SECTORAL CONNECTEDNESS AND RISK SPILLOVERS IN THAILAND'S STOCK MARKET

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PIER | Research Workshop
LIGHTNING SESSION
29th – 30th June 2023

The Motivation

Motivation (1)

- **Volatility is essential:** a measurement of financial risk or uncertainty surrounding financial asset investment
- **Total connectedness** in securities can be attributed to the level of **systematic risk**.
- Different sectors respond to a shock in different ways and it might extend to other industries. **“Sectoral spillover ” or “ Sectoral connectedness”**
- Determining the mechanisms through which risk is transmitted among different sectors in the stock exchange of Thailand could help investors develop **better portfolio diversification** and **hedging strategies**, as well as the policymakers **select the most effective policy actions**.

Motivation (2)

- **The outbreak of COVID-19**: the loss of human lives and the decline in economic activities
- **A decline in the overall Thai stock market returns**; however, the nature in which the pandemic event affects sectoral volatility returns, as well as the intersectoral linkage aspects of volatility spillovers, has been slightly discussed until now.
- Our work attempts to fill up this gap in the recent Thai literature.

Data and Research Methodology

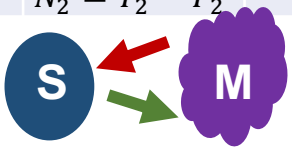
Data and Research Methodology (1)

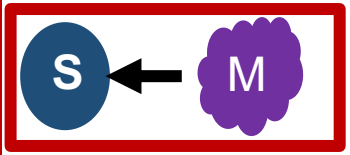
ARMA-GARCH(1,1)	Implied Sectoral Volatilities
Vector Autoregression (VAR) framework	The Volatility in sector-i, that is attributed to Volatility shocks in sector-j. GIRF, FEVD

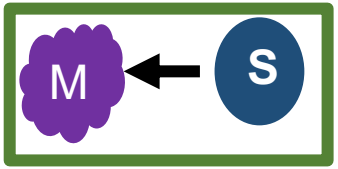
Diebold and Yilmaz (2014)

Data and Research Methodology (2)

	$\sigma^2_{1,t}$	$\sigma^2_{2,t}$	…	$\sigma^2_{K,t}$	FROM others
$\sigma^2_{1,t}$	d_{11}	d_{12}	…	d_{1K}	$F_{1\leftarrow.} = \sum_{j\neq 1} d_{1j}$
$\sigma^2_{2,t}$	d_{21}	d_{22}	…	d_{2K}	$F_{2\leftarrow.} = \sum_{j\neq 2} d_{2j}$
⋮	⋮	⋮		⋮	⋮
$\sigma^2_{K,t}$	d_{K1}	d_{K2}	…	d_{KK}	$F_{K\leftarrow.} = \sum d_{2j}$
TO others	$T_{.\leftarrow 1} = \sum d_{i1}$	$T_{.\leftarrow 2} = \sum d_{i2}$	…	$T_{.\leftarrow K} = \sum d_{iK}$	$\frac{\sum_{i\neq j} d_{ij}}{K}$
NET	$N_1 = T_1 - F_1$	$N_2 = T_2 - F_2$	…	$N_K = T_K - F_K$	







Sectoral connectedness matrix (Source: Adapted from Diebold and Yilmaz (2014))

Data and Research Methodology (3)

- The daily data of 11 sector indices in the Stock Exchange of Thailand

- The series is divided into two periods;
  1. **The pre-COVID period** and the COVID period (from Jan 2012 to Dec 2019) (2087 trading day obs, prior to 2012 - massive flooding.)
  2. **The COVID period** is from Jan 2020 to Dec 2021 (523 trading day obs, the Wuhan cases were first reported by WHO on Dec 31, 2019.

- **The 11 sectors** in the Stock Exchange of Thailand include Automobile(AUTO), Banking(BANK), Commerce (COMMERCE), Construction Materials (CONS), Fashion (FASHION), Insurance (INSUR), Packaging (PACKAGE), Finance and Securities (FINANCE), Food and Beverages (FOOD), Petrochemicals and Chemicals (PETRO), and Tourism and Leisure (TOURISM).

- The data is obtained from Thompson Reuters DataStream International.

