Copernican Journal of Finance & Accounting

2025, volume 14, issue 3

e-ISSN 2300-3065
p-ISSN 2300-1240

Khiari, W., Ben Flah, I., & Bouhali, M.A. (2025). Pandemic Crisis and Increasing Systemic Risk Among Tunisian Listed Banks Using CoVaR Measure: The Case of the COVID-19 Crisis. Copernican Journal of Finance & Accounting, 14(3), 33–60. http://dx.doi.org/10.12775/CJFA.2025.012

Wided Khiari[*]
GEF2A-Lab University of Tunis

Ines Ben Flah[**]
GEF2A-Lab University of Tunis

Mohamed Amine Bouhali[***]
GEF2A-Lab University of Tunis

PANDEMIC CRISIS AND INCREASING SYSTEMIC RISK AMONG TUNISIAN LISTED BANKS USING COVAR MEASURE: THE CASE OF THE COVID-19 CRISIS

Keywords: systemic risk, COVID-19, VaR, CoVaR, return, pandemic effect.

J E L Classification: M210, G1.

Abstract: In recent years, financial institutions have become increasingly interconnected, meaning that failure of one institution can spread to the entire network. This is known as financial contagion. In this article, we examine the evolution of systemic risk

Date of submission: September 30, 2025; date of acceptance: November 22, 2025.

[*] Contact information: khiariwided@yahoo.fr, Higher Institute of Management of Tunis, GEF2A-Lab, University of Tunis, 41, La liberté Street, Bouchoucha City, 2000, Bardo, Tunis, Tunisia, phone: +21698586639; ORCID ID: https://orcid.org/0000-0001-7248-2780.

[**] Contact information: inesbf@hotmail.fr, Higher Institute of Management of Tunis, GEF2A-Lab, University of Tunis, 41, La liberté Street, Bouchoucha City, 2000, Bardo, Tunis, Tunisia, phone: +21622802118; ORCID ID: https://orcid.org/0009-0001-6708-8305.

[***] Contact information: mohamed.amine.bouhali@gmail.com, Higher Institute of Management of Tunis, GEF2A-Lab, University of Tunis, 41, La liberté Street, Bouchoucha City, 2000, Bardo, Tunis, Tunisia.

among the twelve Tunisian banks listed on the stock exchange and address the issue of the impact of COVID-19 on systemic risk in the Tunisian banking sector. We assess the impact of a bank's negative stock market returns on other banks in the sample and thus propose a measure of systemic risk for the banking sector. Systemic risk measures also make it possible to identify systemically important institutions. The results show that the recovery from the crisis has not been uniform. While some banks are gradually emerging from systemic risk, others are seeing their systemic influence grow significantly, perhaps due to their size, interconnectedness, or post-crisis growth strategy.

Introduction

Appearing in December 2019, the coronavirus, known as COVID-19, quickly escalated from a health crisis to a large-scale global economic crisis with a significant impact on financial markets and the economy. It has been defined as a systemic risk, a risk that accumulates over time, is interactive and synergistic, and, once triggered, is difficult to control. Systemic risk factors tend to be cumulative and/or interdependent, leading to profound repercussions, shocks, and even system-wide failures (ICGN, 2018).

The banking sector is also under significant pressure due to the evolving COVID-19 situation. Governments have attempted to find solutions by implementing social and financial measures such as lockdowns, business closures, loan repayment deferrals, regulatory easing, and temporary non-classification of non-performing loans. The banking sector has become increasingly fragile as a result of all these measures.

Like most countries around the world, the coronavirus pandemic has hit the Tunisian economy, which entered a deep recession in 2020. The negative impact on the Tunisian economy is being felt on both the demand and supply sides. The performance of the Tunisian banking system has been affected by the pandemic. Net income on tangible assets fell to 0.5% in early 2020, compared to 1.6% in 2019. The shocks linked to COVID-19 continue to impact the Tunisian banking system, weakening the quality of its assets and its profitability. In 2021, Tunisia's sovereign component was rated ba3, with a "weak to very weak" outlook for the country's banking sector.

The Tunisian Central Bank, like many others around the world, has taken the necessary measures to help businesses overcome the COVID-19 pandemic, preserve jobs, and ensure the continuity of operations. It has set up a special "COVID" financing mechanism with a 50% reduction in the key interest rate, repayable over seven years, including a two-year grace period, up to 25% of the

company's turnover, and a guarantee mechanism enabling nearly 862 million dinars to be mobilized for businesses. In addition, despite the pressure they are under, banks have extended payment deadlines for nearly 20,000 companies, representing a value equivalent to 5 billion dinars.

Most research on the COVID-19 pandemic has focused especially on its impact on the economy and the financial system (Eichenbaum, Rebelo & Trabandt, 2020; Chen, Qian & Wen, 2020; Barro, Ursúa & Weng, 2020). Our work is part of a broader effort to study the impact of the pandemic crisis on the financial sector, particularly the Tunisian banking sector.

According to the interaction model developed by Eichenbaum, Rebelo and Trabandt, (2020), reduced work and consumption can mitigate the impact of a pandemic crisis, but with long-term consequences for the economy. The same results were observed in China by Chen et al. (2020). Investors are becoming more cautious, particularly venture capital investors (Ozili & Arun, 2020; Howell, Lerner, Nanda & Townsend, 2020).

COVID-19 has also had a significant negative impact on the financial system. In this context, Ding, Levine, Lin and Xie (2021) study the reaction of financial markets to the COVID-19 pandemic. They show that certain financial channels have amplified the expected real effects of the health crisis. Using CoVaR measures, Borri and Di Giorgio (2022) study the financial systemic risk of large European banks during the COVID period starting from January 2020 to September 2020. Acharya, Engle, Jager and Steffen (2023) show that the systemic risk measured by SRISK increased during the initial COVID-19 shock in 2020.

Moreover, the balance sheet liquidity risk of banks through their credit lines significantly affects their stock decline. Based on a study conducted on the Australian market, Gomis-Porqueras, Ruprecht and Zhou (2023) observe an increase in financial stress index and the wave of the COVID-19 plot their Australian stress index and the daily new confirmed. Chavleishvili and Kremer (2023) identify the COVID-19 period from March to April 2020 and show that the systemic stress contributes to the GDP drop during the Great Recession and not during the COVID-19 pandemic.

Similarly, Guedhami, Knill, Megginson and Senbet (2021) show that multinationals experience greater price declines than domestic companies during an epidemic crisis. According to them, a strong financial system mitigates the negative effects on performance, while real factors accentuate the negative returns of the crisis.

Fahlenbrach, Rageth and Stulz (2020) and Cheema-Fox, LaPerla, Serafeim and Wang (2020) also show that the pandemic affects businesses differently. As such, many articles examine the impact of the policies implemented by governments to deal with the pandemic crisis. Certain government measures have been implemented to combat the pandemic and mitigate systemic risk (Ozili & Arun, 2020; Hafiz, Oei, Ring & Shnitser, 2020). Ding, Levine, Lin and Xie (2020) show that physical distancing is more important, particularly in countries where there is a strong commitment to social goals, but where participation in community activities is insufficient.

Many authors have developed measures to analyze the consequences and causes of systemic risk in banks. Acharya, Brunnermeier and Pierret (2025) examine market-based measures of systemic risk over more than a century, from the Panic of 1907 to the banking stress of 2023. The authors evaluate whether these measures can predict which financial institutions are most vulnerable during periods of systemic stress. They show that institutions with higher ex-ante systemic risk measures experience higher volatility and lower stock returns during crises. The results highlight the strong explanatory and predictive power of market-based systemic risk indicators and support their relevance for macroprudential regulation and financial supervision. Adrian and Brunnermeier (2016) introduced CoVaR, which has been used as a measure that takes into account changes in the market value of assets. This measure has been used by researchers to distinguish individual risk from systemic risk. In fact, they found no explanation for the impact of the pandemic crisis on the stability of the banking system, despite the policies implemented by governments to minimize the spread of the virus. Numerous studies show that the pandemic crisis led to a slowdown in the economy as a whole and a significant loss of income for households and businesses, which had an impact on their solvency and ability to meet their repayment commitments. It also reduced the use of banking services (Huang, 2025; Fiori & Coenders, 2025; Barua, 2020; Beck & Keil, 2020; Bartik, Bertrand, Cullen, Glaeser, Luca & Stanton, 2020; Boda, 2016). The impact on households and businesses then spread to banks, affecting their solvency, profits, and revenues (Beck & Keil, 2020).

