

Are Modifications in the ETF's Investment Performance and Risks during the COVID-19 Pandemic Event?

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Abstract. *This study focuses on the impact of the COVID-19 pandemic on the investment performance and systematic risk of ETFs. As a result of the early stages of the COVID-19 outbreak, the impact in China was much greater than that in Taiwan. Therefore, by two ETFs investing higher weighted stocks in the Shanghai and Taiwan markets, the ETFs are used to explore the COVID-19 pandemic effect on the two stock markets. Jensen's alpha and the modified model by Jensen (1968) are coupled with GARCH(1,1) to modify and test ETF's performance and systematic risk. The empirical results show that ETF50 performance may be overestimated by using Jensen's alpha. According to the results of modified Jensen's alpha, there is no evidence that abnormal returns are significantly nonzero in both ETFs and that alpha values have not been changed by the COVID-19 event. After the COVID-19 pandemic began, the SSE50 ETF's systematic risk significantly increased, and the asset size of funds significantly decreased. Therefore, the results supported the significant impact of the COVID-19 pandemic on the SSE50 ETF. There is evidence that the SSE50 ETF affects COVID-19 events, and this result echoes the more severe areas of the COVID-19 pandemic in China.*

Keywords: Cross-Border ETF, Effect of COVID-19 Pandemic, Modified Jensen's Alpha, Systematic Risk, Investment Performance

JEL Codes: C22, C58, G12

1. Introduction

The measurement of risk asset investment performance is a topical subject in the field of securities investment. In the case of different portfolios or assets of different natures and differentiated markets, objectively measuring the investment performance of a variety of portfolios or the performance of assets is a great challenge. In earlier times, the performance indicators derived from the returns of investment portfolios or assets were used to compare the returns of the investment portfolios or assets with the consideration of risks (Sharpe, 1966). Moreover, there were performance indicators to compare the returns of investment portfolios or assets after the adjustment of the risks. These performance indicators are commonly used to measure the investment performance of funds or stocks, such as the Treynor ratio (Treynor, 1965) and Jensen's Alpha (Jensen, 1968). These developed investment performance indicators are now widely used (Ledoit & Wolf, 2008; Roy, 2016; Murari, 2020; Rompotis, 2022), particularly in the evaluation of the Fund's investment performance (Agudo, & Marzal, 2004; Arora, 2015; Omri, Soussou & Goucha, 2019; Grau-Carles, Doncel & Sainz, 2019; Ali, Aqil, Kazmi, & Zaman, 2021).

Two indicators are common measures of investment performance. The Treynor ratio and Jensen's alpha are used to evaluate the performance of investment portfolios or assets after risk adjustment (Arora, 2015; Murari, 2020). The main theoretical basis is derived from the CAPM theory proposed by Sharpe (1964), which is based on the fixed systematic risk in the evaluation period (Fama & French, 1992, 1993; Daniel &

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Titman, 1997). However, there is ample literature indicating that the systematic risk of investment portfolios or risk-weighted assets is not fixed or single (Jagannathan & Wang, 1996; Pettengill, Sundaram & Mathur, 2002; Choudhry, 2005; Chen, Liu, & Yang, 2008; Yayvak, Akdeniz & Altay-Salih, 2015; Rojo-Suárez & Alonso-Conde, 2020; Dębski, Feder-Sempach & Szczepocki, 2021). Meanwhile, the price returns of the investment portfolio or risk-weighted assets may have heterogeneity in asset pricing models (Brailsford & Faff, 1997; Hammami, Jilani & Oueslati, 2013). Therefore, the use of traditional performance indicators to measure investment portfolios or risk-weighted assets tends to cause pricing errors because of the change in systematic risk. In particular, if there is any disaster event impact on price trends in the evaluation period or the market is divided into price adjustment trends, there will be a change in systematic risk in investment portfolios or assets (Bai, Hou, Kung, Li & Zhang, 2019). Therefore, this paper proposes a modified Jensen's alpha to be used to evaluate the change in investment performance when investment portfolios or assets cannot capture the changes in systematic risk in the impact of major events or the change in market price adjustment trends during the evaluation period.

Meanwhile, the proposed index is applied in the measurement of the impact on the investment performance and systematic risk of the ETF 50 (cross-border SSEI 50 ETF in Taiwan list trading) Fund with Taiwan (Shanghai) stock market's blue chips as the underlying stocks before and after the COVID-19 pandemic. The constituents of the Taiwan ETF50 are mainly 50 stocks that track the representative Taiwan Stock Exchange. The constituents of the Yuanda SSE 50 ETF are mainly tracked by 50 major constituents of A-shares in China's Shanghai Stock Exchange, and this ETF has offshore cross-market investment attributes in Taiwan.

The Chinese mainland was the region with the severe impact of the COVID-19 outbreak at the beginning. When to stop the large-scale epidemic of COVID-19, strict control measures were implemented to restrict the lives and activities of residents, which had a greater impact on the economy. Compared with the event of COVID-19 in Taiwan, the epidemic has been properly controlled so that the spread is limited, and the living control measures for residents are less restricted. This study examines two ETFs with major stocks in Taiwan and Shanghai stocks as constituents to understand the difference in the degree of impact of the COVID-19 event on the two places, corresponding to the impact of ETFs on investment performance and systematic risk. The empirical results of this study highlight whether the change in the systematic risk of the stock market has any significant impact on investment performance when the COVID-19 event affects ETFs' return risk. In particular, when the degree of impact on the COVID-19 event differs between the Chinese mainland and Taiwan, then the impact on both ETFs. This paper thus determines the impact of the effect of the COVID-19 event on the investment performance and market risk of ETFs.