The Results

The ARMA-GARCH(1,1) results

The Pre-COVID Period

Variance Equation	AUTO	BANK	COMMERCE	CONS	FASHION	FINANCE
Arch	0.1465***	0.0551***	0.0901***	0.0397***	0.1008***	0.1464***
(alpha)	(0.0325)	(0.0100)	(0.0158)	(0.0088)	(0.0197)	(0.0241)
Garch	0.7569***	0.9422***	0.9005***	0.9512***	0.8520***	0.8231***
(beta)	(0.0001)	(0.0096)	(0.0154)	(0.0105)	(0.0231)	(0.0234)
Constant	1.02 ($\times10^{-5}$)***	7.52 ($\times10^{-7}$)**	1.67($\times10^{-6}$)**	1.12($\times10^{-6}$)**	2.41($\times10^{-6}$)***	7.69($\times10^{-6}$)***
	(1.46 ($\times10^{-4}$))	(3.47($\times10^{-7}$))	(5.79($\times10^{-7}$))	(4.87($\times10^{-7}$))	(5.91($\times10^{-7}$))	(1.86($\times10^{-6}$))
alpha + beta	0.9034	0.9974	0.9906	0.9910	0.9528	0.9695
Variance Equation	**FOOD**	**INSURE**	**PACKAGE**	**PETRO**	**TOURISM**	
Arch	0.0972***	0.0571***	0.2134***	0.0612***	0.0380***	
(alpha)	(0.0177)	(0.0123)	(0.0426)	(0.0109)	(0.0084)	
Garch	0.8642***	0.9232***	0.6869***	0.9295***	0.9577***	
(beta)	(0.0220)	(0.0123)	(0.0467)	(0.0122)	(0.0088)	
Constant	3.63($\times10^{-6}$)***	1.84($\times10^{-6}$)***	1.64($\times10^{-6}$)***	2.78($\times10^{-6}$)**	9.71($\times10^{-7}$)**	
	(1.02($\times10^{-6}$))	(6.85($\times10^{-7}$)	(3.70($\times10^{-6}$))	(1.11($\times10^{-6}$))	(4.60($\times10^{-7}$))	
alpha + beta	0.9615	0.9803	0.9004	0.9907	0.9957	

Notes: Standard errors are in parentheses. Superscripts *, **, and *** denote the significance at 10 percent, 5 percent, and 1 percent confidence levels, respectively.

The COVID Period

Variance Equation	AUTO	BANK	COMMERCE	CONS	FASHION	FINANCE
Arch	0.2078**	0.0653**	0.0695***	0.0730***	0.1406**	0.1406***
(alpha)	(0.0938)	(0.0310)	(0.0269)	(0.0260)	(0.0566)	(0.0469)
Garch	0.6533***	0.9168***	0.8918***	0.8970***	0.6868***	0.7984***
(beta)	(0.0003)	(0.0314)	(0.0397)	(0.0317)	(0.1195)	(0.0545)
Constant	2.14($\times10^{-5}$)**	1.48($\times10^{-5}$)	5.95($\times10^{-6}$)*	5.01($\times10^{-6}$)***	1.09($\times10^{-6}$)**	2.22($\times10^{-6}$)**
	(3.40($\times10^{-4}$))	(9.31($\times10^{-6}$))	(3.36($\times10^{-6}$))	(2.68($\times10^{-6}$))	(5.24($\times10^{-6}$))	(9.93($\times10^{-6}$))
alpha + beta	0.8612	0.9822	0.9614	0.9700	0.8274	0.9390
Variance Equation	**FOOD**	**INSURE**	**PACKAGE**	**PETRO**	**TOURISM**	
Arch	0.0890***	0.1629**	0.0851**	0.0653***	0.0286**	
(alpha)	(0.0301)	(0.0658)	(0.0412)	(0.0200)	(0.0140)	
Garch	0.9047***	0.6531***	0.9138***	0.9258***	0.9709***	
(beta)	(0.0255)	(0.0658)	(0.0327)	(0.0198)	(0.0137)	
Constant	2.14($\times10^{-6}$)	2.69($\times10^{-5}$)**	6.68($\times10^{-6}$)	4.08($\times10^{-6}$)	1.62($\times10^{-6}$)*	
	(1.32($\times10^{-6}$))	(1.16($\times10^{-5}$))	(5.32($\times10^{-6}$))	(3.06($\times10^{-6}$))	(2.43($\times10^{-6}$))	
alpha + beta	0.9937	0.8160	0.9989	0.9910	0.9995	

Notes: Standard errors are in parentheses. Superscripts *, **, and *** denote the significance at 10 percent, 5 percent, and 1 percent confidence levels, respectively.

