COVID-19, Mobility, and Stock Markets Performance: Evidence From ASEAN–5

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Time-series and time frequency domain analyses were used to examine the impact of mobility in ASEAN-5 stock markets. Using daily data, most markets (except for two) were found to have a long-run association with mobility. We found no Granger causality in the short run, except for two markets. The frequency domain analysis revealed strong co-movement between mobility and stock markets performance, as the impact of mobility can be seen over the longer period with the emergence of different COVID-19 variants. These findings offer further understanding on the impact of mobility-based causes on designing better investment strategies and policies.

I. Introduction

The world is currently facing a health crisis, which has altogether become a financial crisis. In March 2020, the World Health Organization (WHO) defined this fast-paced virus outbreak as a pandemic (AlAli, 2020; Gherghina et al., 2020). The confirmed cases of COVID-19 are reported as 395 million with more than 5.74 million death cases (Google, 2022). The pandemic has proved to have dire consequences, with much unexpected negative impact towards economic activities in addition to the causalities (Yilmazkuday, 2020). Given the rapid spread of COVID-19 with emergence of various variants and mutants, the worldwide economic and financial systems indicators show volatile positions, especially for stock markets, foreign exchange rate, and interest rate (Kartal et al., 2020).

To measure the severity of the financial impact due to the pandemic, the Google Mobility Index (*GMI*) was used as a proxy to study the mobility effect and the analysis restricted to stock markets' performance. This restriction was to reflect that less mobility by people, transportation, travelling, and businesses will result in various implications, particularly on business performance. As business revenue shrinks due to less demand and more supply, this shrinkage of revenue will subsequently cause share prices to drop and thereby influence stock indexes. The continued drop in mobility would result in investment withdrawal by investors which will severely impact the economy and financial performance of the country.

The recent literature on *GMI* and COVID-19 clearly evidence the fact that financial and economic movement are highly volatile and significantly subject to the mobility of an individual. This demands a better policy decision by considering the mobility factor of an individual during the pandemic (Kydland & Martínez-García, 2020).

In this paper, the ASEAN markets were used for these analyses as there are many studies dealing with developed markets, with less concentration on emerging economies like the ASEAN. Thus, the intention is to zoom in on how mobility affects the ASEAN stock markets, thus bringing the issue of COVID-19 and stock market performance into perspective. This paper thus duly claims two main contributions. First, I believe this is a pioneering paper dealing with ASEAN markets as the present literature mainly focuses on the developed and developing countries. The focus of this paper is mobility and its impact on the stock markets which has implications for investors as well as policymakers regarding the management of COVID-19. From a methodological perspective, this paper combines time-series and wavelet transform which have significant reference to investigation involving different time horizons.

The rest of the paper is organized as follows. Section II illustrates methodology. Section III discusses results and Section IV concludes the paper.

II. Data and Methodology

As stated, *GMI* was employed in this research to measure the mobility index.[1] The use of *GMI* shows a rapid increase in the recent literature investigating the issue of COVID-19 (Nouvellet et al., 2021). Returns for the stock indexes were calculated using the following formula: $R_t = [ln\,(P_t)\, -\, ln\,(P_{t-1})]/ln\,(P_{t-1})$ where R_t is represent return of the individual stock index and later for the equa-

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tion section, this variable proxied as a *MI*, $ln\,(P_t)$ is represent the current index value in natural log form while $ln\,(P_{t-1})$ is known as the index value for the day before in natural log form. The time-series analysis was utilized using the vector error correction model (VECM), followed by time-frequency domain analysis. The VECM model is presented as follows:

$$\Delta MI_i = \mu_{1t} - \theta_1\left(\Delta MI - \gamma_0 - \gamma_1 GMI_i\right)t$$
$$- 1 + \sum_{i=1}^{j} \beta_{1,j} MI_{1t-i}$$
$$+ \sum_{i=1}^{j} \beta_{2,j} GMI_{1t-i} + \varepsilon_{1t}. \tag{2}$$

The variable *MI* is representing the market index of the individual series.