Finally, the modified Jensen performance indicator proposed in this paper can be used as a performance-risk measurement indicator in the case of non-single fixed systematic risk. The findings contribute to a method for capturing bullish or bearish market price change trends and measuring investment performance in the case of the market environment with the impact of major events.

2. Methodologies

This study aims to explore whether investment performance and market risk for ETFs may change during the COVID-19 pandemic event. The fund investment performance index used in this study is Jensen's alpha, which was proposed by Jensen (1968). The Treynor ratio and Sharpe ratio are only used to make comparisons after fund performance evaluation; thus, Jensen's alpha has been proposed. It has no absolute standard restriction and is used to measure fund investment portfolio performance. Jensen's alpha is mainly

used to examine the fund's abnormal return rate based on CAPM and the difference between the actual return rate and expected return rate. Jensen's alpha model is described as follows:

$$R_{i,t} - R_{f,t} = J_{i,index} + \beta_i \cdot (R_{M,t} - R_{f,t}) + \varepsilon_{i,t} \quad (1)$$

In Eq. (1), $R_{i,t}$ is the return rate of i^{th} Exchange-Traded Fund (ETF) in the t^{th} period; $R_{f,t}$ is the risk-free interest rate in the t^{th} period, represented by the average interest rate of the one-month fixed deposit rate of the five largest banks in Taiwan; $R_{M,t}$ is the return rate of the market investment portfolio in the t^{th} period, represented by Taiwan weighted stock index rate (TAIEX) and Shanghai Stock Exchange Composite Index (SSECI) are used here as the proxy market portfolio return rate of ETF 50 and cross-border SSE50 ETF, respectively. $R_{i,t} - R_{f,t}$ is the excess return rate of the i^{th} ETF in the t^{th} period; $R_{M,t} - R_{f,t}$ is the risk premium of the market investment portfolio in the t^{th} period. $\varepsilon_{i,t}$ is an error. This $\varepsilon_{i,t}$ term, which cannot be explained by the excess return rate of the market investment portfolio in the t^{th} period, is called unsystematic risk. It is assumed that $E(\varepsilon_{i,t}) = 0$ and $Var(\varepsilon_{i,t}) = \sigma^2$, where σ^2 is a constant.

$J_{i,index}$ is the risk premium of the i^{th} ETF, i.e., Jensen's alpha is used to measure fund investment performance; β_i is the systematic risk or market risk of the i^{th} ETF. When Jensen's alpha $J_{i,index}$ is greater, the i^{th} ETF has better performance and vice versa. If Jensen's Alpha $J_{i,index}$ is positive, the i^{th} ETF investment performance is greater than the performance of the risk-adjusted market investment portfolio. Thus, this i^{th} ETF has better investment performance.

If CAPMs' residual variance was heterogeneous, the regression coefficient estimated by Eq. (1) of Jensen's performance index has bias. When the residual error ($\varepsilon_{i,t}$) in Eq. (1) of the Jensen's performance index has condition heterogeneity, GARCH(1,1) is used to adjust and estimate the performance index and systematic risk. Jensen's performance index obtained by adjusting the model is as follows:

$$R_{i,t} - R_{f,t} = J_{i,adj1} + \beta_{i,adj1} \cdot (R_{M,t} - R_{f,t}) + \varepsilon_{i,t}; \varepsilon_{i,t} | \Omega_{t-1} \sim N(0, h_{i,t})$$

$$h_{i,t} = \omega_i + \delta_i \cdot h_{i,t-1} + \gamma_i \cdot \varepsilon_{i,t-1}^2 \quad (2)$$

In Eq. (2), $J_{i,adj1}$ is a risk premium adjusted of the i^{th} ETF and estimated by GARCH, i.e., modified Jensen's alpha; $\beta_{i,adj1}$ is the systematic risk of the i^{th} ETF after modification; and $\varepsilon_{i,t}$ is the error term and has heterogeneity. Thus, Eq. (2) added equation is a heterogeneous equation. $h_{i,t}$ is the heteroscedasticity in the t^{th} period. In addition, Ω_{t-1} is the information set of period $t-1$. In Eq. (2), the estimated parameters are ω_i , δ_i , and γ_i which must be greater than 0 and satisfy restrictive conditions $0 \leq Var(\varepsilon_{i,t}) < \infty$ and $\delta_i + \gamma_i < 1$. In Eq. (2), maximum likelihood estimation (MLE) is used for parameter estimation. Finally, the conditional variance of unsystematic risk ($\varepsilon_{i,t}$) can be captured in Eq. (2) and can be explained by the heteroscedasticity and unsystematic risk of the previous period. This diagnostic checking uses the ARCH effect test to infer whether the null hypothesis ($\varepsilon_{i,t}$ is not heterogeneous) is accepted or rejected.

