=VaR_q^i} = \hat{\alpha}\hat{\alpha}_q^i + \hat{\beta}_q^i VaR_q^i$$, when replacing value X^i with value VaR_q^i of asset variation X^i at quantile of q% corresponding to 1%, 5% and 25% respectively.

(iii)   Perform post-inspection to determine the function form of the regression equation based on Ramsey test. This test was to ensure a reliable regression coefficient.

- *Step 2*: After performing the estimation in step 1, the result obtained was as follows:

$$\Delta CoVaR_q^{j|i} = CoVaR_q^{j|X^i=VaR_q^i} - CoVaR_q^{j|X^i=VaR_{50}^i} = \hat{\beta}_q^{j|i}(VaR_{q,t}^i - VaR_{t,0.5}^i)$$

b.   *Process 2: Results Calculated Over Time*

Process 1 allowed the calculation of CoVaR and ΔCoVaR at a set time to be determined and this requires a subsequent cycle to possibly monitor the fluctuations of the CoVaR and ΔCoVaR variables over time. This required the process of estimating CoVaR and ΔCoVaR in turn by variables that are likely to accumulate and bring about the systemic risk (as analyzed in the causes). The variables of CoVaR and ΔCoVaR in this process are called conditional CoVaR and ΔCoVaR.

Process 2 is based on the implication that the yield of an asset depends on the growth size of its entire asset market.

The variables that were applied included: macroeconomic variable groups and the overall growth rate of the asset market which is the total market value of assets of listed companies, X^j

- *Step 1*: Test stationary series
- *Step 2*: Perform quantile regression based on monthly data in accordance with the following equation:

$$X_t^i = \propto_q^i + \gamma_q^i M_{t-1} + \varepsilon_{q,t}^i \qquad (*4)$$

$$X_t^{j|i} = \propto_q^{j|i} + \gamma_q^{j|i} M_{t-1} + \beta_q^{j|i} X_t^i + \varepsilon_{q,t}^{j|i} \qquad (*5)$$

After conducting regression according to equations (*4) and (*5) above, the calculation of values of $VaR_t^i(q)$

, $CoVaR_t^i(q)$ and $\Delta CoVaR_t^i(q)$ were carried out in accordance with the following equations:

$$VaR_{q,t}^i = \propto_q^i + \gamma_q^i M_{t-1} \qquad (*6)$$

$$CoVaR_{q,t}^i = \propto_q^{j|i} + \beta_q^{j|i} VaR_{q,t}^i + \gamma_q^i M_{t-1} \, (*7)$$

$$\Delta CoVaR_{q,t}^i = CoVaR_{q,t}^i - CoVaR_{0.5,t}^i = \beta_q^{j|i}(VaR_{q,t}^i - VaR_t^i(.50)) \qquad (*8)$$

- *Step 3*: Continue to perform Ramsey tests to ensure the reliability of regression coefficients and function forms.

The selection of macroeconomic variable groups was essential in the study of systemic risk. The macroeconomic event is one of the triggering ones that can lead to risks of the whole stock market as well as the financial system. Therefore, the process of selecting macro variables was based on the theory of stock yields, an overview of domestic and foreign measures related to the stock market and based on qualitative research.

According to Adrian and Brunnermeier (2008) macro variables were determined based on the following criteria: their direct impact on the chronical variation of the asset value in the economy, the variables' capability of describing liquidity in the economy, and their ability to be tracked over time The total number of macro variables was limited to ensure that over fitting wouldn't occur and that the macro variables were selected based on the appropriate time period for the entire research model. They included:

Table-2. Macro variables in the model

Variable	Symbol
Difference of government bond yields for 1-year and 10-year term	Spread
Profit of Vnindex	Index
CDS (Credit Default Swap)	CDS
Consumer price index	CPI
Money supply	M2
Exchange rate	Exrate

4. RESEARCH OUTCOME

a. *Systemic Risk at a Time based on the Quantile Regression Method*

VaR, CoVaR and DeltaCoVaR were calculated at three quantile levels of 1%, 5% and 25% for September 2017. The selection of various quantile levels proved to be more convenient in reference and comparison. VaR calculation results were separated into two groups:

- Group 1: 41 sequences of normal distribution

As a result of the verification process, 41 data sequences obtained the normal distribution. VaR is determined

based on the method of variance- covariance.