Thus, the COVID-19 shock can be considered a determining factor in the fragility of the banking system. However, banks may be more resilient to the shock of the pandemic thanks to regulatory reforms implemented after the global financial crisis. Businesses, banks, and households have been supported by public authorities, which has helped to minimize the negative effects of the crisis.

According to Fernandes (2020), COVID-19 has led to a decline in demand and supply. Barua (2020) examines the macroeconomic effects of pandemics. According to him, experience has shown that epidemic crises lead to economic slowdowns and can have a significant impact on the stability of the banking sector.

Similarly, Demirguç-Kunt, Pedraza and Ruiz Ortega (2021) show a negative relationship between the pandemic and bank stock returns. Furthermore, according to Beck and Keil (2020), the banks most geographically exposed to the pandemic were the hardest hit. Indeed, their loan loss provisions and nonperforming loans increased. Second, according to Eichenbaum et al. (2020), decisions to reduce consumption and work during a pandemic may mitigate the negative impact of an epidemic but lead to a decline in economic indicators and a loss of income for businesses and households. All of this affects creditworthiness and the ability to repay loans and also reduces access to banking services (Beck & Keil, 2020; Bartik et al., 2020; Chen et al., 2020).

Borri and Di Giorgio (2022) studied systemic risk in a sample of large European banks listed on the stock exchange. They show that all banks contribute significantly to systemic risk. In addition, large banks and those whose business model is more vulnerable to fluctuations in financial markets and trading operations contribute more to systemic risk. However, in the case of the smaller sample characterized by COVID-19, sovereign default risks had an impact on the contribution to systemic risk of all banks. The ECB's announcement of an emergency purchase program in response to the pandemic brought calm to the European banking sector.

Huang (2023) attempted to identify the factors affecting the formation of systemic risk in the banking sector in the presence of the COVID-19 pandemic. His methodology was based on the time series model, using a set of economic, econometric, and statistical methods, and was tested in the Chinese context. The results show that the increase in household debt following fatal cases of the pandemic contributes to the spread of systemic risk among banks.

Using the difference-in-differences approach, Yan, Jeon and Wu (2023) examined the effect of COVID-19 on banks' contribution to systemic risk. They determined whether the impact of the pandemic may vary depending on the characteristics of the economy and banks.

Based on CoVaR and MES measures, they found that banks' contribution to systemic risk increased significantly after the COVID-19 crisis. Moreover, the impact of COVID-19 has been less pronounced in emerging countries than in developed countries. In addition, large banks have been more severely affected

by the crisis, while higher bank capitalization is not sufficient to protect them from the negative effects of such a pandemic.

Baumöhl, Bouri, Hoang, Shahzad and Výrost (2022) proposed a systemic risk score based on the cross-quantile plot approach of Han, Linton, Oka and Whang (2016) and has shown how extremely negative stock returns of one bank can spread to other banks in the network during the COVID-19 pandemic. He also showed that systemic risk and the extent of contagion between banks have never been greater than during the COVID-19 pandemic and are even greater than during the 2008 global financial crisis.

The above literature review highlights that interdependence among banks is a major driver of systemic risk and that strong dependence and contagion effects can propagate vulnerabilities across institutions. According to Oguntuase and Ajibare (2024), a mature financial system's inherent interconnectedness exposes it to systemic risk. Interconnectedness of financial institutions – banks and other financial agents – increases systemic risk.

Building on these findings, this article aims to extend the existing literature by applying an advanced contagion-measurement framework to Tunisian banks, thereby providing a more precise assessment of their individual and collective contributions to systemic risk within the banking sector.

Moreover, this study seeks to enrich the emerging research on the impact of the COVID-19 crisis by examining how this unprecedented shock influenced the systemic risk contribution of Tunisian banks. Specifically, we analyze the evolution of systemic risk across the twelve Tunisian banks listed on the stock exchange during the pandemic period. To the best of our knowledge, this is the first study to investigate the effects of a health crisis on systemic risk in the Tunisian banking context, thus offering novel empirical insights with important policy implications.

The article is organized as follows. Section 2 describes the sample, variables, research methodology and descriptive statistics. In section 3, we present the main results. We conclude in section 4.

The research methodology and the course of the research process

Data Selection

The stock market index reflects the stock market performance of a group of stocks. It refers to a series of selected stocks and reflects market fluctuations. The Tunindex is one of the Tunisian stock market indices that reflects fluctuations in the Tunisian stock market. Share price data was obtained from the Tunis Stock Exchange for the period from January 2, 2017, to June 25, 2021, representing a total of 1,119 daily observations of closing prices, including the period during which the euro/dinar exchange rate crossed the three barriers (January 2018).

To measure stock market risk and banking sector risk, we used VaR data from TUNINDEX and TUNBANK, respectively.

To construct the systemic risk indicator, we calculate the returns, using the closing prices respectively at times 1 and t-1, according to the following formula:

$$R_{i,t} = \frac{(P_{i,t} - P_{i,t-1})}{P_{i,t-1}}$$

With

- $P_{i,t}$: The stock price of the bank i at t,
- $P_{i,t-1}$: The stock price of the bank i et t-1.

Based on the approach developed by Adrian and Brunnermeier (2016), we constructed the CoVaR measure, which allows us to assess systemic risk for the banks in the sample.

The first step is to examine the distribution of the data.

Table 1. Descriptive Statistics of TUNBANK and TUNINDEX Indexes

	N	Mean	Std	Min	Max	Skewness	Kurtosis	Jacque-Bera test (5%)
TUNBANK	1,119	0.01814	0.663113	-4.77846	4.033609	-0.58987	9.635983	0.00
TUNINDEX	1,119	0.026625	0.489627	-4.09945	2.713875	-1.48231	12.15681	0.00

S o u r c e : author's own elaboration.

Descriptive statistics for TUNBANK and TUNINDEX returns, which provide an overview of how these indices have performed over time, are presented in table 1. We note that the skewness is negative, indicating that these indices have recorded below-average returns over the period studied.

The kurtosis is greater than 3, which means that we are dealing with a leptokurtic distribution. These do not follow the normal distribution, as confirmed by the Jarque-Bera test (see table 1).

The extremes in the left tails of these leptokurtic distributions provide a better estimate of extreme variations in financial returns, so it seems justified to study their behavior. The estimation of VaR and CoVaR based on the assumption of a normal distribution of returns must therefore be rejected, and we must calculate them in a non-normal framework.

Table 2. Descriptive Statistics of Banks Returns During the Study Period

	N	Mean	Standard deviation	Min	Max	Skewness	Kurtosis
Amen Bank	1,119	-0.00445	1.106487	-7.44822	4.498886	0.17266	3.5575
ATB	1,119	-0.03383	1.635031	-7.88043	6.040268	-0.36255	12.68072
Attijaari Bank	1,119	0.022592	1.4164	-8.98204	6.077231	0.843111	3.24047
BH	1,119	-0.04122	1.738929	-20.0081	6.084656	0.509832	3.04038
BIAT	1,119	-0.00827	1.866279	-46.9607	6.088841	0.649413	3.071442
BNA	1,119	-0.00143	1.424587	-9.3199	10.59524	1.020528	7.670391
BT	1,119	-1.01268	1.202333	-23.2514	6	0.702959	37.95045
BTE	1,119	-0.04647	2.001684	-9.71564	14.02778	0.393875	9.25875
STB	1,119	-0.01299	1.763985	-7.54717	7.349081	0.508085	5.075646

Table 2. Descriptive...

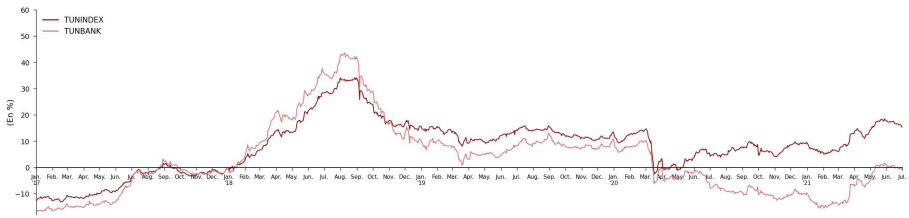
	N	Mean	Standard deviation	Min	Max	Skewness	Kurtosis
UBCI	1,119	-0.00067	1.590952	-8.67896	7.589286	0.550565	59.61357
UIB	1,119	-0.00121	1.291857	-6.08	6.078343	0.712533	3.390107
Wifack Int Bank	1,119	-0.00247	1.029067	-5.97015	6	-0.22942	5.27752

S o u r c e : author's own elaboration.