All estimated coefficients of variance equation (ARCH and GARCH coefficients) are significant at 10%; the results hold true under both sub-sample analyses. Moreover, the sums of the two coefficients associated with the volatility's equations (alpha + beta) are lower than one; the GARCH(1,1) estimations are stationary and stable. Given our simple diagnostic checking methods, we have detected **no signs of unusual results**.

The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand

The Pre-COVID Period

	AUTO	BANK	COM MERCE	CONS	FASHI ON	FIN- ANCE	FOOD	IN- SURE	PACK -AGE	PE- TRO	TOUR -ISM	FROM
AUTO	48.56	3.29	3.89	3.12	2.06	7.11	9.12	6.00	11.51	1.57	3.78	**51.44**
BANK	3.85	41.33	6.33	8.96	0.47	5.77	9.89	8.75	5.94	4.63	4.08	**58.67**
COM- MERCE	4.52	7.47	47.01	6.01	0.44	4.19	12.22	8.45	4.63	1.53	3.51	**52.99**
CONS	6.36	8.75	5.30	39.89	0.55	5.87	8.73	7.07	7.52	4.60	5.36	**60.11**
FASH- ION	4.19	0.60	0.75	0.65	81.41	1.28	2.38	0.90	6.85	0.53	0.47	**18.59**
FIN- ANCE	8.10	3.07	3.52	4.53	0.90	48.60	9.49	6.77	8.49	1.61	4.92	**51.40**
FOOD	6.06	6.85	11.56	7.31	1.37	7.06	35.90	7.78	9.20	2.22	4.68	**64.10**
INSURE	8.85	5.30	6.60	4.59	0.60	4.04	8.30	48.79	7.93	1.68	3.33	**51.21**
PACK- AGE	9.88	4.07	2.48	5.52	2.14	7.11	9.59	7.26	45.80	2.13	4.03	**54.20**
PETRO	4.45	5.99	2.19	5.49	0.88	3.11	5.11	3.93	10.79	54.85	3.19	**45.15**
TOUR- ISM	3.47	3.41	2.91	5.90	0.25	7.12	7.99	6.66	6.91	1.08	54.30	**45.70**
TO	**59.72**	**48.81**	**45.54**	**52.09**	**9.64**	**52.66**	**82.82**	**63.58**	**79.77**	**21.59**	**37.35**	**50.32**
NET	**8.28**	**-9.86**	**-7.45**	**-8.03**	**-8.95**	**1.25**	**18.72**	**12.37**	**25.57**	**-23.56**	**-8.35**	

The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand

The COVID Period

	AUTO	BANK	COM MERCE	CON S	FASHI ON	FIN- ANCE	FOOD	IN- SURE	PACK -AGE	PE- TRO	TOUR -ISM	FROM
AUTO	49.59	6.40	9.25	2.50	5.42	1.62	6.78	5.10	1.35	7.77	4.23	**50.41**
BANK	7.04	22.44	8.31	3.78	8.64	3.56	11.52	13.00	2.43	15.98	3.31	**77.56**
COM- MERCE	3.41	4.75	19.50	6.80	4.43	5.97	18.74	13.12	2.65	17.30	3.33	**80.50**
CONS	2.86	4.27	9.79	10.99	5.37	7.10	18.39	16.71	4.44	17.92	2.16	**89.01**
FASH- ION	3.31	3.77	9.06	4.24	35.22	3.67	12.38	11.45	4.46	11.64	0.80	**64.78**
FIN- ANCE	2.10	5.36	10.66	8.59	4.39	10.76	18.09	15.23	5.29	17.42	2.11	**89.24**
FOOD	3.09	5.14	12.43	6.31	3.40	6.27	19.76	17.23	3.87	20.26	2.23	**80.24**
INSURE	4.58	5.91	10.06	5.67	3.58	5.79	14.92	25.94	3.89	16.96	2.68	**74.07**
PACK- AGE	6.85	4.86	8.94	5.79	4.81	4.41	13.88	12.35	23.30	12.87	1.95	**76.70**
PETRO	3.08	6.44	10.93	5.41	3.89	4.33	17.01	18.35	3.13	25.34	2.09	**74.66**
TOUR- ISM	8.44	5.19	11.22	4.06	4.62	3.37	11.77	11.04	2.61	15.90	21.78	**78.22**
TO	**44.76**	**52.08**	**100.65**	**53.16**	**48.53**	**46.10**	**143.48**	**133.58**	**34.13**	**154.02**	**24.90**	**75.94**
NET	**-5.65**	**-25.48**	**20.14**	**-35.85**	**-16.25**	**-43.14**	**63.25**	**59.52**	**-42.57**	**79.36**	**-53.32**	