This study further verifies whether a significant difference exists in Taiwan's ETF investment performance or market risks after the COVID-19 outbreak. It intends to confirm whether modified $J_{i,adj1}$ changes during the COVID-19 outbreak, resulting in significant changes in ETF investment performance and systematic risk. Thus, the dummy variable D_t of the COVID-19 pandemic assumes $D_t = 1$ after the COVID-19 outbreak; assume $D_t = 0$ before the COVID-19 outbreak. In addition, we also verified whether ETF's systematic risk varies significantly during the COVID-19 event. This study presents a test model to

discuss whether significant differences exist in fund performance and systematic risk after the COVID-19 outbreak. The model is as follows:

$$R_{i,t} - R_{f,t} =$$

$$J_{i,adj2} + \Delta J_i \cdot D_t + \beta_{i,adj2} \cdot (R_{M,t} - R_{f,t}) + \Delta \beta_i \cdot D_t \cdot (R_{M,t} - R_{f,t}) + \varepsilon_{i,t}; \varepsilon_{i,t} | \Omega_{t-1} \sim N(0, h_{i,t})$$

$$h_{i,t} = \omega_i + \delta_i \cdot h_{i,t-1} + \gamma_i \cdot \varepsilon_{i,t-1}^2 \quad (3)$$

In Eq. (3), the first equation is the modified Jensen performance index model added to the dummy variable D_t of the COVID-19 event and is used to measure the risk premium and investment performance before the COVID-19 outbreak. ΔJ_i is the i^{th} fund risk premium change after the COVID-19 outbreak and is used to measure the difference in investment performance before and after the COVID-19 outbreak; $\beta_{i,adj2}$ is the i^{th} fund systematic risk after modification and is used to measure the i^{th} fund of systematic risk before the COVID-19 outbreak; $\Delta \beta_i$ is the systematic risk change after the COVID-19 outbreak and is used to measure the difference in the systematic risk before and after the COVID-19 outbreak.

3. Data and Empirical Results

3.1. Data

The study collected daily intraday highest, lowest, and closing prices of two ETFs listed on the Taiwan Stock Exchange, the Yuanta/P-shares Taiwan Top 50 Exchange Traded Funds (shorter form: “ETF 50”; Code: 000050) and the Yuanta/A-shares Shanghai Stock Exchange 50 ETF (shorter form: “SSE 50 ETF”; Code: 006206), as well as daily market trading information for stock markets in Taiwan and Shanghai, including the Taiwan Weighted Stock Price Index (shorter form: “TAIEX”) and the Shanghai Composite Index (shorter form: “SSECI”). In addition, the average interest rate of one-month fixed deposits of Taiwan's five major banks is collected. During the study period, from 1/3/2017 to 26/1/2022, there were a total of 1242 daily trading data. These study data are taken from the Database of Taiwan Economic Journal (TEJ).

3.2. Empirical Results

Figure 1 shows the line charts of the daily closing price (see Chart 1 to Chart 4) and spike charts for the daily excess return rate (see Chart 5 to Chart 8) of ETF50, SSE50 ETF, TAIEX, and SSECI. From the daily closing price of line charts (Chart 1 to Chart 4), they found that in the early stages of the COVID-19 outbreak (1/20/2020), the four closing prices of ETF50, SSE50 ETF, TAIEX, and SSECI were affected by the short term and showed a declining trend in the first quarter of 2020. As the epidemic is gradually under some control and a series of stimuli by the local government has saved the economy from recession (including interest rate cuts and bailout policies). In the second quarter of 2020, the stock price trend began to show an upward trend. Roughly, ETF50 is better than TAIEX; TAIEX is superior to SSECI and SSE50 ETF.