Table 2 presents the various statistics for the financial time series. All series have negative averages, reflecting the financial difficulties of Tunisian banks. The asymmetry indicator implies asymmetric yield distributions. Most of these banks show positive asymmetry, meaning they are skewed to the right.

However, only ATB and WIFACK INT BANK have negative asymmetry. They are therefore skewed to the left. They have extreme negative values. All have high kurtosis values, which proves the non-normality of their return series. We then proceeded to represent the evolution of the daily returns of the TUNINDEX and TUNBANK indices throughout the study.

Figure 1. Daily Evolution of TUNINDEX and TUNBANK Indexes



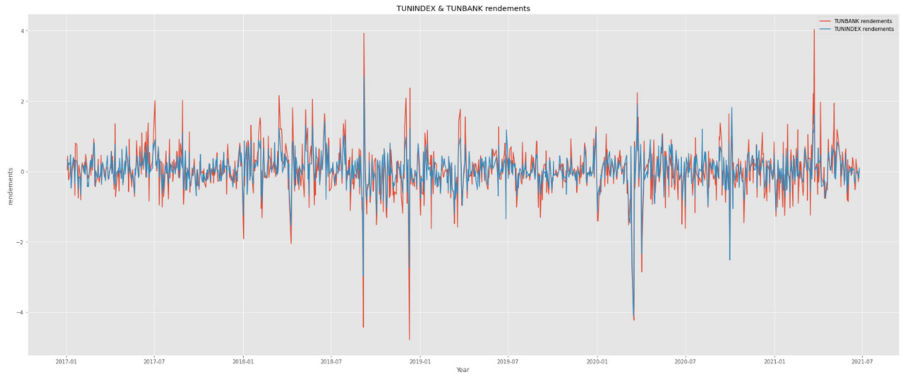
S o u r c e : author's own elaboration.

The graphs in figure 1 show the evolution of daily returns for the banking sector (TUNBANK index) and the overall market, including the banking sector (TUNINDEX), for the period from January 1, 2017, to June 25, 2021.

These trends are characterized by a series of volatility spikes. The time series chart of index returns shows cyclical movements over the period under

review. We then identified critical dates characterized by a notable decline in TUNBANK index returns, as shown in figure 2.

Figure 2. Time Series of Stock Return for the TUNBANK Index



S o u r c e : author's own elaboration.

The peak volatility illustrated in figure 2, covering the period from early 2018 to early 2021, can be linked to a series of major events that impacted all sectors of several markets around the world.

These include terrorist attacks, natural disasters such as Hurricanes Florence and Michael in the United States, floods in southern France, and the Notre Dame de Paris fire in April 2019.

In terms of financial shocks, the Tunisian market experienced an increase in the key interest rate during this period, which led to higher interest rates and therefore lower returns for TUNBANK. The surge in exchange rates, particularly the euro/dinar rate, which exceeded the 3 threshold due to the decline in foreign exchange reserves, may also help explain the decline in TUNBANK and TUNINDEX index returns.

Finally, the health crisis caused by COVID-19, the total lockdown, and the slowdown in the economic system, which suffered from the pandemic, may also provide a plausible explanation for the fluctuation in the returns of the TUNBANK and TUNINDEX indices.

Model Specification

To calculate value at risk (VaR), we chose to use the semi-parametric method presented by Adesi & Giannopoulos (1999), namely filtered historical simulation, as it is perfectly suited to abnormal distributions. It handles asymmetric distributions and clusters of high volatility.

It is a combination of non-parametric simulation methods and parametric conditional volatility models that is relatively simple to apply. It does not require any assumptions about the distribution of returns, but guarantees high-quality estimates. According to Paolella & Taschini (2008), this method is therefore considered "very effective".

To correct for heteroscedasticity, a GARCH filter was used to process the residuals. We then scaled the normalized residual returns in ascending order.

The VaR of bank i in quantile q is:

$$VaR_{q,t}^{i} = \mu_t + VaR_q\sqrt{h_t}, \quad (1)$$

μ_t is the expected return,
h_t is the standardized standard deviation.
Applying equation (1), we obtain the series of daily VaR_q^i.

Historical simulation does not require any assumptions about the statistical distribution of market factors. It is calculated based on the definition of VaR. Using historical data, we simulate future profits and calculate potential losses. This method ranks the N historical profit data points from lowest to highest, then the critical profit value R* at $(1 - \alpha) * N$ is the estimated VaR value.

The most appropriate method for measuring market risk co-dependence is quantile regression. It offers a more detailed analysis than the OLS method, a simple and robust method for exploring the relationship between variables in extreme quantiles. Indeed, it allows us to take into account the non-linearity of dependencies between returns.

As a non-parametric technique, it does not require any assumptions about the distribution of variables. This avoids the bias inherent in the distribution assumptions of parametric methods.

We calculate coefficients of the regression α_q^i et β_q^i using this equation (2):

$$X_q^{i,sys} = \alpha_q^{sys} + \beta_q^{sys} X^{sys}, \quad (2)$$

with:

$X_q^{i,sys}$: Return of bank conditionally to that of the banking system to the quantile q,
X^{sys}: Return of the banking sector.

This method estimates the loss of bank i when the system faces an extreme event as follows:

$$CoVaR_{q,t}^{i\,/\,X^{sys}=VaR_q} = VaR_q^i \,/\, VaR_q^{sys} = \widehat{\alpha_q^{sys}} + \widehat{\beta_q^{sys}} VaR_{q,t}^{sys}, \quad (3)$$

where:

$VaR_{q,t}^i$: The VaR of the institution i to a $q\%$.

The use of the historical simulation method is justified in our case by the fact that the Tunisian financial market is not very developed, which considerably limits the available data, constituting an obvious flaw in the historical simulation method. This lack of data makes it more difficult to choose a very high confidence level. That is why we opted for a confidence level of 95%.

The outcome of the research process and conclusions

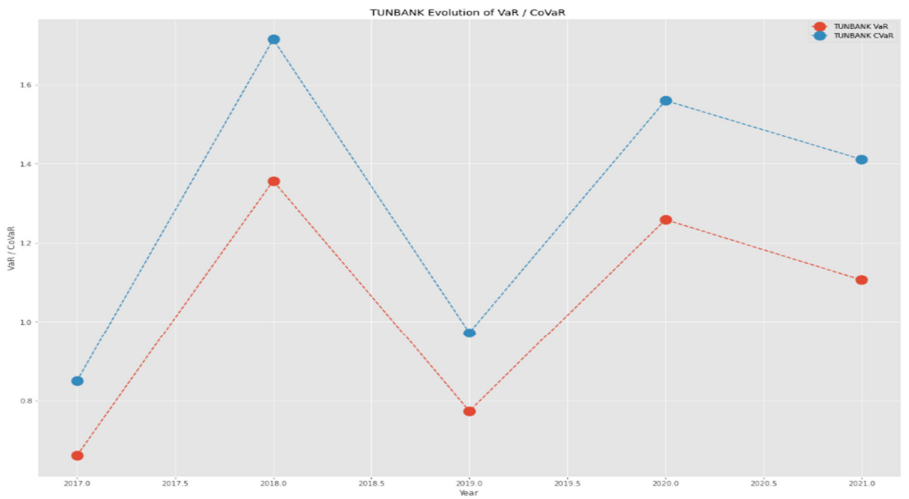
We present our main findings (further details are available in the appendix). Our data cover the period from January 2, 2017, to June 25, 2021, for a total of 1,119 daily observations of stock market closing prices. Our sample covers particularly the sharp declines in global stock markets during the COVID-19 outbreak in early 2020.

To justify the use of CoVaR, we compare the trend curves of the two measures. We plot the average VaR and COVaR of TUNBANK on an identical graph. This

resulted in the illustration shown in figure 3. VaR tends to underestimate risk, as it records the highest potential loss as lower than that calculated by CoVaR.