- Group 2: For the rest of the series, the researchers used the simulation method by attaching the normal distribution to the series with the mean variance equal to that of the old distribution, so that the number of observations was equal to that of the sequence. Then the series was re-tested to determine if the series really followed the normal distribution of the Kolmogrov - Smirnov Tests method. After testing, there were 123 series that met the normal distribution requirements.

Thus, based on the steps of filtering data and calculating VaR, the VaR results were as follows:
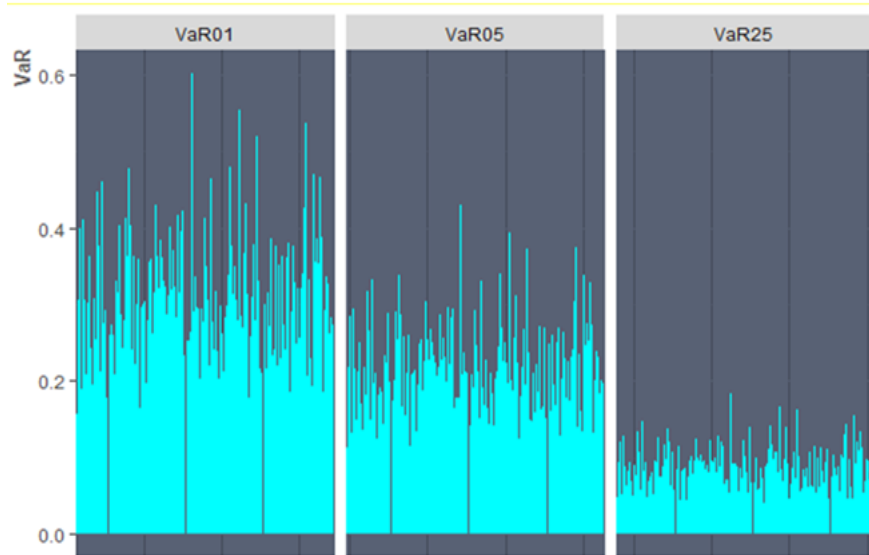
Figure-1. VaR at the quantiles

Source: Calculation of authors based on software R

The above chart showed the calculation of VaR of 165 data series in the research sample. The results showed similarities in trends at different levels of quantile. VaR values ranged from 0.156 to 0.601 (corresponding to 15.6% to 60.1%). Ten out of 165 enterprises had an impact level of less than 20%, accounting for 6% of the total samples. There were 133 out of 165 businesses with losses ranging from 20 to 40%, accounting for 80.6% of the total samples. This showed that the loss level of over 40% of the enterprise group was relatively small.

Meanwhile, at the quantile of 5%, the loss of listed companies ranged from 0.112 to 0.429 (11.2% to 42.9%, respectively). 61 out of 165 enterprises had loss levels of below 20%, accounting for 37% of the total samples. There were 103 out of 165 businesses with losses ranging from 20 to 40%, accounting for 62.4% of the total samples. The impact level of above 40% only fell into one enterprise in the material industry.

Table-3. Top ten companies with the highest VaR and MVA

Companies with the highest VAR		Companies with the highest MVA	
Code	**VAR01**	**Code**	**MVA**
KSH	0.601	MBB	395489.5
PXT	0.553	VCB	2335.547
TTF	0.536	BID	1575.174
SGT	0.52	RAL	472.7692
PTC	0.479	CTD	435.6327
DRH	0.478	MWG	416.9325
VHG	0.469	HBC	405.4205
VIS	0.465	STB	380.2254
OGC	0.464	PTB	367.4034

Source: Calculation of authors based on software R

The research results showed that there were no similarities between the top companies with the highest VaR

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value and those with the highest asset market value. The KSH joint stock company, despite ranking the first in the list of companies with the highest value of VaR at all three quantiles, lay in the group of ten companies with the lowest market value of assets. Meanwhile, the remaining companies in the group of companies with the highest value of VaR were in the middle range or some companies were in the low group when compared to the market value of the company's assets.

Table-4. Top ten companies with the lowest VaR and MVA

Companies with the lowest VAR		Companies with the lowest MVA	
Code	VAR01	Code	MVA
AAM	0.156	LCM	1.228991
EIB	0.164	VHG	1.805004
SBA	0.178	KSH	3.311457
CMV	0.178	NTL	3.448869
TMP	0.185	NSC	3.935674
VNL	0.186	CDO	4.097829
APC	0.189	HHS	4.330993
VFG	0.193	TSC	4.575922
BTT	0.195	HQC	4.88314

Source: Calculation of authors based on software R

Similarly, the group of companies with the lowest VaR value was not similar to that with the lowest asset value market. In this case, the group of companies with low VaR usually have the market value of their assets in the first or middle range of those in the research samples. This could be explained by the fact that small-scale companies have weak risk management capabilities. Trading stocks of small companies are also often easily manipulated in the market, leading to relatively high VaR values.