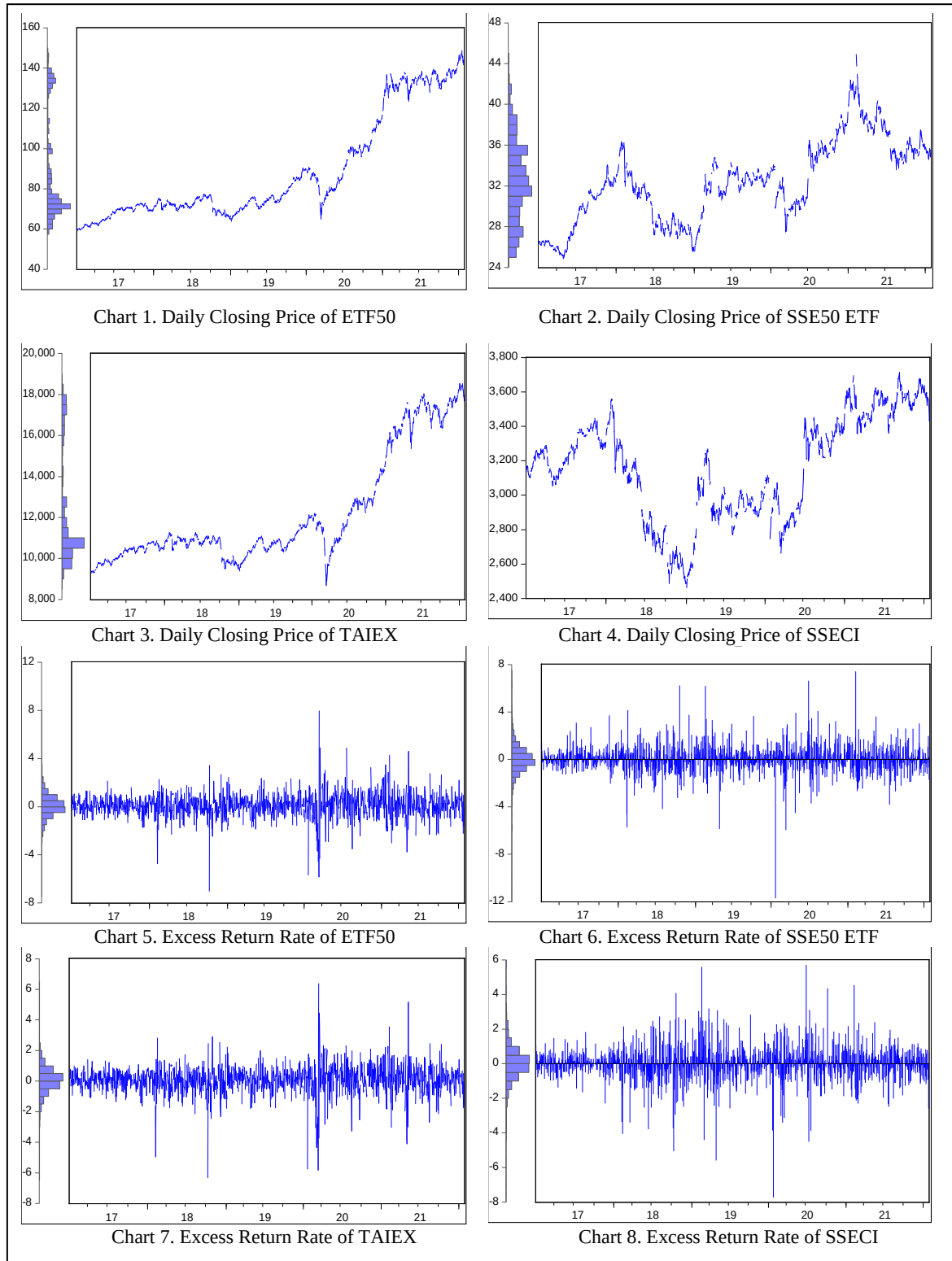


Fig. 1: Statistical diagram of the daily closing price and excess return rate (Obs. =1242).

Second, in the spike charts of the daily excess return rate (see Chart 5 to Chart 8), it was found that in the early stages of the outbreak (1/20/2020), the SSE50 ETF had a daily excess return rate of nearly -12%, and the SSECI had an excess return rate of nearly -8%. These daily excess return rates are lower than the return rates of approximately -6% for ETF50 and TAIEX. This shows that the Shanghai stock market was more negatively affected in the early stage of the COVID-19 outbreak, while the Taiwan stock market remained stable due to the epidemic, leading to the stock price in the SSECI and SSE50 ETF. The highest daily excess return rate of ETF50 was nearly 8%, which was approximately 6% higher than that of TAIEX. China was gradually under control after the outbreak, and the highest daily excess return rate of the SSECI and SSE50 ETFs was nearly 6% at the beginning of the third quarter of 2020. The COVID-19 pandemic being controlled, vaccine development and technological advances in dealing with the virus have led to a gradual reduction in the magnitude of the changes in the excess return rate. Judging from the structure of the distribution chart, ETF50 and TAIEX are inclined to positively excess return rate, and the best performance is the ETF 50, which may be related to the proper control of the COVID-19 epidemic in Taiwan.

Figure 2 shows the line charts of the daily turnover rate of ETF50, TAIEX, SSE50 ETF, and SSECI (see Chart 1 to Chart 4) and the spike charts of the daily high-low price spread (see Chart 5 to Chart 8). The line charts of the daily turnover rate (see Chart 1 to Chart 4) found that ETF50 rose at one point in the early days of the COVID-19 outbreak (1/20/2020) but then gradually showed a steady downward trend, showing a stable state of investor confidence. Due to out-of-control doubts in Taiwan in the second quarter of 2021, which led to the implementation of control measures to further restrict people's activities by the local government and caused panic in the stock market, it was found that the daily turnover rates of TAIEX and SSE50 ETF soared to approximately 2.0% and 8%, respectively, at the same time. Therefore, it was found that the SSE50 ETF in the daily turnover rate part, there was a higher linkage with the daily turnover rate of the Taiwan stock market, reflecting that the SSE50 ETF was affected by the panic of local investors about the rising epidemic crisis in Taiwan.

Second, in the spike charts of the daily high-low price spread (see Chart 5 to Chart 8), it was found that during the initial outbreak around March 2020 and the second quarter of 2021, ETF50 and TAIEX's daily high-low price spread were expanding at the same time. Especially when the crisis of home-grown infections in Taiwan's second outbreak of COVID-19 was more severe than in the early days of the COVID-19 outbreak, the daily high-low price spread expanded even higher than in the early stages of the epidemic. The SSE50 ETF is similar to the SSECI's sharp rise in the daily high-low price spread, mainly concentrated in the first and third quarters of 2020, in line with the more serious damage caused by the early stage of the COVID-19 epidemic for the Chinese mainland. According to the spike charts of the daily high-low price spread (see Chart 5 to Chart 8), it can be observed that the information asymmetry (daily high-low price spread) in the local stock market increases when the epidemic tends to break out. It is worth noting that the impact of the daily high-low price spread (information asymmetry) for ETFs is mainly from the listing market of the invested constituent stocks for the local COVID-19 epidemic situation.