This is because VaR examines each bank in isolation, thereby neglecting the results of negative externalities (Adrian & Brunnermeier, 2014). In addition, CoVaR, which can be a conditional VaR, analyzes risk interdependencies. It thus compensates for the limitations of VaR by introducing the condition relating to the distress status of the financial arrangement. It therefore takes into account contagion effects and also the negative repercussions that the distressed industry will have on all its components (Adrian & Brunnermeier, 2014).

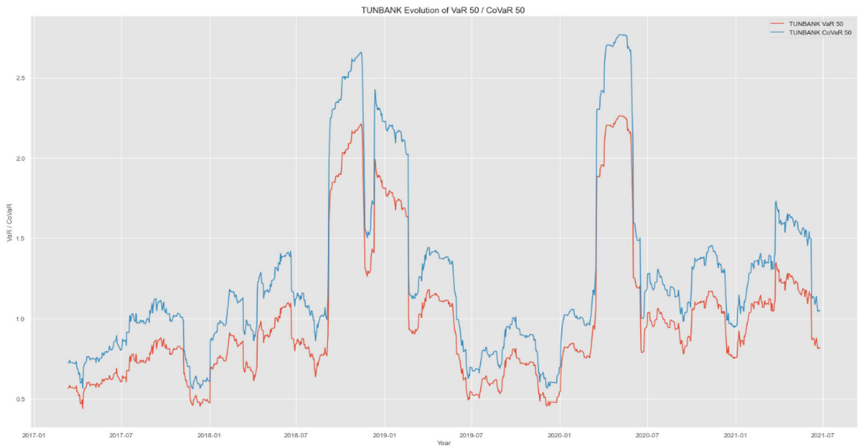
Figure 3. Average VaRs and CoVaRs of the TUNBANK



S o u r c e : author's own elaboration.

Figure 4 shows a continuous curve that facilitates the extraction of significant events. It also highlights the superiority of CoVaR in terms of quantifying systemic risk and helps to distinguish between the two periods characterized by sharp increases in risk measure values.

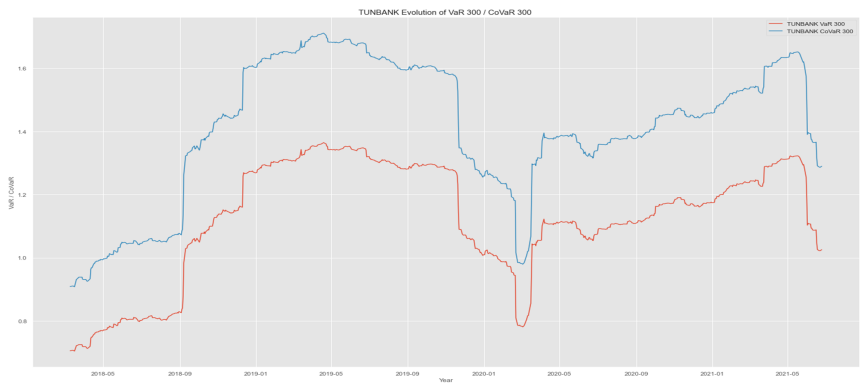
Figure 4. Average Risk Levels over 50 days Ongoing for the TUNBANK Index (CoVaR50[1] and VaR50[2])



S o u r c e : author's own elaboration.

The CoVaR300 and VaR300 presented in figure 5 help to detect risk trends relating to equities.

Figure 5. Average Risk Levels over 50 days Ongoing for the TUNINDEX Index (CoVaR300 et VaR300)



S o u r c e : author's own elaboration

[1] CoVaR50t is the average CoVaR of the last t-49 days as well as that of day t.
[2] VaR50t is the average of the VaR of the last t-49 days as well as that of day t.

Using VaR and CoVaR measures calculated on the basis of TUNBANK, we see that the level of risk expressed by the graphs corresponds to a peak in volatility in 2018 rather than at the end of 2020 and beginning of 2021. These seemingly abnormal levels can be explained by the 15% cap applied by the BVMT to the weighting of bank free floats when calculating the TUNBANK.

To mitigate this effect, we constructed a portfolio of twelve bank stocks whose weighting reflects the actual free floats of the banks concerned. The results of the VaR and CoVaR estimates are presented in tables 3, 4, and 5 and in figure 6.

Table 3. Annual VaR and CoVaR for TUNBANK Index

Year	VaR	CoVaR
2017	0.66258	0.849763
2018	1.356958	1.71491
2019	0.773896	0.972301
2020	1.258938	1.560069
2021	1.106336	1.411181

S o u r c e : author's own elaboration.

Table 4. Banks Annual VaR

	2017	2018	2019	2020	2021
Amen Bank	0.019352	0.016158	0.011771	0.021956	0.022575
ATB	0.024025	0.017447	0.037579	0.028512	0.020413
Attijari Bank	0.0159	0.026252	0.025707	0.021724	0.025423
BH	0.034082	0.02523	0.028134	0.029076	0.025667
BIAT	0.01589	0.02329	0.017057	0.022546	0.075916
BNA	0.022815	0.026563	0.018012	0.023951	0.025796
BT	0.011516	0.030837	0.01405	0.016669	0.018992
BTE	0.027135	0.032843	0.034406	0.036495	0.03826
STB	0.028606	0.0324	0.028979	0.028192	0.025239
UBCI	0.021047	0.021791	0.027884	0.033038	0.025277

Table 4. Banks…

	2017	2018	2019	2020	2021
UIB	0.012649	0.023263	0.019381	0.025679	0.024946
Wifack Int Bank	0.013712	0.015835	0.019887	0.020857	0.007983

S o u r c e : author's own elaboration.

Table 5. Banks Annual CoVaR

	2017	2018	2019	2020	2021
Amen Bank	0.024292	0.020427	0.01482	0.027241	0.028251
ATB	0.030077	0.021756	0.047302	0.035433	0.025428
Attijari Bank	0.0200251	0.033071	0.032035	0.027121	0.032222
BH	0.042787	0.03129	0.035258	0.036248	0.032447
BIAT	0.020271	0.029245	0.021369	0.028115	0.09472
BNA	0.028892	0.033538	0.022435	0.029757	0.032224
BT	0.014487	0.033538	0.022435	0.020807	0.023683
BTE	0.034164	0.040797	0.042967	0.045651	0.047832
STB	0.035822	0.040677	0.036627	0.035056	0.031327
UBCI	0.026404	0.027271	0.035279	0.04107	0.031878
UIB	0.01608	0.029271	0.024317	0.031941	0.031232
Wifack Int Bank	0.017169	0.019837	0.024913	0.026123	0.01016

S o u r c e : author's own elaboration.

Figures 5 and 6 further demonstrate the superiority of CoVaR over VaR. On the other hand, these figures show that systemic risk at the end of 2020 and the beginning of 2021 is greater than in 2018.

Figure 6. Bank Portfolio Annual Risk Levels

S o u r c e : author's own elaboration.

According to our portfolio, the COVID-19 period presents more uncertainty and risks of contagion and spread of the crisis to the entire economy than the 2018 period (despite all the circumstances surrounding the latter).

Figure 6 shows the evolution of annual risk. We note that the two measures of systemic risk behave in the same way during the COVID-19 period. They peak at the beginning of 2021 and reach their highest values at that date. This significant systemic risk can be attributed in part to the increase in the key interest rate, which led to higher interest rates and thus lower returns for TUNBANK. Similarly, the surge in exchange rates, particularly the euro/dinar rate, which exceeded the 3 thresholds due to declining foreign exchange reserves, may also help explain this spike in systemic risk measures and increased oil price volatility.

Appendix 1 allows a better visualization of systemic risk before, during, and after the pandemic crisis. Table 4 presents the average of systemic risk during the study period. The results show that the year 2020, was a major eco-

nomic turning point. This year was marked by the global health crisis linked to COVID-19. This crisis had significant repercussions on the Tunisian banking sector, visible through variations in CoVaR. There was an increase in CoVaR between 2019 and 2020 for most banks, indicating more contribution to systemic risk during the crisis (AMEN BAK, BIAT, BNA, UBCI, UIB, BT, BTE). This increase reflects heightened systemic stress during the COVID crisis, and can be interpreted as the consequence of economic uncertainty, falling activity, deteriorating credit portfolios, and declining liquidity. These banks are typically medium-to-large institutions with substantial market presence, which amplifies their systemic footprint. As a result, their vulnerability during the crisis heightened the risk of financial contagion.