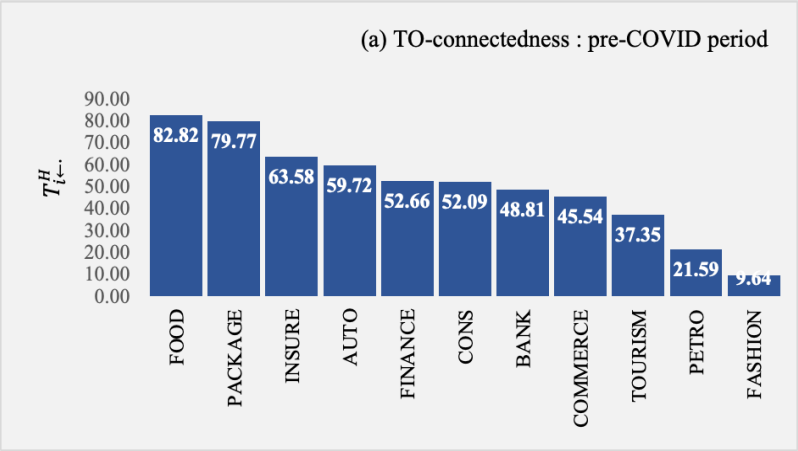
The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand

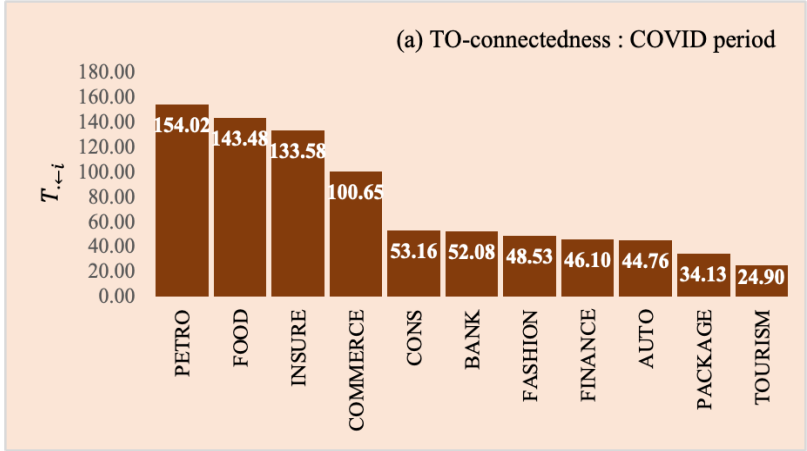
Overall, the total connectedness in the COVID period, **75.94**, is significantly higher than the pre-COVID period **50.32**. This increase in total connectedness may imply a **rise in systematic risk.** The degree of connectedness is related to systematic risk.

Risks that are not connected can be diversified, and as a result, cannot be systematic.

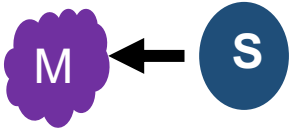
Many sectoral connectedness studies (Bui et al.(2022), Ekinci and Gençyürek (2021), Laborda and Olmo (2021), Shahzad et al. (2021)) also found that total connectedness increased sharply during the COVID-19 pandemic.

