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Can investors benefit from corporate social responsibility and portfolio model during the Covid19 pandemic?

Ternence T. J. Tan[a*] and Baliira Kalyebara[b]

[a]*Faculty of Business, Economics and Social Development, University of Malaysia Terengganu, Kuala Nerus, Terengganu, Malaysia*
[b]*Department of Accounting and Finance, School of Business, American University of Ras Al Khaimah, United Arab Emirates*

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A B S T R A C T

Since late 2019 and throughout 2020, the global economy has been experiencing difficult times due to the outbreak of the lethal Coronavirus (COVID-19). This study looks at the financial impact of this epidemic on the global economy using Malaysian market index i.e., FTSE Bursa Malaysia KLCI before and during COVID-19. Measuring the financial impact of this epidemic on the Malaysia economy may help policy makers to develop measures to avert similar financial catastrophic impacts on the global economy. The study uses Sharpe optimal and naïve diversification model to solve a scenario that factors in the level of corporate social responsibility (CSR) exhibited before and during the epidemic to measure the financial impact on the stock portfolio. The results show that the emergence of COVID-19exacerbated the already weak Malaysian economy. Our findings may help the policy makers in Malaysia to develop and maintain techniques and policies that may mitigate the negative financial impact and handle similar epidemics in the future. Future studies could cover the financial impact of CSR using variable scoring and apply the portfolio model with practical and prevailing constraints.

1. Introduction

In responding to the COVID-19 epidemic, the majority of countries in the world including Malaysia announced lockdown policies (Express, 2020). On 18th March 2020, Malaysia introduced such a policy that allowed only businesses offering essential services to operate (Tang, 2020). Due to the pandemic, it has been widely reported that the virus and lockdowns have direct impacts on financial performance and the global stock markets. Therefore, analysis of the investment portfolios due to the global pandemic is an important and topical subject. The mathematical framework for portfolio models was developed by Harry Markowitz (1952) who was awarded the Nobel Memorial Prize in Economic Sciences for his contributions. Frankfuther, Philips and Seagle (1976) documented that Sharpe model could produce more reliable results than the Markowitz model as it could eliminate the excess and inefficient inputs. DeMinguel, Garlappi and Uppal (2009) discussed the conditions that could help Modern Portfolio Theory (MPT) to outperform Naive diversification. The results concluded that additional constraints and small portfolio size are the basic conditions that helped achieve a result similar to those from Simaan 1997. According to Brinson, Singer, Beebower (1991), asset allocation carries a large portion in determining portfolio performance. The estimation error increased with portfolio size and reduced the performance of a portfolio. Later, Nwakanma (2014) showed that Markowitz model could take the privilege of naive diversification if and only if the study uses between 6-10 assets. Recently, Nor and Islam (2016, 2017) further prove found similar results that MPT dominated naive diversification with the assistance of small portfolio size and practical constraints. Extending the studies of Nakai, Yamaguchi, Takeuchi (2016), and Tan and Kalyebara (2019), this

* Corresponding author. Tel.: +60177912628
E-mail address: ternencetan@yahoo.com (T.T.J. Tan)

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study applies the data sample to the current pandemic situation to incorporate practical views of the effect of CSR in portfolio financial performance. According to Alexandar and Burcholz (1978), Brammer and Brooks (2006), corporate social responsibility (CSR) does not have any financial effect on stock value. However, Godfrey et al. (2009) found that there is an effect of CSR on capital preservation; but it does not expand the capital structure of the firm. In other words, CSR act as a cushion for a firm to withstand negative financial impact. Later, CSR was incorporated in portfolio theory and applied in investments in 2015 (Oikonomou, Platanakis and Sutcliffe, 2015; Calvo, Ivorra and Liern, 2015). Furthermore, Nakai, Yamaguchi, Takeuchi (2016) found that Corporate Social Responsibility (CSR) assists a firm to withstand the negative financial impact of financial crises. The results showed that a portfolio with CSR and constraints can outperform the Naïve diversification and classics Markowitz model. These results are what is expected in theory. Nor and Zawawi (2018) conducted a study on the financial impact of CSR in portfolio performance specifically from the perspective of corporate governance. However, the results show that weak corporate governance can dominate strong corporate governance during out-sample analysis. Tan and Kalyebara (2019) conducted research that analyzed the financial impact of CSR on portfolio investment. Firstly, they ranked the Top constituent FTSE KLCI according to their Environmental, Social, and Governance variable scoring. After asset screening, they optimized the portfolio and recorded the performance. The results show that Sharpe-optimal model can outperform Naïve diversification, while Bottom ESG scoring outperforms Top ESG scoring. These results may be due to portfolio factors and economic factors. A more recent study by Rehman et al. (2021) in BRICS argues that investors are becoming more interested in socially responsible investments in emerging economies. They also suggested future research to explore portfolios based on environment, social and governance (ESG) using 1/N and Markowitz (1952) efficient frontier, among others.