Three banks saw their CoVaR decline between 2019 and 2020 (ATB, ATTIJARI BANK, STB). These banks either benefited from stronger capitalization, more conservative risk profiles, or more effective crisis-management mechanisms. These declines suggest that these banks were less exposed or better managed the systemic shock, either through their strength or thanks to institutional or government support. They were perceived as less dangerous to the stability of the system during the crisis.

The year 2021, marking a partial economic recovery, shows mixed developments. Some banks are stabilizing their CoVaR (BNA, BT, BTE), but others are recording a decline (ATB, STB, UIB, WIFACK), reflecting a gradual easing of stress.

However, the systemic risk behavior of BIAT is significantly different which is quite surprising. During this period, the systemic risk of BIAT is highest in 2021. Considering that it is the third largest capitalization of the equity market, BIAT has historically low valuation levels even taking into account the impact of COVID-19 and the deterioration of the coverage rate of classified debts since 2014. Given the controlled level of the rate of classified debt, the additional hedging efforts to be made by the bank should be limited in time.

According to the Group's consolidated financial statements, the percentage of the Group's banking operating income at BIAT, which ended on December 31, 2020, decreased by 3.38% to BN 1,586.6 from BN 1,642.1 in 2019. The Group generated net banking income of €1,034bn at end-2020, compared with €1,042.8bn the previous year, representing a very slight decrease of 0.84%. Over the same period, operating income fell by 14.2% due to the increase in provisions, with a risk ratio of 25.43% to 154.1 billion.

These statistics suggest that BIAT faced post-crisis adjustments – notably higher provisioning, strategic repositioning, and asset-quality concerns – that elevated its systemic importance in 2021. Given its large size, deep market interconnectedness, and central role in credit intermediation, any distress at BIAT carries stronger systemic implications. Therefore, the rise in CoVaR in 2021 may reflect the market's anticipation of slower recovery within a large, structurally important bank.

Overall, the recovery from the COVID-19 pandemic has not been uniform across the Tunisian banking sector, and differences in bank size and capitalization can be considered ones of principal factors. First, large and highly interconnected banks tended to amplify systemic stress during the crisis and, in some cases (like BIAT), continued to exhibit elevated systemic risk during the recovery. Second, better-capitalized or state-supported banks (such as Attijari Bank and STB) showed more resilience and even reduced systemic impact during the crisis period. Finally, smaller or moderately sized banks generally benefited more rapidly from the post-crisis recovery, reducing their CoVaR as macroeconomic conditions improved. These findings underscore that systemic risk is not only cyclical but also structurally linked to bank size, capitalization, and strategic positioning.

The COVID-19 health crisis has impacted the global economy. As a result, banks faced high default and liquidity risks, as well as losses in intermediate income. The interconnection between them can lead to the spread of individual problems throughout the institution's network, leading to a general overheating of the financial system.

The results show an increase in systemic risk during the COVID-19 period for the sampled banks. However, by the end of April 2020, they show flattened systemic risk curves that may be due to the government's policy responses. These results certainly have managerial implications. First, the results demonstrate the positive response of systemic risk to policy responses, as discussed in the theoretical part.

Second, institutions that are considered systemically important in the COVID-19 era can serve as reference tools for regulators to better manage systemic risk. In a context of uncertainty, these results can help all stakeholders (policymakers, investors, portfolio managers) align their investment strategies with long-term macroprudential policies. For future research, we propose analyzing the causal relationship between systemic risk and policy responses.

References

Acharya, V.V., Brunnermeier, M.K., & Pierret, D. (2025). *Systemic risk measures: From the Panic of 1907 to the banking stress of 2023* (NBER Working Paper No. 33211). National Bureau of Economic Research. https://doi.org/10.3386/w33211.

Acharya, V.V., Engle, R.F., & Steffen, S. (2021). Why Did Bank Stocks Crash during COVID-19? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3799590.

Acharya, V.V., Engle, R.F., Jager, M., & Steffen, S. (2023). *Why Did Bank Stocks Crash during COVID-19? The Review of Financial Studies, 37*(9), 2627–2684. https://doi.org/10.1093/rfs/hhae028.

Adesi, G.B., & Giannopoulos, K. (1999). VaR without correlations for portfolios of derivative securities. *Journal of Futures Markets*, 19(5), 583–602. https://doi.org/10.1002/(SICI)1096-9934(199908)19:5%3C583::AID-FUT5%3E3.0.CO;2-S.

Adrian, T., & Brunnermeier, M.K., Federal Reserve Bank of New York, Institute for Quantitative Investment Research Europe, & Alfred P. Sloan Foundation. (2014). COVAR. In *Federal Reserve Bank of New York Staff Reports* (No. 348). https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr348.pdf (accessed: 03.02.2026).

Adrian, T., & Brunnermeier, M.K. (2016). CoVaR. *American Economic Review*, 106(7), 1705–1741. https://doi.org/10.1257/aer.20120555 jrc.princeton.edu+2ideas.repec.org+2.

Barro, R., Ursúa, J., & Weng, J. (2020). *The Coronavirus and the Great Influenza Pandemic: Lessons from the "Spanish Flu" for the Coronavirus's Potential Effects on Mortality and Economic Activity*. https://doi.org/10.3386/w26866.

Bartik, A.W., Bertrand, M., Cullen, Z.B., Glaeser, E.L., Luca, M., & Stanton, C.T. (2020). How are small businesses adjusting to COVID-19? Early evidence from a survey (NBER Working Paper No. 26989). *National Bureau of Economic Research.* https://doi.org/10.3386/w26989.

Barua, S. (2020). Understanding Coronanomics: The Economic implications of the coronavirus (COVID-19) pandemic. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3566477.

Baumöhl, E., Bouri, E., Hoang, T.-H.-V., Shahzad, S.J.H., & Výrost, T. (2022). Measuring systemic risk in the global banking sector: A cross-quantilogram network approach. *Economic Modelling*, 109, 105775. https://doi.org/10.1016/j.econmod.2022.105775.

Beck, T., & Keil, J. (2020). Are banks catching corona? Effects of COVID on lending in the U.S. *CEPR Discussion Paper/SSRN*. https://doi.org/10.2139/ssrn.3766831 ResearchGate+2papers.ssrn.com+2.

Boda, M. (2016). The impact of the 2007–2009 financial crisis on risk management in credit institutions. *Copernican Journal of Finance & Accounting*, 5(2), 45–56. https://doi.org/10.12775/CJFA.2016.014.

Borri, N., & Di Giorgio, G. (2022). Systemic risk and the COVID challenge in the European banking sector. *Journal of Banking & Finance*, 140, 106073. https://doi.org/10.1016/j.jbankfin.2021.106073.

Chavleishvili, S., & Kremer, M. (2023). Measuring Systemic Financial Stress and its Risks for Growth. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4551569.

Cheema-Fox, A., La Perla, B.R., Serafeim, G., & Wang, H. (2020). Corporate resilience and response during COVID-19. *SSRN.* https://doi.org/10.2139/ssrn.3578167.

Chen, H., Qian, W., & Wen, Q. (2020). The Impact of the COVID-19 Pandemic on Consumption: Learning from High Frequency Transaction Data. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3568574.

Demirgüç-Kunt, A., Pedraza, A., & Ruiz-Ortega, C. (2021). *Banking sector performance during the COVID-19 crisis*. *Journal of Banking & Finance*, 133, Article 106305. https://doi.org/10.1016/j.jbankfin.2021.106305.

Ding, W., Levine, R., Lin, C., & Xie, W. (2020). Social distancing and social capital: Why U.S. counties respond differently to COVID-19. *NBER Working Paper No. 27393*. *National Bureau of Economic Research.* https://doi.org/10.3386/w27393.

Ding, W., Levine, R., Lin, C., & Xie, W. (2021). Corporate immunity to the COVID-19 pandemic. *Journal of Financial Economics*, 141(2), 802–830. https://doi.org/10.1016/j.jfineco.2021.03.005.

Eichenbaum, M.S., Rebelo, S., & Trabandt, M. (2020). The macroeconomics of epidemics (NBER Working Paper No. 26882). *National Bureau of Economic Research.* https://doi.org/10.3386/w26882.