The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand



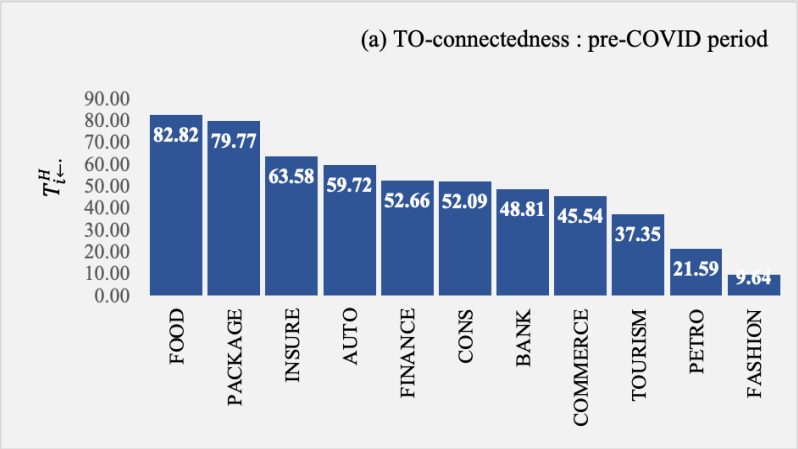


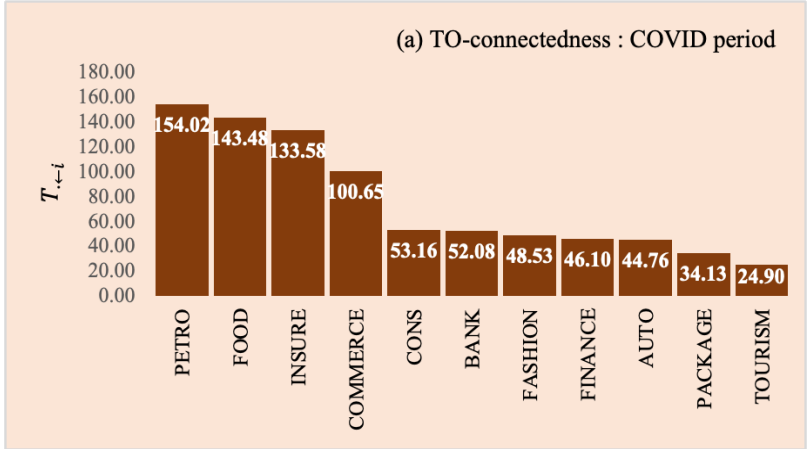
The Petrochemicals and Chemicals sector **was the second lowest transmission** of shocks to other sectors in the market, but during the pandemic, it had **the strongest volatility spillover effects** on other sectors.



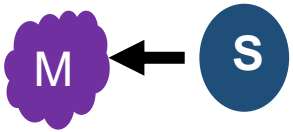
This result is in line with Ahmad et al. (2021), Choi (2022), Costa et al. (2022), and Laborda and Olmo (2021) : Volatilities Spillovers in the other stock markets. Hongsakulvasu et al. (2020) found that the impact of Singapore's oil price on SET is higher during the COVID-19 period

The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand

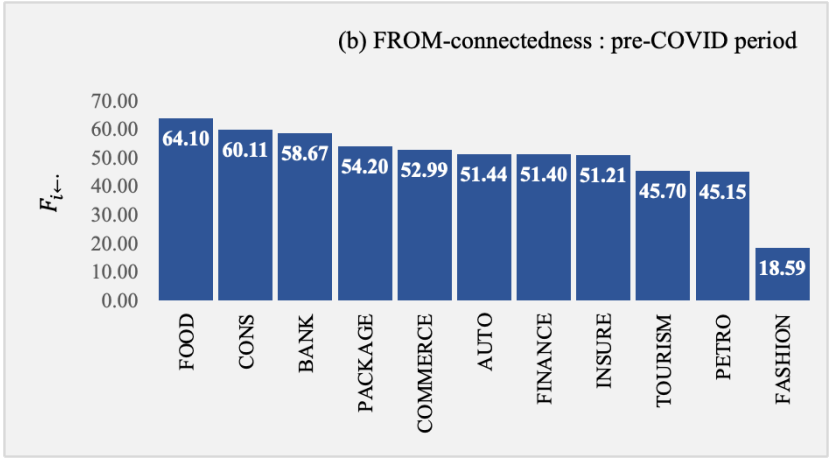


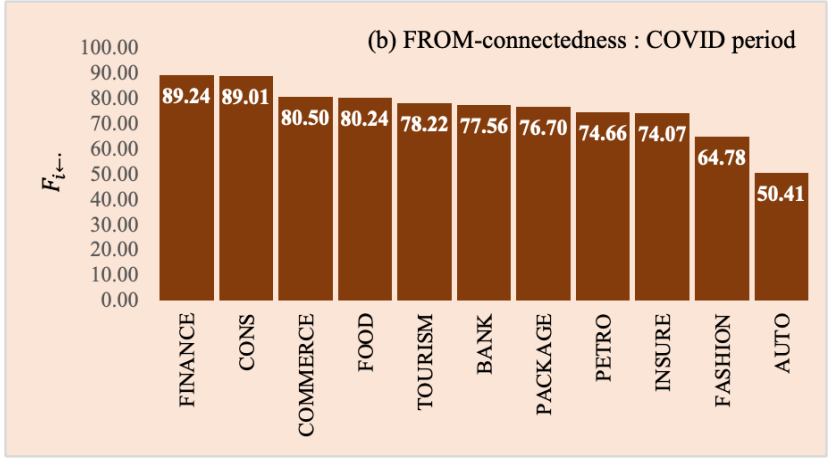


Banking and Finance and Securities do not transmit much volatility to the market both during the pre-COVID period and the COVID period.