Next, the time-frequency domain analysis based on Coherence Wavelet Analysis (CWA) transformation signal is the cross-wavelet spectrum of *GMI* and market returns of the individual series is defined as $W^1_{GMI,\,Returns}\,(\tau,s) = W_{GMI}(\tau,s)\,W^*_{Returns}(\tau,s)$. The τ is called as time horizon while s is known as scale and the power spectrum was generated using the R-Studio. The following abbreviations are defined as follows. *GMI*MYR is Malaysia google mobility index, *GMI*SGD is Singapore google mobility index, *GMI*TH is Thailand google mobility index, *GMI*IDX denotes Indonesia google mobility index, *GMI*PH is Philippines google mobility index, *TRKLCI* represent Malaysia stock index, *TRFTSESGD* is Singapore stock index, *TRSET* is Thailand stock index, *TRIDX* denotes Indonesia stock index and *TRPSEI* represents Philippines stock index.

III. Empirical Results
A. Time Series ECM-Based Causality Experiment and Regression Analysis

Table 1 shows the long-run association between stock markets and mobility indexes. The values of the coefficients are significant at 5 percent for all five ASEAN markets. Four markets revealed a negative sign with *GMI* (Malaysia, Thailand, Indonesia and the Philippines) while Singapore has a positive relationship with *GMI*. To illustrate, if the *GMI* for Malaysia increases by one percent, it will disrupt the performance of Malaysia's stock market. Significant high decreases occur in the Philippines market, followed by the Thailand, Malaysian, and Indonesian stock markets. The findings by Sifat and Thaker (2020) and the argument by Tantaopas et al. (2016) provide some indication on this phenomenon of Singapore's positive association. Investors' attention and stock market direction are strong when it comes to small, well-established, and productive countries like Singapore. The country is thus able to perform better given the idiosyncratic and good economic factors (i.e., driven by local economy production). Looking into the error

correction term (ECT) to capture the speed of adjustment in the long-run, all selected ASEAN countries recorded negative association. For instance, the market index with *GMI* is -0.92 for the Philippines, meaning that 92 percent of that disequilibrium was anticipated for the next period and 8 percent remained. The higher percentage revealed that *GMI* impacted the stock markets quite tremendously and only a small percentage remained, thus an unexplanatory variable. The results for ECT for selected ASEAN countries were more than 80 percent. To measure the individual relationship between the stock market and *GMI*, a single ordinary least square (OLS) test was performed. The results show that three markets have a positive association with *GMI*: Malaysia (0.3037), Indonesia (0.0620), and the Philippines (0.6689). The other two markets, conversely, have an indirect relationship: Singapore (-1.0033) and Thailand (-0.8722). The results are significant and yielding that *GMI* plays an important role in explaining the behavior of the financial markets especially during the period of the pandemic, together with other direct and indirect factors. In capturing short-run association, I carried out the Granger Causality Test and found that only two markets had an association with *GMI*: Thailand and the Philippines. Typically, the impact of crisis, including any health crisis, will result in long-term impact and in the short-term, the impact would not be apparent (see Table 2).

B. Time Frequency Domain Analysis - Coherence Wavelet Analysis

I used CWA to measure the association of *GMI* to the ASEAN-5 markets in capturing their association in different time domains. My findings revealed that, for the short-run (i.e., 1-16 days), three markets offer mixed results with a moderate relationship with *GMI* (Malaysia, Singapore, and the Philippines), while a strong relationship can be observed for Thailand only. Meanwhile, lead-lag association occurred only for Malaysia and Thailand. In the medium-run, three markets encountered a weak relationship with blue dominancy (Malaysia, Indonesia, and the Philippines). Three markets showed a lead-lag relationship (in-phase) between stock markets and *GMI*. For the long-run, most of the markets offer a no-phase relationship as vaccination efforts took place aggressively worldwide including in the ASEAN region and the slow economic recovery. Three markets (Malaysia, Thailand, and Indonesia) show a strong association due to the emergence of different COVID-19 variants throughout the period, which impacted the financial markets and policy implementations. The conclusion and summary of findings for CWA are presented below.