Fahlenbrach, R., Rageth, K., & Stulz, R.M. (2020). *How valuable is financial flexibility when revenue stops? Evidence from the COVID-19 crisis. Review of Financial Studies*, 34(11), 5474–5521. https://doi.org/10.1093/rfs/hhaa134.

Fernandes, N. (2020). Economic effects of coronavirus outbreak (COVID-19) on the world economy. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3557504.

Fiori, A.M., & Coenders, G. (2025). Turning Points in the Core–Periphery Displacement of Systemic Risk in the Eurozone: Constrained Weighted Compositional Clustering. *Risks*, 13(2), 21. https://doi.org/10.3390/risks13020021.

Gomis-Porqueras, P., Ruprecht, R., & Zhou, X. (2023). A financial stress index for a small open economy: the Australian case. *Finance and Economics Discussion Series*, 2023–029, 1–43. https://doi.org/10.17016/feds.2023.029.

Guedhami, O., Knill, A. M., Megginson, W.L., & Senbet, L.W. (2021). The Dark Side of Globalization: Evidence from the Impact of COVID-19 on Multinational Companies. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3868449.

Hafiz, H., Oei, S., Ring, D.M., & Shnitser, N. (2020). Regulating in Pandemic: Evaluating economic and financial policy responses to the coronavirus crisis. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3555980.

Han, H., Linton, O., Oka, T., & Whang, Y.J. (2016). The cross-quantilogram: Measuring quantile dependence and testing directional predictability between time series. *Journal of Econometrics*, 193(1), 251–270. https://doi.org/10.1016/j.jeconom.2016.03.001.

Howell, S.T., Lerner, J., Nanda, R., & Townsend, R.R. (2020). Financial distancing: How venture capital follows the economy down and curtails innovation (NBER Working Paper No. 27150). *National Bureau of Economic Research.* https://doi.org/10.3386/w27150.

Huang, X. (2025). Financial Systemic Risk and the COVID-19 Pandemic. *Risks*, 13(9), 169. https://doi.org/10.3390/risks13090169.

Huang, Z. (2023). Systemic risk in banking against the backdrop of the COVID-19 pandemic. *Systems*, 11(2), 87. https://doi.org/10.3390/systems11020087.

International Corporate Governance Network. (2018). *ICGN global governance principles. International Corporate Governance Network*.

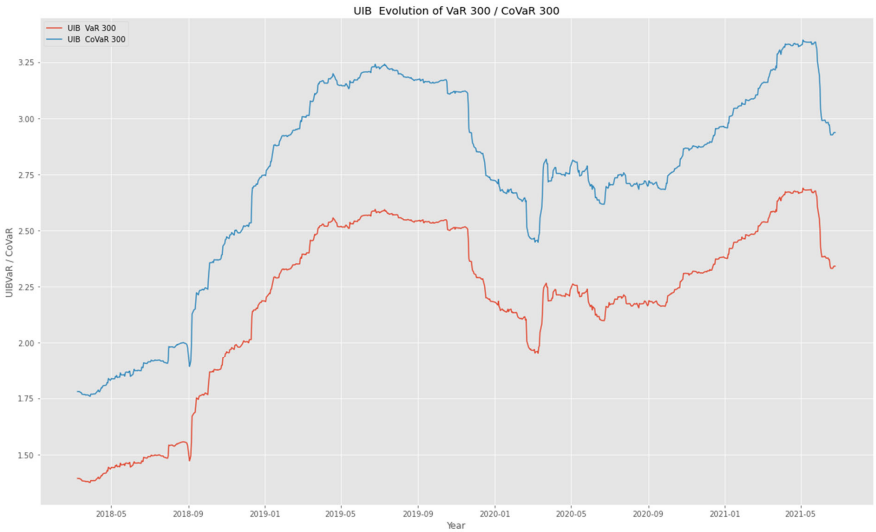
Oguntuase, O.J., & Ajibare, A.O. (2024). Quo Vadis Climate Transition Risk? A Literature Review and Recommendations. *Copernican Journal of Finance & Accounting*, 13(2), 63–87. http://dx.doi.org/10.12775/CJFA.2024.008.

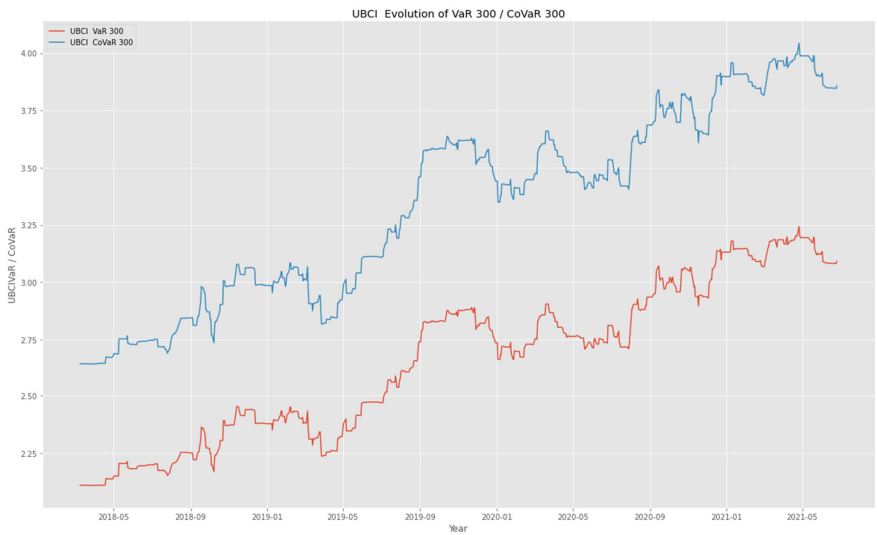
Ozili, P. K., & Arun, T. (2020). Spillover of COVID-19: Impact on the global economy. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3562570.

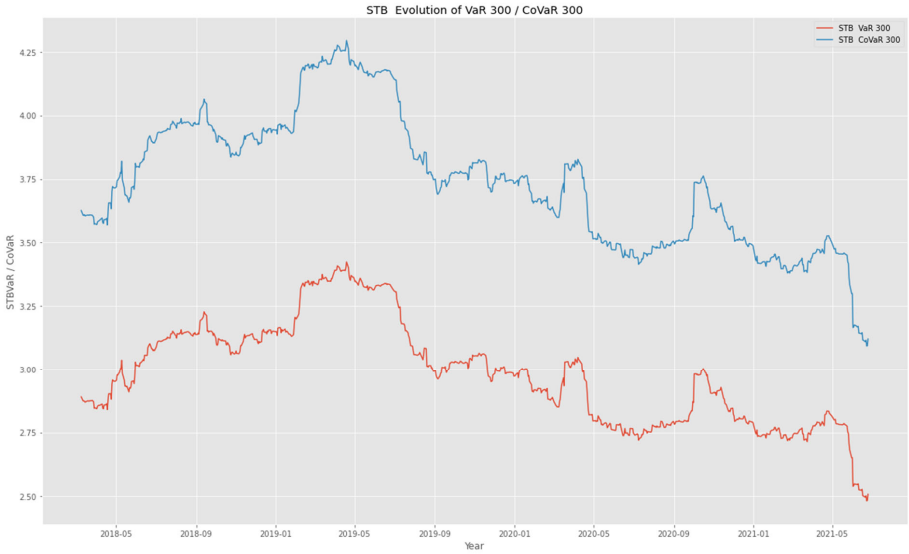
Paolella, M. S., & Taschini, L. (2008). An econometric analysis of emission allowance prices. *Journal of Banking & Finance*, 32(10), 2022–2032. https://doi.org/10.1016/j.jbankfin.2007.09.024.