Table 1 shows descriptive statistics, unit root tests, and t-tests of pairwise difference values between the after- and before-COVID-19 outbreak. The statistical whole period is from January 3, 2017, to December 26, 2022, totaling 1242 trading days. The COVID-19 pandemic event date of January 23, 2020, was a lockdown announced by the Wuhan city of China to contain the widespread epidemic of the COVID-19 virus (Liu & Lee, 2020). The COVID-19 pandemic event date was used to divide the period into two subperiods before (Obs.=748) and after (Obs.= 494) the COVID-19 pandemic event.

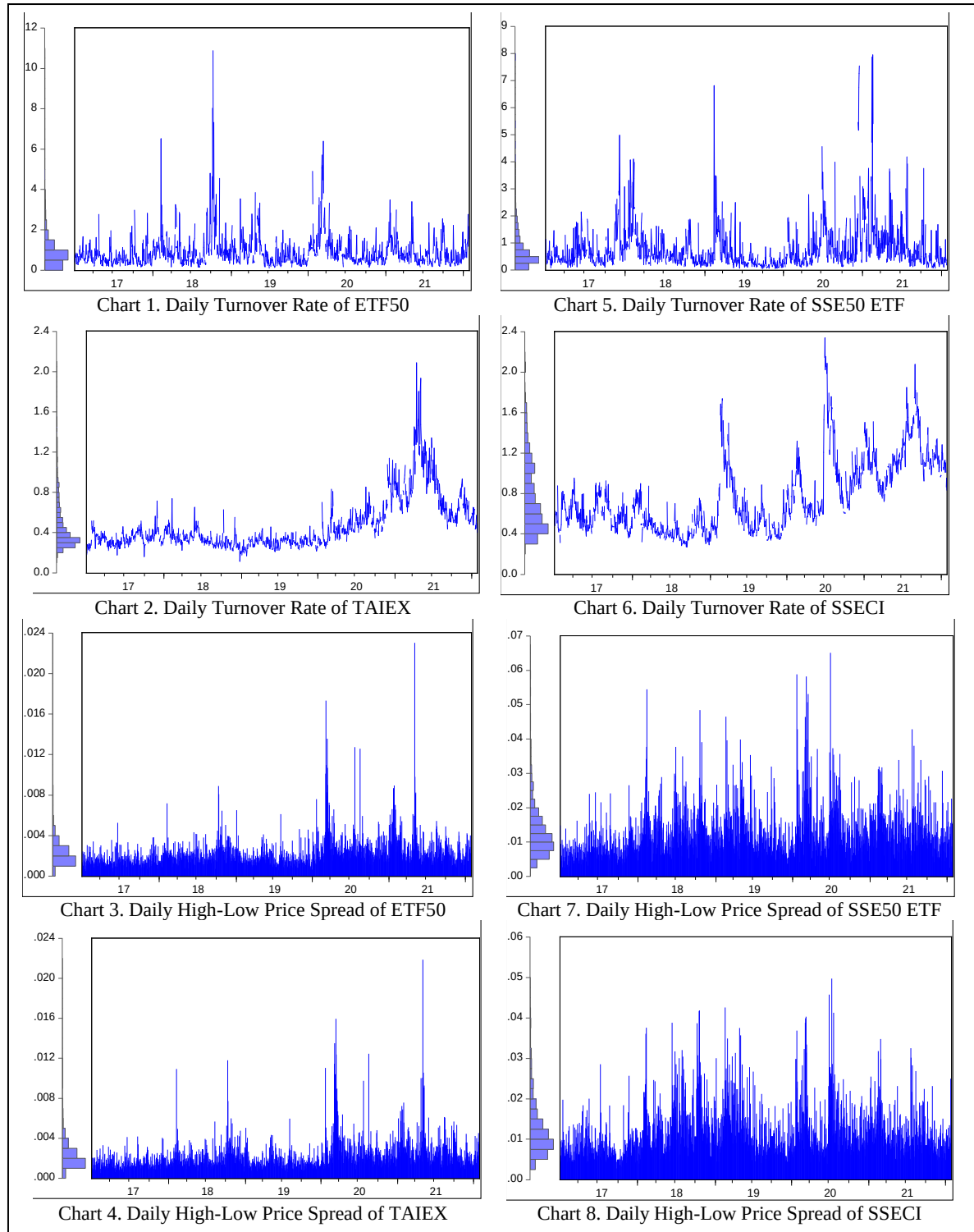


Fig. 2: Statistical diagram of the daily turnover rate and high-low price spread (Obs. =1242).

Table 1: Descriptive statistics, unit root tests, and t-tests of the pairwise difference values between the after- and before-COVID-19 outbreak (2017.1.3 ~ 2022.1.26)