After calculating VaR, 165 regression models were estimated to extract 165 CoVaR and DeltaCoVaR estimation coefficients. Before making an estimate, the Dickey-Fuller stationary series test was applied. The results showed that the 165 data series were all stationary series.

Following the quantile regression process, based on the functional format test, there were five data series which were removed, resulting in 160 remaining data series being used to calculate VaR, CoVaR and DeltaCoVaR.
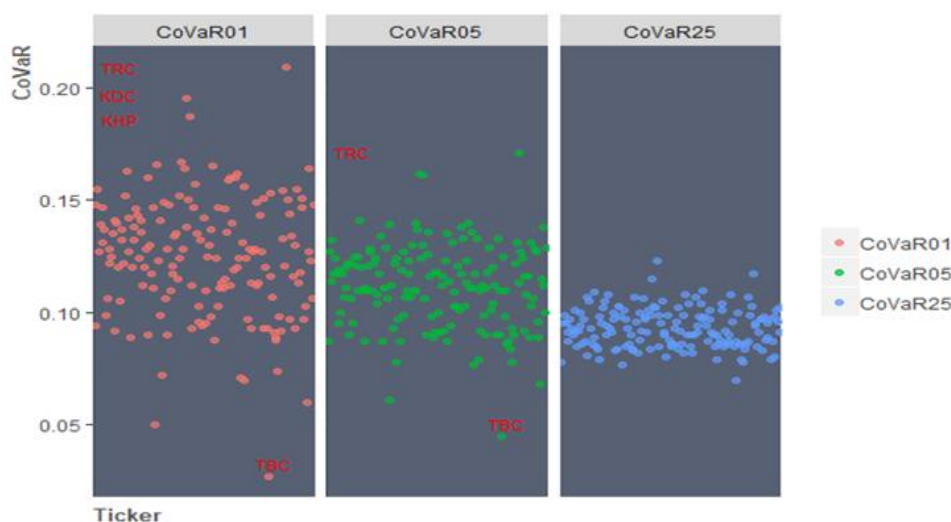

Figure-2. CoVaR at the quantiles
Source: Calculation of authors based on software R

The CoVaR results of 165 data series in the study sample also showed similarities in trends at various quantiles. In general, the impact level of listed enterprises on the systemic risk of study sample was relatively uniformed, ranging from 0.027 to 0.209 (corresponding to 2.7% to 20.9%).

32 out of 165 enterprises had an impact level of less than 1%, accounting for 19% of the total research sample. This showed that the level of impact on 1% of the remaining enterprise group was considerably large. The most noticeable was the TRC code with the level of marginal contribution to the systemic risk of 20.9% and the marginal impact level of 9.8% (shown on both quantiles of 1% and 25%).
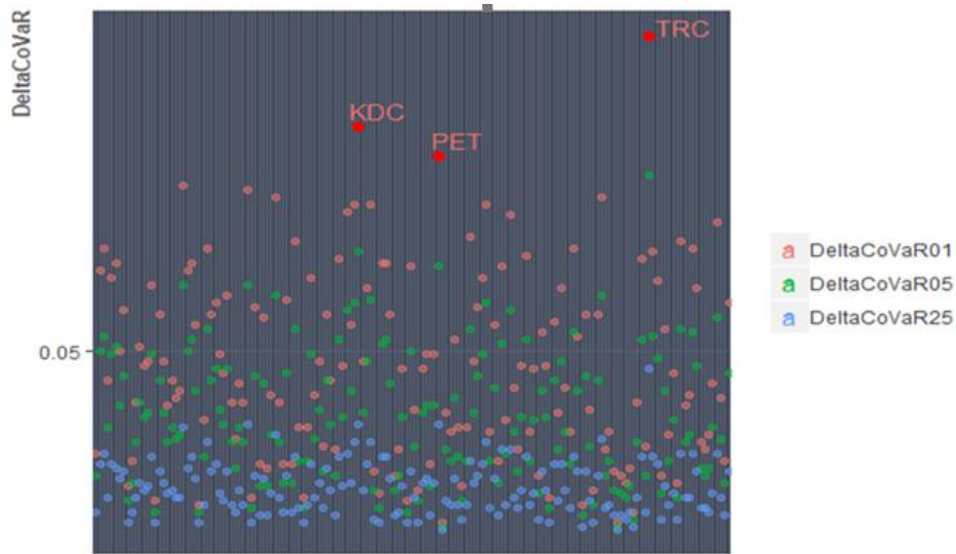