IV. Conclusion

Overall, COVID-19 has had a significant impact on the ASEAN-5 stock markets and this was influenced by the mo-

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1 Data for the GMI is freely available and accessible at the following link: https://www.google.com/covid19/mobility/ and details for the stock markets were extracted from https://www.investing.com/ and https://www.wsj.com/.

Table 1. VECM and ECM-based Causality Experiment and Regression Analysis of Market Index with Google Mobility Index (*GMI*)

Tests	Countries				
	Malaysia	Singapore	Thailand	Indonesia	Philippines
ECT	-0.8599 **	-0.8968*	-0.8722**	-0.8487**	-0.9225*
OLS	*GMI*MYR = 0.3037**	*GMI*SGD = -1.0033**	*GMI*TH = -0.4417*	*GMI*IDX = 0.0620**	*GMI*PH = 0.6689**
R-squared	0.0623	0.0555	0.0185	0.0295	0.0146
F-stats	45.3726**	40.0778**	12.8980*	20.7841**	10.1555**
Batteries of diagnostic measurements:					
Variance Inflation Factor	3.5441	2.7502	3.8012	2.4397	2.7316
Breusch-Godfrey Serial	3.9381	0.0000	0.0000	0.0000	0.0977
Correlation LM Test	0.3130	1.7211	0.9256	0.9071	0.3588
Ramsey RESET Test	2.0104	2.1575	2.1927	2.1254	2.1973
Durbin- Watson					
Obs	684	684	684	684	684

Long – run relationship	
Malaysia	*GMI*MYR is negatively related to *TRKLCI*
Singapore	*GMI*SGD is positively related to *TRFTSESGD*
Thailand	*GMI*TH is negatively related to *TRSET*
Indonesia	*GMI*IDX is negatively related to *TRIDX*
Philippines	*GMI*PH is negatively related to by *TRPSEI*

Note: Our daily data spans the period 16 February 2020 to 30 December 2021. Variance inflation factor less than 10 revealed there is no serial multicollinearity issues. Null hypothesis for Breush–Godfrey serial correlation LM test with probability chi-Square is there is no serial correlation of any order of residual set up. Null hypothesis of Ramsey RESET is that there is no omitted variables. The null hypothesis for Durbin-Watson test is that there is no first order autocorrelation. The regression analysis was carried out individually for each market index with *GMI*. ***, **, * denotes statistical significance at 1%, 5% and 10% levels, respectively.

Table 2. Short-Run Granger Causality Test

Countries	Null Hypothesis	F-Statistics
Malaysia	*GMI*MYR does not Granger Cause *TRKLCI*	0.1774
	TRKLCI does not Granger Cause *GMI*MYR	0.4260
Singapore	*GMI*SGD does not Granger Cause *TRFTSESDG*	0.6401
	TRFTSESDG does not Granger Cause *GMI*SGD	0.3141
Thailand	*GMI*TH does not Granger Cause *TRSET*	0.1758
	TRSET does not Granger Cause *GMI*TH	2.3492*
Indonesia	*GMI*IDX does not Granger Cause *TRIDX*	0.6967
	TRIDX does not Granger Cause *GMI*IDX	0.7622
Philippines	*GMI*PH does not Granger Cause *TRPSEI*	1.7805
	TRPSEI does not Granger Cause *GMI*PH	2.6022*

Note: This table reports pairwise Granger causality test results. ***, **, * denotes statistical significance at 1%, 5% and 10% levels, respectively.

bility factor. This paper has thrown light on the significant relationship between ASEAN-5 markets and mobility, as the impacts are impactful and momentous in the long run instead of the short run. Furthermore, this paper has found that there is a strong co-movement between mobility and stock markets performance in the long run for ASEAN-5 due to the different variants of COVID-19 and the progressive implementation of vaccinations around the globe. It is observed that mobility plays an important role as one of the drivers for the financial market, which reflects investors' confidence and country-specific performance. Through the advanced methodology this paper employs, attention is drawn to the mobility factor by providing a novel discussion from different time horizons to capture the association between the variable and stock markets, particularly for the ASEAN-5 during the COVID-19 pandemic as intimated in the corresponding tables and figures.