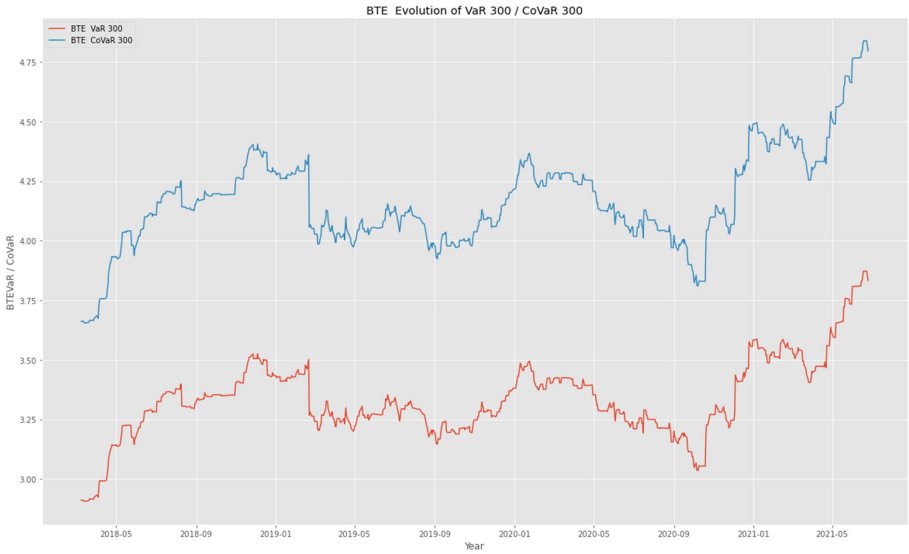
Yan, Y., Jeon, B. N., & Wu, J. (2023). The impact of the COVID-19 pandemic on bank systemic risk: Some cross-country evidence. *China Finance Review International*, 13(3), 388–409. https://doi.org/10.1108/CFRI-08-2022-0158.

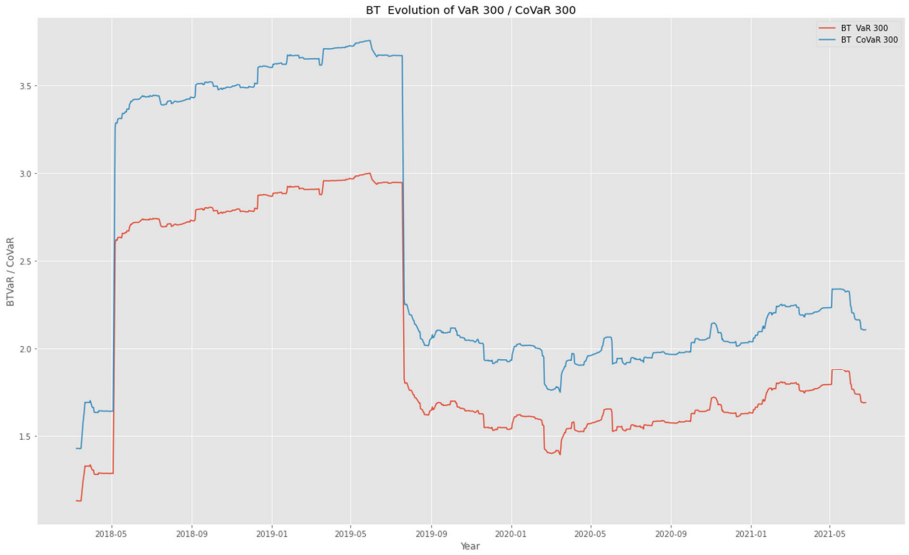
Appendix 1. Individual Banks VaRs300 et CoVaRs300

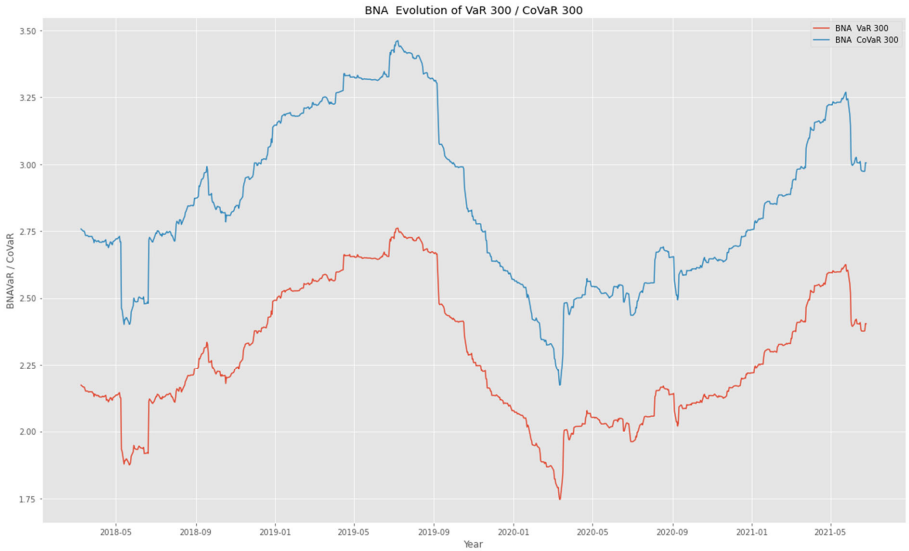


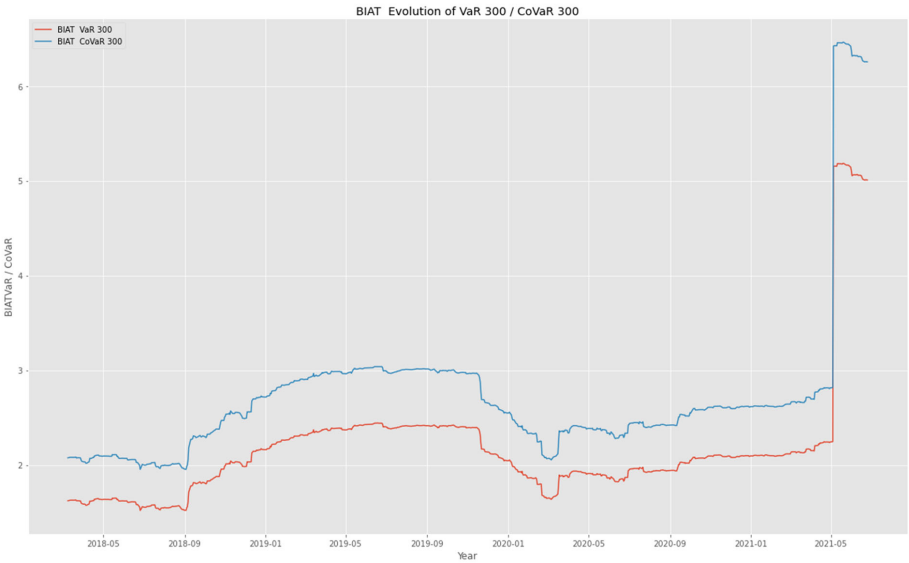


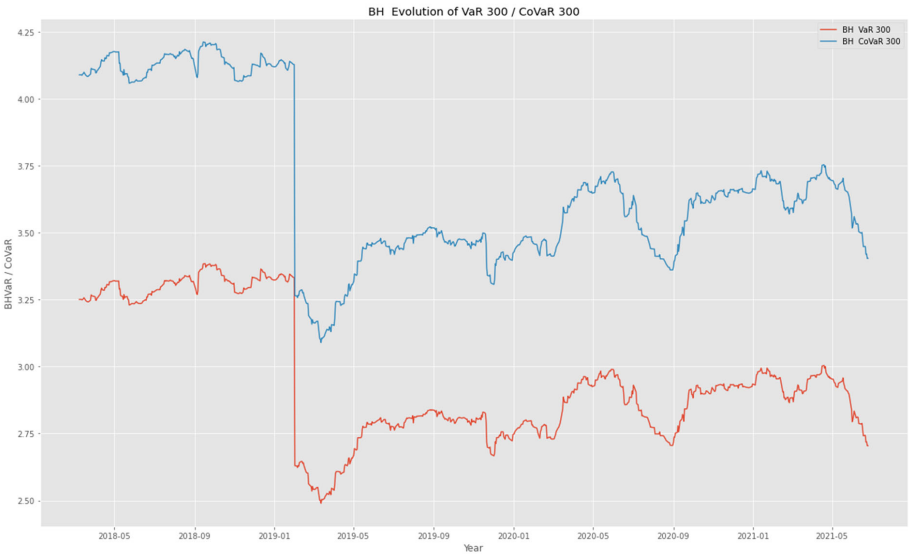

STB Evolution of VaR 300 / CoVaR 300
STB VaR 300
STB CoVaR 300
STB VaR / CoVaR
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year