Figure-3. DeltaCoVaR at the quantiles

Source: Calculation of authors based on software R

Figure 4 showed quite a similar change in all three quantiles for VaR, CoVaR and DeltaCoVaR. In particular, the systemic risk of listed companies were quite large, however, the degree of impact has remarked such a change in systemic risk of the general market. The results also indicated that, at the quantiles of 1% and 5%, the difference in impact levels and marginal impact levels would be more visible than those at the quantiles of 25%.
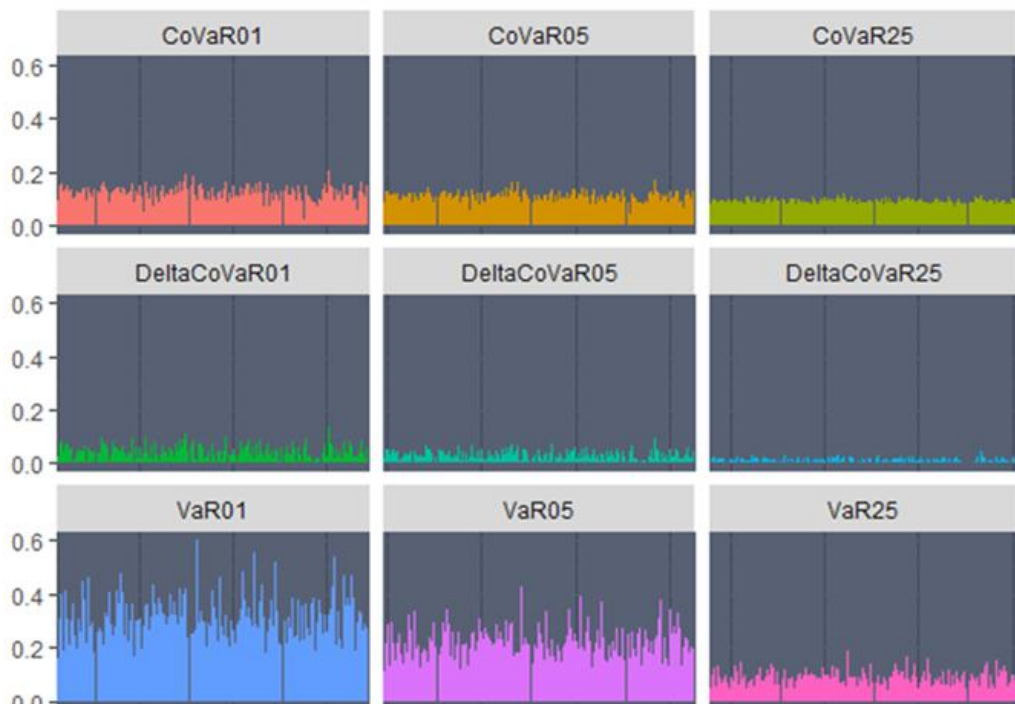

Figure-4. Comparison of values of VaR, CoVaR and DeltaCoVaR at the quantiles

Source: Calculation of authors based on software R

In addition, businesses with high systemic risk had varying levels of contribution to the common systemic risk of the market (equal or smaller). This was most evidently demonstrated in the group of ten companies with the highest value of VaR, CoVaR and DeltaCoVaR.