Table 3. Summary of Time Frequency Analysis - CWA

	Pairs	FREQUENCIES		
		SR (1-16) DAYS Colour dominancy: relationship Lead-lag relationship	MR (16-64) DAYS Colour dominancy: relationship Lead-lag relationship	LR (>64) DAYS Colour dominancy: relationship Lead-lag relationship
ASEAN – 5 STOCK MARKETS	TRKLCI vs *GMI*MYR	Mixed colour dominancy: Moderate relationship In-phase	Blue colour dominancy: weak relationship Anti-phase	Red colour dominancy: Strong relationship No-phase
	TRFTSESGD vs *GMI*SGD	Mixed colour dominancy: Moderate relationship No-phase	Red colour dominancy: Strong relationship In-phase	Blue colour dominancy: weak relationship No-phase
	TRSET vs *GMI*TH	Red colour dominancy: Strong relationship In-phase	Red colour dominancy: Strong relationship In-phase	Red colour dominancy: Strong relationship No-phase
	TRIDX vs *GMI*IDX	Blue colour dominancy: weak relationship No-phase	Blue colour dominancy: weak relationship In-phase	Red colour dominancy: Strong relationship No-phase
	TRPSEI vs *GMI*PH	Mixed colour dominancy: Moderate relationship No-phase	Blue colour dominancy: weak relationship No-phase	Blue colour dominancy: weak relationship No-phase

Note: This table presents summary of time frequency analysis based on CWA for ASEAN-5.
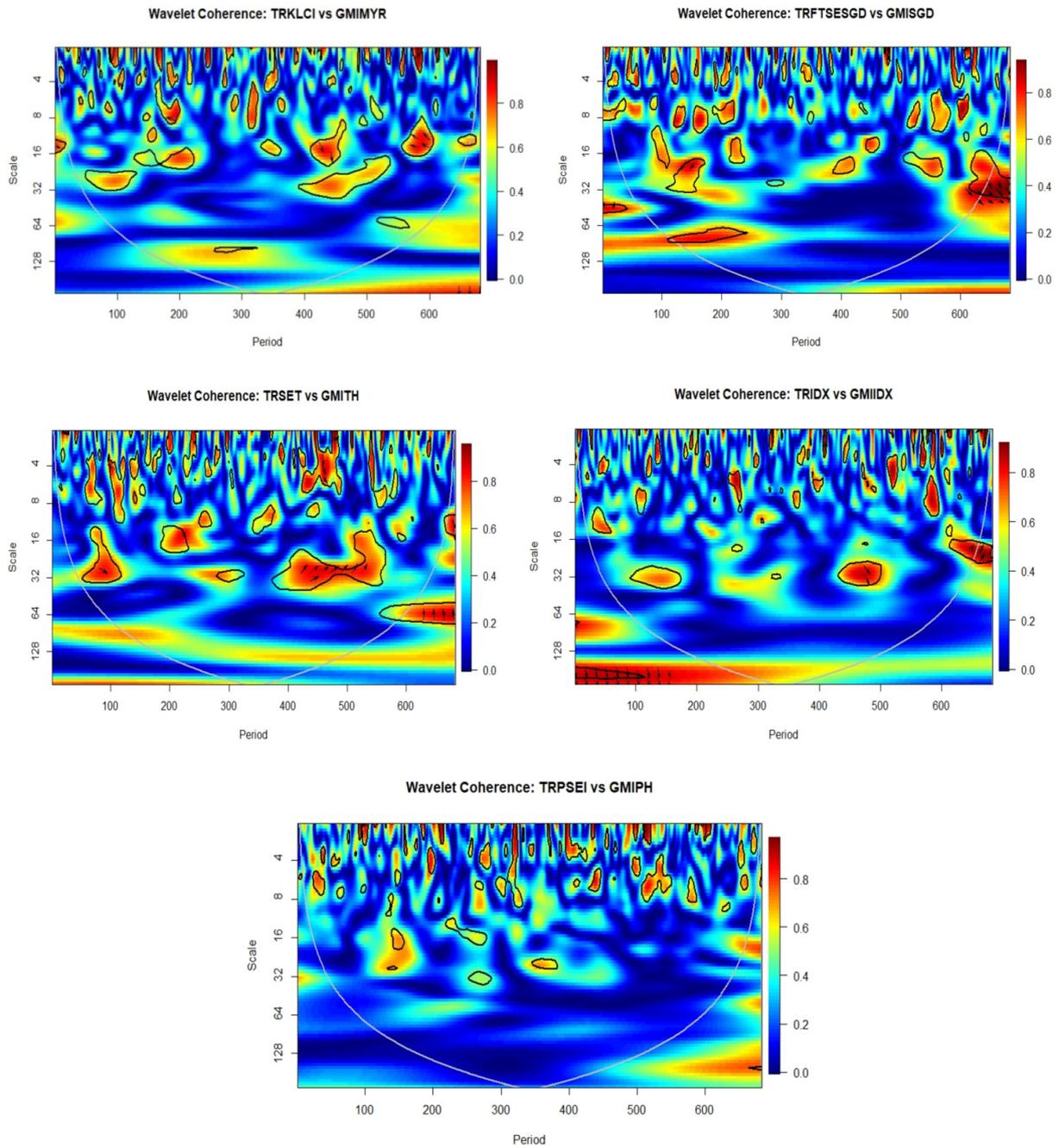
Figure 1. Coherence Wavelet Analysis (CWA)