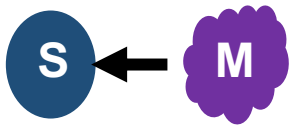


The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand



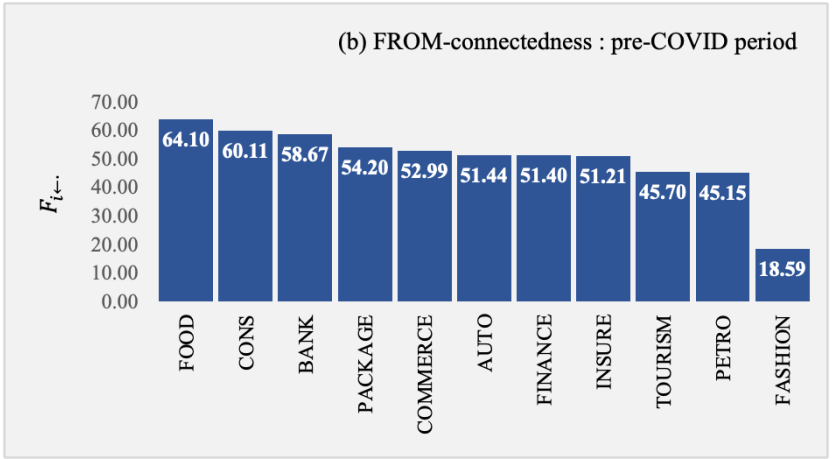


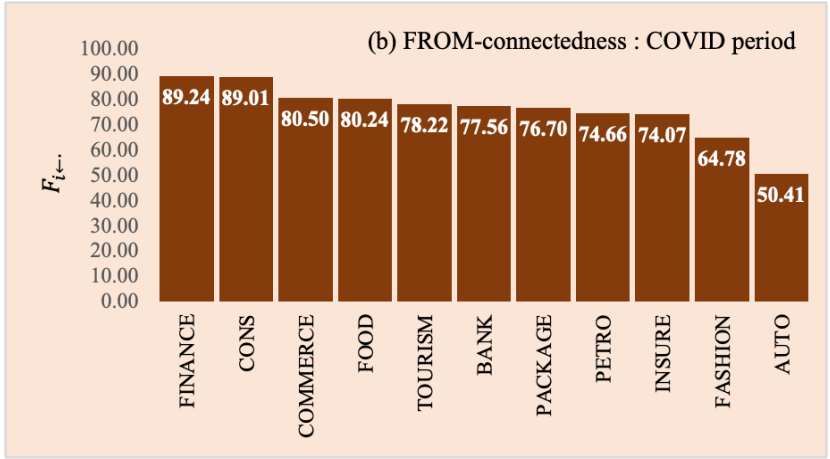
Before the COVID pandemic, **the Finance and Securities sector** was not among the sectors with the highest FROM-connectedness. The sector became the major receiver of the volatility shocks sent from the market during the COVID pandemic.



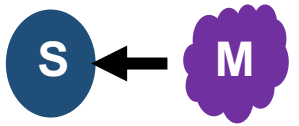
This result aligns with the finding of Panyagometh (2020). The COVID-19 had a significant negative impact on the business and household sectors, the primary clients of the financial sector