Table-5. 10 companies with the highest VaR, CoVaR and DeltaCoVaR

Code	VaR01	Code	CoVaR01	Code	DeltaCoVaR01
KSH	0.601	**TRC**	0.209	**TRC**	0.136
PXT	0.553	**KDC**	0.195	**KDC**	0.111
TTF	0.536	**KHP**	0.187	**PET**	0.103
SGT	0.52	ITA	0.167	CTS	0.095
PTC	0.479	**GMC**	0.166	DXV	0.094
DRH	0.478	**PET**	0.165	**GMC**	0.092
VHG	0.469	**KBC**	0.164	TCM	0.092
VIS	0.465	VPK	0.164	**KHP**	0.09
OGC	0.464	DHC	0.163	**KBC**	0.09
CLG	0.461	REE	0.162	PVT	0.09

Source: Calculation of authors based on software R

The codes with the highest systemic risk did not match the corresponding contribution level of enterprises to the overall systemic risk. This clearly revealed the disadvantage of VaR in measuring "individual" and "single" systemic risk without considering the spread among different entities in the market. The enterprises that appeared in the top ten DeltaCoVaR values showed that the sensitivity of listed companies between under normal and volatile conditions would vary. To be more specific, enterprises with a large contribution to systemic risk under normal conditions did not necessarily have a significant impact in volatile conditions (and were not even included in the top ten for values such as CTS, DXV, TCM and PVT) .
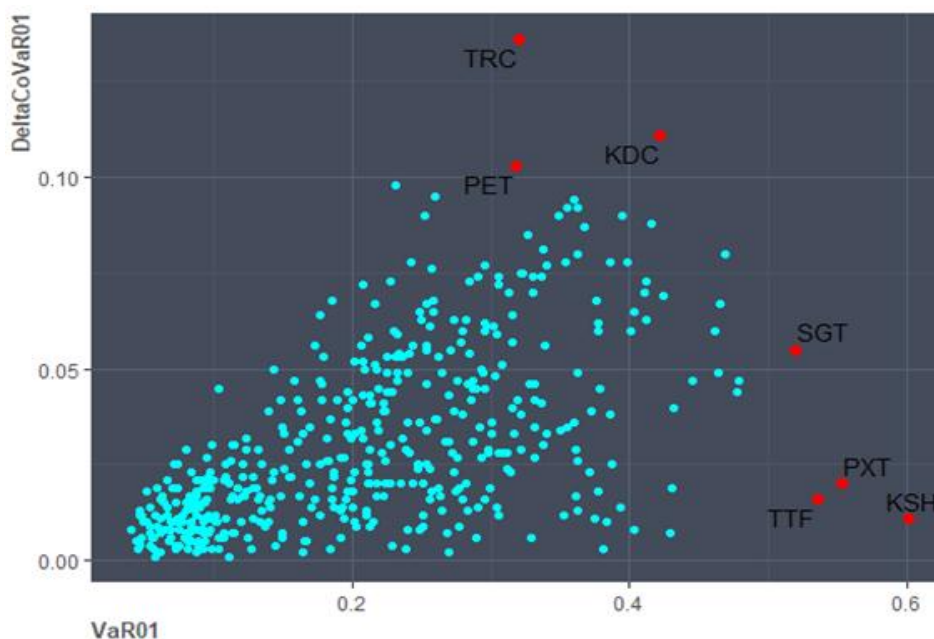

Figure-5. Comparison of VaR to Delta CoVaR at quantile 1%
Source: Calculation of authors based on software R

Meanwhile, for the industry average, the results indicated a clear similarity among the VaR, CoVaR and DeltaCoVaR measurements. The impact of various sectors on overall systemic risk is quite evident. Among these, the outstanding sectors are: industry (A2), consumer goods (A6), materials (A8) and finance (A9).