This figure plots five series. The CWA analysis was carried out individually for each market index with *GMI*. Our data spans the period 16 February 2020 to 30 December 2021.

References

AlAli, M. S. (2020). Risk velocity and financial markets performance: Measuring the early effect of covid-19 pandemic on major stock markets performance. *International Journal of Economics and Financial Research*, *6*(4), 76–81. https://doi.org/10.32861/ijefr.64.76.81

Gherghina, Ş. C., Botezatu, M. A., Hosszu, A., & Simionescu, L. N. (2020). Small and medium-sized enterprises (SMEs): The engine of economic growth through investments and innovation. *Sustainability*, *12*(1), 4–22. https://doi.org/10.3390/su12010347

Google. (2022). https://www.google.com/

Kartal, M. T., Depren, Ö., & Depren, S. K. (2020). The determinants of main stock exchange index changes in emerging countries: Evidence from Turkey in COVID-19 pandemic age. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3659154

Kydland, F. E., & Martínez-García, E. (2020). *Checking the path towards recovery from the COVID-19 isolation response*.

Nouvellet, P., Bhatia, S., Cori, A., Ainslie, K. E. C., Baguelin, M., Bhatt, S., Boonyasiri, A., Brazeau, N. F., Cattarino, L., Cooper, L. V., Coupland, H., Cucunuba, Z. M., Cuomo-Dannenburg, G., Dighe, A., Djaafara, B. A., Dorigatti, I., Eales, O. D., van Elsland, S. L., Nascimento, F. F., … Donnelly, C. A. (2021). Reduction in mobility and COVID-19 transmission. *Nature Communications*, *12*(1), 1–9. https://doi.org/10.1038/s41467-021-21358-2

Sifat, I. M., & Thaker, H. M. T. (2020). Predictive power of web search behavior in five ASEAN stock markets. *Research in International Business and Finance*, *52*, 101191. https://doi.org/10.1016/j.ribaf.2020.101191

Tantaopas, P., Padungsaksawasdi, C., & Treepongkaruna, S. (2016). Attention effect via internet search intensity in Asia-Pacific stock markets. *Pacific-Basin Finance Journal*, *38*, 107–124. https://doi.org/10.1016/j.pacfin.2016.03.008

Yilmazkuday, H. (2020). Stay-at-home works to fight against COVID-19: International evidence from Google mobility data. *Journal of Human Behavior in the Social Environment*, *31*(1–4), 210–220. https://doi.org/10.2139/ssrn.3571708