Portfolio	Variable	Period	The whole period (Obs.=1242)		Before-COVID-19 (Obs.=748)		After-COVID-19 (Obs.= 494)	
		Estimate	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
ETF50	Closing Price***		88.846	25.997	71.771	6.255	114.701	23.018
	Excess Return Rate#		0.075	1.048	0.058	0.829	0.101	1.312
	Market Value***		89984.5	46146.0	61948.3	23754.1	132436.1	38819.9
	Turnover Rate		0.924	0.837	0.890	0.858	0.975	0.801
	SPREAD*		0.002	0.002	0.002	0.001	0.003	0.002
TAIEX	Closing Price***		12210.13	2679.61	10564.33	583.02	14702.15	2688.32
	Excess Return Rate#		0.056	0.962	0.038	0.752	0.083	1.213
	Market Value ***		36746999.0	8534854.0	31453828.0	1968829.0	44761760.0	8403309.0
	SPREAD***		0.002	0.002	0.002	0.001	0.003	0.002
	Turnover Rate ***		0.468	0.254	0.326	0.069	0.683	0.281
	PBR***		1.867	0.287	1.702	0.093	2.117	0.302
	PER***		18.169	3.030	16.617	1.3128	20.520	3.363
SSE50 ETF	Closing Price ***		32.397	3.940	30.322	2.783	35.539	3.304
	Excess Return Rate#		0.031	1.242	0.041	1.118	0.015	1.411
	Market Value ***		4216.2	2225.3	5652.7	1673.4	2041.0	592.0
	Turnover Rate ***		0.803	0.873	0.673	0.669	0.999	1.085
	SPREAD***		0.013	0.008	0.012	0.007	0.015	0.008
SSECI	Closing Price ***		3161.551	297.643	3038.223	249.057	3348.291	266.457
	Excess Return Rate#		0.014	1.059	0.004	1.022	0.028	1.113
	Market Value ***		35361923.95	5867675.08	31458209.79	2077689.88	41272810.98	4690000.50
	SPREAD***		0.012	0.007	0.012	0.007	0.013	0.007
	Turnover Rate ***		0.767	0.357	0.570	0.214	1.065	0.322
	PBR***		1.249	0.173	1.336	0.166	1.118	0.070
	PER***		12.944	1.609	13.198	1.717	12.560	1.345

NOTE: *, **, and *** represent significance at the 10%, 5%, and 1% levels on the t-tests of the paired difference variables between the after- and before-COVID-19 outbreak, respectively. # indicates significance at the 5% level on the t-statistic of the Phillips-Perron unit root test. Market Value in ETF50, SSE50 ETF, and TAIEX used units of million NTD, whereas SSECI used units of million RMB. SPREAD is the daily high-low price spread (Paule-Vianez, Prado-Román & Gómez-Martínez, 2020), where $SPREAD = (high\ price - low\ price) / average\ of\ the\ high\ price\ plus\ low\ price$; PBR showed that the price-book ratio = market price per share/book value per share; PER showed that the price-to-earnings ratio = market price per share/earnings per share.

Table 1 shows that the average excess return rates of ETF50 (SSE50 ETF) and TAIEX (SSECI) are 0.075% (0.031%) and 0.056% (0.014%) during the whole study period, respectively, and the average excess return rate of ETF50's (SSE50 ETFs) is more than the market index of TAIEX (SSECI). The Taiwan stock market has an average excess return rate that is more than three times higher than that of the Shanghai stock market, while the ETF50's average excess return rate is more than twice as high as that of the SSE50 ETF. These results indicate that the overall performance of investing in the Taiwan stock market will be better than that of investing in the Shanghai stock market.

In addition, the SSECI's average market value was RMB 35,361,923.95 million, which was greater than TAIEX's average market value of NTD 36,746,999.0 million, but the average market value of the SSE50 ETF was NTD 4,216.2 million, which is much less than the average market value of NTD 89,984.5 million for the ETF50. These statistics show that the SSE50 ETF is not generally favored by investors in the Taiwan stock market.

The results of the t-tests on the pairwise difference values between the after- and before-COVID-19 outbreak for study variables. At a significance level of 1%, it can be found that the average daily closing prices, market value, daily high-low price spread, and daily turnover rate will be significantly larger after the COVID-19 outbreak than before the outbreak on TAIEX and SSECI. The average PBR and average PER of TAIEX (SSECI) on the COVID-19 pandemic will be significantly greater than (less than) in the before-outbreak period. TAIEX and SSECI have inconsistent results, and the Shanghai stock market will have a significantly lower average PBR and average PER after the COVID-19 outbreak, which may be partly related to the impact of Sino-US trade frictions on the confidence of market investors.

At a significance level of 1%, the average closing price and average market value of the ETF50 and the average closing price, average turnover rate, and average SPREAD of the SSE50 ETF show that the after-COVID-19 outbreak will be significantly larger than in the before-outbreak period. It is worth noting that the average market value of the SSE50 ETF after COVID-19 (NTD 2,041.0 million) was significantly smaller than that in the before-outbreak period (NTD 5,652.7 million). The SSE50 ETF listed on the Taiwan stock market after the after-COVID-19 outbreak shows a serious contraction in fund asset size due to the nature of cross-border investments in China's equities. A possible reason is that the COVID-19 pandemic has exacerbated the risk (uncertainty) of cross-border investment, which is related to the risk aversion of investors in the Taiwanese market. This result illustrates that due to the COVID-19 pandemic event, there may be a negative impact on the development of Taiwanese ETFs invested across the Shanghai stock market. This study does not infer that after the COVID-19 outbreak, the average daily excess return rate at ETF50, TAIEX, SSE50 ETF, and SSECI will be significantly larger than before the outbreak. Whether it had a severe impact on parts of China (Wuhan) in the early stages of the COVID-19 outbreak or the fact that Taiwan was well controlled by the spread of COVID-19 compared to the world, the long-term investment performance of the two stock markets was not significantly affected after the COVID-19 outbreak.