Figure-6. Comparison of VaR, CoVaR and DeltaCoVaR at the quantiles by sector

Source: Calculation of authors based on software R

b. Results Calculated Over Time

The above results represented the systemic risk of the listed companies as of the second quarter of 2017. However, the nature of systemic risk included the accumulation factor; therefore, in the next steps, VaR, CoVaR and DeltaCoVaR were calculated over time, under the influence of macro variables. The average loss level of listed companies was relatively high compared to the level of impact on systemic risk of the study sample as well as the marginal impact level of DeltaCoVaR.
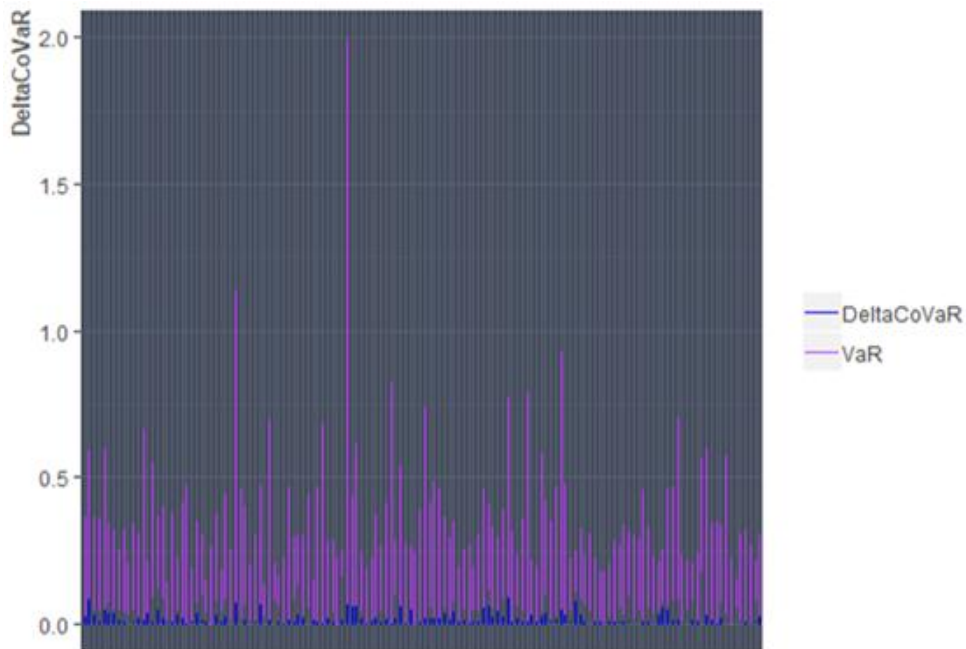
Figure-7. Volatility of DeltaCoVaR in 2017

Source: Calculation by authors based on software R

Additionally, the change in the impact level of the listed companies on the overall systemic risk indicated that there was hardly any fixed maintenance on the impact level of companies over the years. Exceptionally, FDC was a code that had a significant impact on overall risk and remained almost unchanged during the period from 2010 to the second quarter of 2017. This result was similar to the calculated value of systemic risk and the impact level at a time.

Figure-8. Volatility of CoVaR of 10 companies in the period of 2010 – 2017

Source: Calculation by authors based on software R

Figure 9 illustrates the variation of a group of twenty companies that had had the largest impact on the overall systemic risk from 2010 until the second quarter of 2017. The results showed that the second quarter of 2017 and the first quarter of 2012 were the periods when listed companies had the highest impact on systemic risk. At the same time, the marginal impact level of the companies on systemic risk also revealed quite similar results.
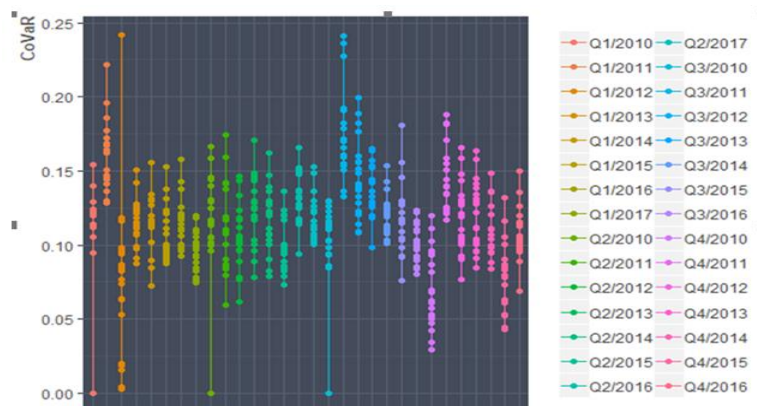

Figure-9. Volatility of CoVaR of 20 companies in the period of 2010 – 2017

Source: Calculation by authors based on software R

5. CONCLUSION

The paper studied the systemic risk measurement method for the Vietnamese stock market over the period from the first quarter of 2010 to the second quarter of 2017. The research results showed that the application of systemic risk measurement is of great necessity for a stock market in the process of upgrading like the one in Vietnam.

The research results indicated that there was no similarity between the top companies with the highest VaR value and the top companies with the highest asset market value.

The results also clearly revealed that, at the quantiles of 1% and 5%, the differences in the impact and marginal impact levels would be more apparent than those at quantiles of 25%.

The study also found the disadvantage of VaR in measuring systemic risk was that it focused on the "individual" and "single" and didn't consider the spread of systemic risk or its impact among various entities in the market. Additionally, the sensitivity of listed companies between under normal and volatile conditions would vary. More specifically, enterprises with a large contribution to systemic risk under normal conditions did not necessarily have a significant impact under volatile conditions.

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