The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand



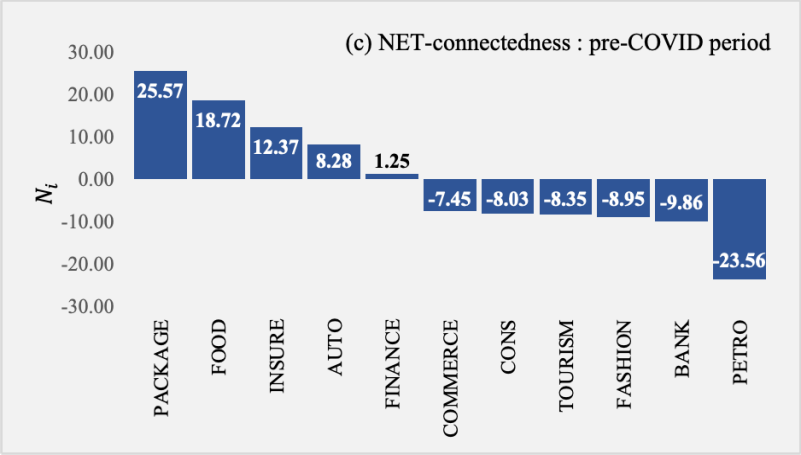


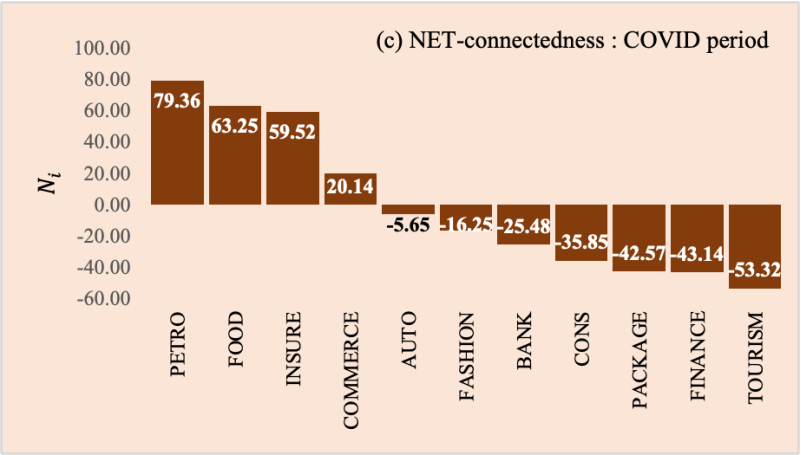
The Food and Beverage sector, on the other hand, had the highest FROM-connectedness before the pandemic but was not one of the major receivers during the pandemic.



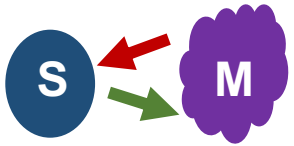
All industries were negatively affected by the situation. The Food and Beverage sector was relatively affected less by the shocks. The demand for food and beverage is usually steady, and it is not significantly affected by shocks in the market or external factors as much as other sectors in the economy due to its nature of necessities.

The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand





The role of certain sectors has shifted.

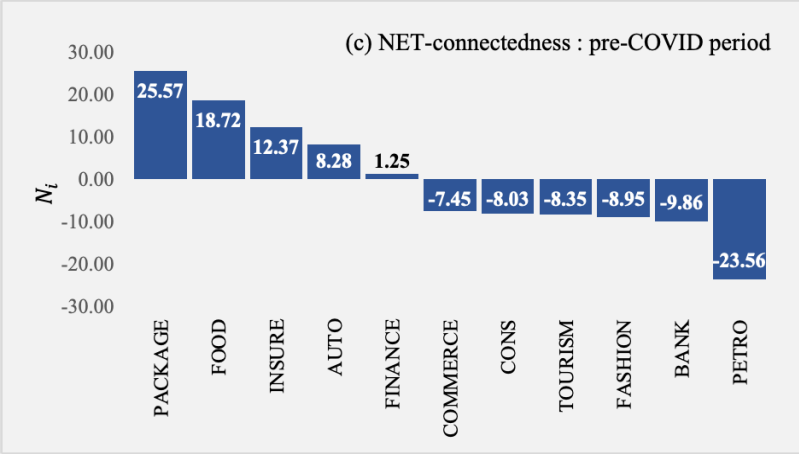


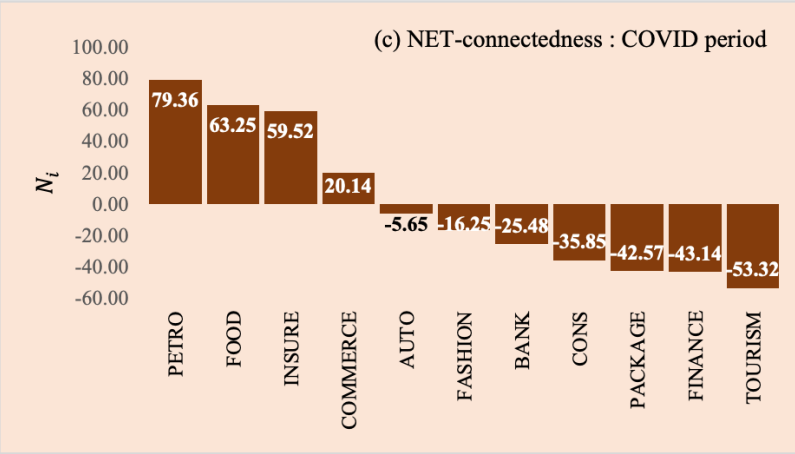
Automobile, Finance and Securities, and Packaging sectors switched their roles from **a transmitter** to **a receiver.**

Commerce and Petrochemicals and Chemicals sectors experienced a shift in their role from being **a receiver** to being **a transmitter**.