Finally, the unit root tests are the results of validation that take the Phillips-Perron tests (Phillips & Perron, 1988) and are in the form that considers intercept and temporal trends. At a significance level of 5%, the t-statistics of ETF50, TAIEX, SSE50 ETF, and SSECI sequences of the daily excess return rate were estimated by Phillips-Perron tests, and the estimated t-statistics of these four sequences were found to be significant. Therefore, it can be inferred that the four sequences of daily event return rates do not have unit roots, which is consistent with the property of stationarity. This property is required in Eq. (1) through (3).

Table 2 shows changes in the performance and systematic risk of ETFs before and after the COVID-19 pandemic event using models of Jensen's alpha and modified Jensen's alpha. First, PARTI shows the ETF's performance index $J_{i,index}$, and systematic risk β_i estimated by the conventional Jensen's alpha model

based on the ordinary least squares (OLS) method. At the significance level of 1%, the t-statistic of ETF50 (SSE50 ETF) systematic risk β_i is 111.3705 (32.6262) and is significantly greater than zero, and ETF 50 (SSE50 ETF) systematic risk β_i is 1.0386 (0.7977) more than (lower than) 1. This result found that the risk of ETF 50 (SSE50 ETF) carries an above (below) risk of the market portfolio. ETF 50 (SSE50 ETF) of Jensen's alpha index $J_{i,index} = 0.0165$ (0.0198); the t-statistic is 1.8392 (0.7657) and (not) significantly more than (equal to) zero. This result shows that ETF 50 has significant positive performance over the long term, while the SSE50 ETF cannot prove that Jensen's alpha index is not zero.

Table 2: The changes in the performance and systematic risk on ETFs testing the after- and before-COVID-19 events using models of Jensen's alpha and the modified Jensen's alpha (2017.1.3 ~ 2022.12. 26)

PART I.		$R_{i,t} - R_{f,t} = J_{i,index} + \beta_i \cdot (R_{M,t} - R_{f,t}) + \varepsilon_{i,t}$						(1)	
Parameter Fund	$J_{i,index}$	-	β_i	-	-	-	R^2 $l(\theta)$	ARCH Test (F- stat.)	
ETF50	0.0165* (1.8392)	-	1.0386*** (111.3705)	-	-	-	0.9091 -330.59	14.5675** *	
SSE50 ETF	0.0198 (0.7657)	-	0.7977*** (32.6262)	-	-	-	0.4619 -1646.58	10.4893** *	
PART II.		$R_{i,t} - R_{f,t} = J_{i,adj1} + \beta_{i,adj1} \cdot (R_{M,t} - R_{f,t}) + \varepsilon_{i,t}; \varepsilon_{i,t} \Omega_{t-1} \sim N(0, h_{i,t})$ $h_{i,t} = \omega_i + \delta_i \cdot h_{i,t-1} + \gamma_i \cdot \varepsilon_{i,t-1}^2$						(2)	
Parameter Fund	$J_{i,adj1}$	-	$\beta_{i,adj1}$	ω_i	δ_i	γ_i	R^2 $l(\theta)$	ARCH Test (F- stat.)	
ETF50	0.0125 (1.4834)	-	1.0432*** (149.6881)	0.0114*** (4.6885)	0.7407*** (19.6532)	0.1496*** (6.7996)	0.9091 -273.41	0.1912	
SSE50 ETF	0.0102 (0.4168)	-	0.8429*** (48.1513)	0.2989*** (4.4088)	0.4904*** (5.0053)	0.1501*** (6.4260)	0.4604 -1606.96	0.0246	
PART III.		$R_{i,t} - R_{f,t} = J_{i,adj2} + \Delta J_i \cdot D_t + \beta_{i,adj2} \cdot (R_{M,t} - R_{f,t}) + \Delta \beta_i \cdot D_t \cdot (R_{M,t} - R_{f,t}) + \varepsilon_{i,t}$ $;\varepsilon_{i,t} \Omega_{t-1} \sim N(0, h_{i,t}), \quad h_{i,t} = \omega_i + \delta_i \cdot h_{i,t-1} + \gamma_i \cdot \varepsilon_{i,t-1}^2$						(3)	
Parameter Fund	$J_{i,adj2}$	ΔJ_i	$\beta_{i,adj2}$	$\Delta \beta_i$	ω_i	δ_i	γ_i	R^2 $l(\theta)$	ARCH Test (F- stat.)
ETF50	0.0171 (1.6168)	-0.0153 (-0.9118)	1.0438*** (97.3142)	-0.0007 (-0.0518)	0.0116*** (4.6721)	0.7362*** (19.2916)	0.1516*** (6.8175)	0.9091 -273.01	0.1847
SSE50 ETF	0.0396 (1.2716)	-0.0754 (-1.4956)	0.7703*** (34.1296)	0.1747*** (5.3845)	0.2898*** (4.5861)	0.4917*** (5.2707)	0.1565*** (6.2389)	0.4613 -1599.10	0.0188

NOTE: In part I, numbers in parentheses are t-statistics. In parts II and III, the numbers in parentheses are z-statistics; *, **, and *** represent significance at the 10%, 5%, and 1% levels, respectively.