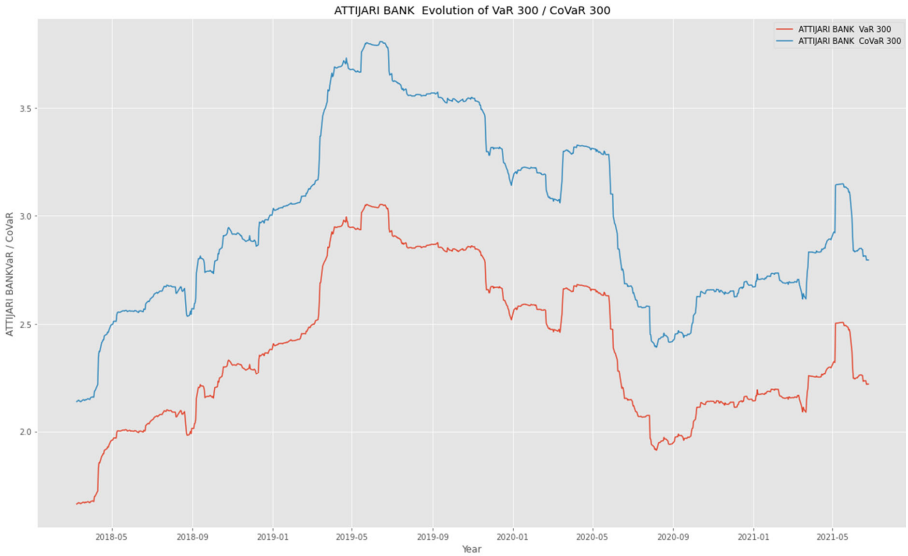

BTE Evolution of VaR 300 / CoVaR 300
BTE VaR 300
BTE CoVaR 300
BTE VaR / CoVaR
4.75
4.50
4.25
4.00
3.75
3.50
3.25
3.00
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year

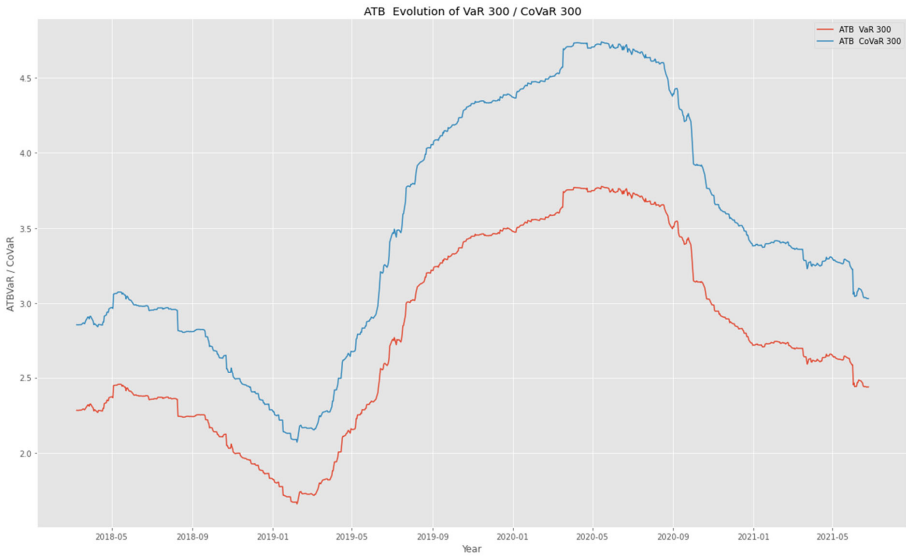

BT Evolution of VaR 300 / CoVaR 300
BT VaR 300
BT CoVaR 300
BTVaR / CoVaR
3.5
3.0
2.5
2.0
1.5
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year

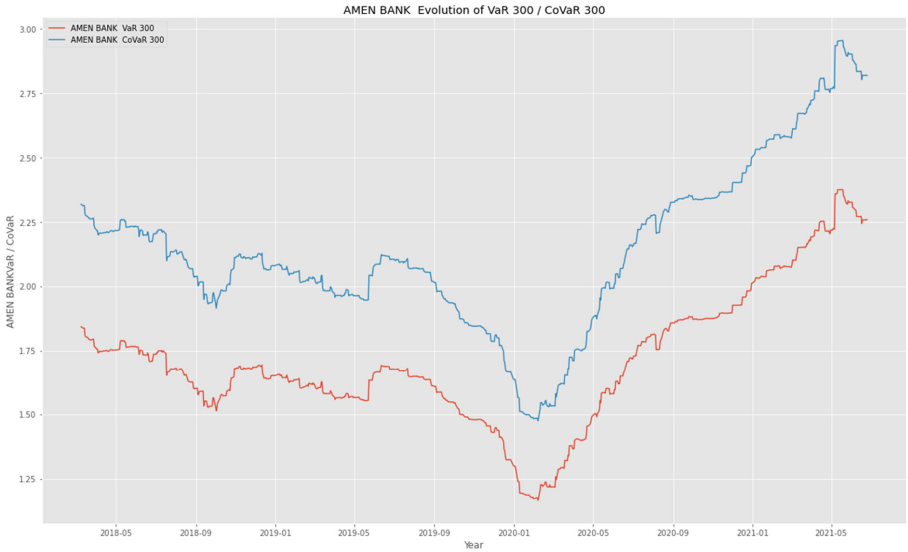

BNA Evolution of VaR 300 / CoVaR 300
BNA VaR 300
BNA CoVaR 300
BNAVaR / CoVaR
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year

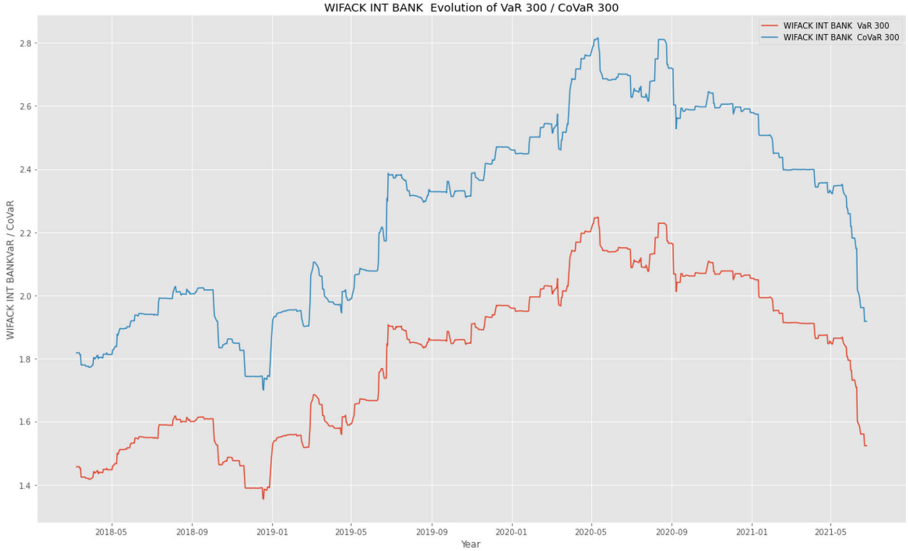

BIAT Evolution of VaR 300 / CoVaR 300
BIAT VaR 300
BIAT CoVaR 300
BIATVaR / CoVaR
6
5
4
3
2
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year


BH Evolution of VaR 300 / CoVaR 300
BH VaR 300
BH CoVaR 300
BHVaR / CoVaR
4.25
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year


ATTIJARI BANK Evolution of VaR 300 / CoVaR 300
ATTIJARI BANK VaR 300
ATTIJARI BANK CoVaR 300
ATTIJARI BANKVaR / CoVaR
3.5
3.0
2.5
2.0
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year


ATB Evolution of VaR 300 / CoVaR 300
ATB VaR 300
ATB CoVaR 300
ATBVaR / CoVaR
4.5
4.0
3.5
3.0
2.5
2.0
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05
Year


AMEN BANK Evolution of VaR 300 / CoVaR 300
AMEN BANK VaR 300
AMEN BANK CoVaR 300
AMEN BANKVaR / CoVaR
Year
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05


WIFACK INT BANK Evolution of VaR 300 / CoVaR 300
WIFACK INT BANK VaR 300
WIFACK INT BANK CoVaR 300
WIFACK INT BANKVaR / CoVaR
Year
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
2018-05
2018-09
2019-01
2019-05
2019-09
2020-01
2020-05
2020-09
2021-01
2021-05