- Investors should be aware of the change in the risk spillover pattern

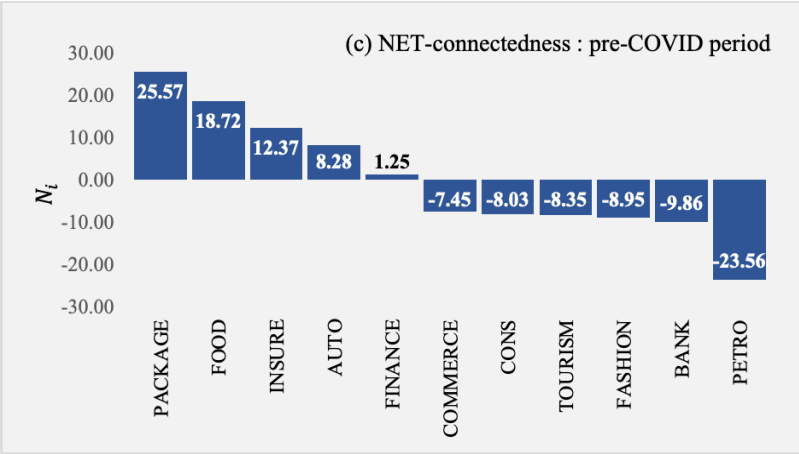
The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand

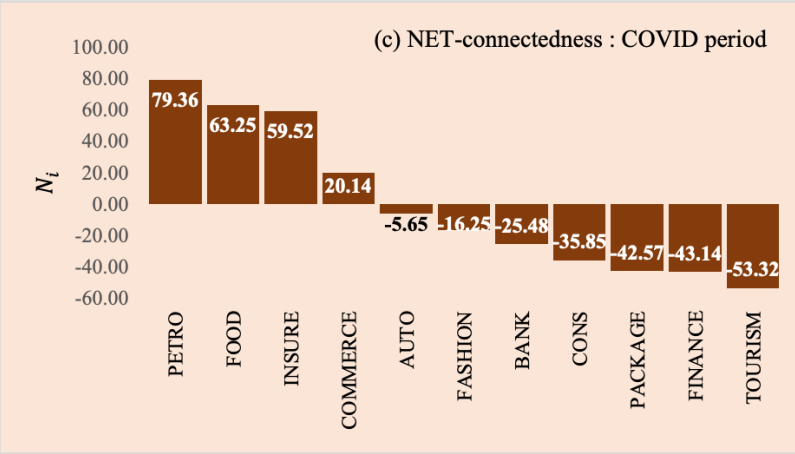




Tourism and Leisure sector became **the largest receiver of the shocks** (-53%).

The Spillovers Effects Across 11 Sectors in the Stock Exchange of Thailand





Banking and the Finance and Security sectors are **the net receivers** of the volatility shocks. The COVID situation is different from the financial crisis, in which the shocks began and spread from the Banking and Finance and Securities sectors. It is possible that the COVID shocks, on the other hand, directly impacted the real sectors and then the volatility shocks were transmitted to the financial sector.

Policymakers may need to monitor the state of the financial industry closely to prevent the economy from a financial crisis.

Conclusion

- Volatility spillovers are a reliable indicator of the transfer of risk between industries.
- There have been several changes in connectedness during the pre-COVID and COVID periods.
- The **spillover effect has intensified** during the COVID period.
- **The Petrochemical and Chemical** sector **was the main transmitter** while **the Finance and Security sector** was **the main receiver** during the COVID crisis.
- The COVID crisis could be different from a financial crisis (Laborda and Olmo (2021), the financial sector was the relevant risk transmitter during the global financial crisis.
- The stock market's activity may serve as a leading predictor of what will happen in the real economy. The finding that the financial industry was the primary receiver of the volatility shocks raised **concerns about the future stability of the financial system.**

Policymakers may need to monitor the state of the financial industry closely to prevent the economy from a financial crisis.