At a significance level of 5%, if the F-statistics of the ARCH effect test are the significant results, it can be inferred that the residual term $\varepsilon_{i,t}$ exhibits heteroscedasticity in the Jensen's alpha model of Eq. (1). The results estimated from the F-statistic of the ARCH test of ETF 50 (SSE50 ETF) are equal to 14.5675

(10.4893). These F-statistics are significant. This result shows that the residual sequence of the traditional Jensen model exhibited heterogeneity in ETF 50 (SSE50 ETF).

Second, PART II in Table 2 shows Jensen's alpha model modified based on GARCH(1,1), as well as the modified performance index $J_{i,adj1}$, and systematic risk $\beta_{i,adj1}$ is estimated by maximum likelihood estimation (MLS). At the significance level of 1%, the modified systematic risk of ETF 50 (SSE50 ETF) is $\beta_{i,adj1} = 1.0432$ (0.8429); the t-statistic is 149.6881 (48.1513), which is significantly greater than zero, and the modified Jensen's alpha is $J_{i,adj1} = 0.0125$ (0.0102). The t-statistic is 1.4834 (0.4168), which is not significantly more than zero. There is therefore no evidence to support that ETF50 (SSE50 ETF) investment performance has significantly positive abnormal returns. The estimated parameters of ARCH and GARCH are $\delta_i = 0.7407$ (0.4904) and $\gamma_i = 0.1496$ (0.1501) in ETF50 (SSE50 ETF). At the significance level of 1%, they are significantly greater than zero. Thus, it supports that residual error has heterogeneity in ETF50 (SSE50 ETF). Moreover, it is found that in the F-statistic of the ARCH test of ETF50 (SSE50 ETF) equal to 0.1912 (0.0246) estimated by PART II, namely, the traditional Jensen's alpha model, the residual error heterogeneity is fully explained by GARCH (1, 1) and disappeared in ETF50 (SSE50 ETF).

In Table 2, PART III is the modified Jensen model based on the effect of the COVID-19 pandemic. Estimation of the modified performance index $J_{i,adj2}$ and the modified systematic risk $\beta_{i,adj2}$ can also verify the ETF50 (SSE50 ETF) performance index variation parameter ΔJ_i and systematic risk variation parameter $\Delta \beta_i$ after the COVID-19 outbreak. At the significance level of 1%, the systematic risk of ETF50 (SSE50 ETF) is $\beta_{i,adj2} = 1.0438$ (0.7703); the t-statistic is 97.3142 (34.1296), which is significantly greater than zero. The modified Jensen's alpha of ETF50 (SSE50 ETF) is $J_{i,adj2} = 0.0171$ (0.0396); the t-statistic is 1.6168 (1.2716), which cannot prove that the argument is significantly greater than zero. Thus, it supports that ETF50 (SSE50 ETF) investment performance will significantly have positive abnormal returns. As seen in PART III in Table 2, the ETF50 (SSE50 ETF) estimated coefficients of performance index difference and systematic risk difference are $\Delta J_i = -0.0153$ (-0.0754) and $\Delta \beta_i = -0.0007$ (0.1747), and the t-statistics are -0.9118 (-1.4956) and -0.0518 (5.3845), respectively. At the significance level of 5%, the performance index difference is not significantly lower than zero, and thus, it does not support that ETF50 (SSE50 ETF) investment performance significantly decreased after the COVID-19 outbreak. In addition, the systematic risk difference is significantly more than zero in the SSE50 ETF, which supports that the market risk of the SSE50 ETF significantly increases after the COVID-19 outbreak.

By comparison of PART I and PART II, ETF50 investment performance confirmed the existence of results greater than zero by the conventional Jensen's Alpha model, but after considering the influence of heterogeneity of the residual terms in the modified Jensen's alpha model based on GARCH (1, 1). It can be found that the originally significant positive abnormal return is reduced and the significance disappears. This study found that the conventional Jensen's alpha is overrated, and the systematic risk is underestimated in the conventional Jensen's beta.

Observing the impact of the COVID-19 epidemic in Part III, it was observed that the alpha value ($J_{i,adj2} + \Delta J_i$) after COVID-19 was lower than the before-outbreak alpha value ($J_{i,adj2}$), while the SSE50 ETF beta value ($\beta_{i,adj2} + \Delta \beta_i$) after COVID-19 was significantly higher than the before-outbreak beta value ($\beta_{i,adj2}$). Therefore, the systematic risk of the SSE50 ETF fund in the after-COVID-19 outbreak will be significantly increased, which may be related to the larger impact of the Chinese mainland in the early stages of the COVID-19 outbreak. However, since the outbreak of COVID-19 in Taiwan, there have been only sporadic community infections, and there is no comprehensive regulatory regime in place and therefore has less impact on economic activity, implying that there has been no significant change in alpha and beta values after the COVID-19 pandemic. Finally, the event effect of the COVID-19 pandemic exists only within the

systematic risk (the size of fund assets) of the SSE50 ETF, echoing the results of the outbreak control of the COVID-19 pandemic.

4. Conclusions

This study discusses the impact of the COVID-19 event on (cross-border) ETFs' systematic risk and investment performance and the deficiency of the conventional Jensen performance evaluation model that does not consider heterogeneity in residual error. Its evaluation result of the fund performance index may have a pricing error in ETF 50. Moreover, the COVID-19 pandemic event with higher infectious disease risk can change systematic risk in cross-border SSE 50 ETFs, and significantly, the Fund-Size has decreased. These findings suggest that the COVID-19 pandemic event has an impact on the capital market.

5. References

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