2. Data and model

This study analyzes the financial effect of Corporate Social Responsibility (CSR) and shares price using the portfolio model during the COVID-19 epidemic. Hence, 40 listed firms listed on FTSE Bursa Malaysia KLCI are employed to analyze for the period of 11 years (1 Jan 2009 - 1 Sept 2020). The time covers a pre-epidemic period (2009-2019), and during the epidemic period (2020). This paper maintains the portfolio size in 20, a majority of risk reduced during portfolio size reaching 10-20 (Edwin and Martin, 1977), while Nor and Islam (2017) document Sharpe optimal portfolio can outperform naïve diversification during portfolio size 15-30. The study shows the practical financial effect of CSR during the epidemic situation in Malaysia. Firstly, all the involved companies are categorized according to their scoring in Environmental, Social and Governance variables, which are calculated by financial professionals. Secondly, each category undergoes portfolio optimization computation and formed four (4) portfolios by applying the Naive diversification and Sharpe optimal model. Accordingly, Sharpe optimal model used simple constraints which are 0.01 as the floor portion to avoid estimation error. In this study, it is assumed that the Malaysia Stock Market is in weak form efficiency and a simple buy-hold strategy is the preferred management strategy. Meanwhile, this study also uses the 12-month Malaysia Treasury Bill as the risk-free rate (3.17%). The optimization portfolio model used in this study is as flows:

$$max \ \frac{\sum_{k=1}^{N} W_k \, E(R_k) - TR}{\sqrt{\sum_{i,j=1}^{i,j=N} W_i W_j \sigma_{ij}}} \tag{1}$$

subject to

$$\sum_{k=1}^{N} W_k = 1 \tag{2}$$

$$0.01 \ \leq \ W_k \ \leq 0.10 \tag{3}$$

whereas:

W_i : weight of stock i

W_j : weight of stock j

W_k : weight of stock k in a portfolio

σ_{ij} : covariance of stock i and stock j

$E(R_k)$: expected return of stock k

TR : risk-free rate

In this paper, the General Reducing Gradient Non-linear (GRG Non-linear) algorithm is applied to solve the optimization problem due to its robustness in computation time. The GRG Non-linear is an extension of reducing gradient to solve the inequalities constraints and thus suitable for our portfolio selection problem. Besides, the objective function of this paper is to find the maximum value of Sharpe ratio with floor and ceiling constraints which providing a smooth function graph that permissible the solver to run through and tracking the optimal solution (see Maia et al., 2017; Arora, 2017; Charlie, nd).

3. Results and Discussion

The goal of this study is to find out the financial impact of incorporating CSR into the investment portfolio of stocks listed on KLCI in Malaysia before and during COVID-19. Therefore, the sample data covers the pre-epidemic period (Oct 2018 - Dec 2019) and the COVID-19 period from Jan 2020 to Sept 2020. The results from the investment portfolios constructed show that Sharpe optimal model produces higher stock prices than the naive diversification.

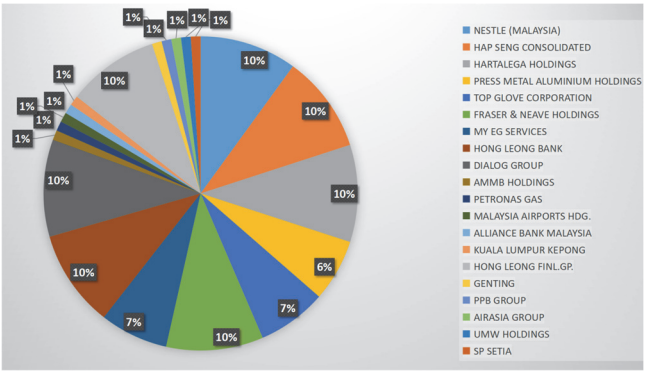


Fig. 1. Composition of Bottom Rating Sharpe Optimal Portfolio

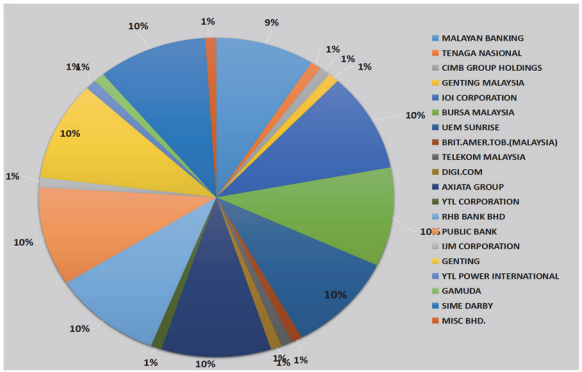


Fig. 2. Composition of High Rating Sharpe Optimal Portfolio

Table 1

Optimization report (Bottom Rating portfolio 20)

Objective Cell (Max)			
Cell	Name	Original Value	Final Value
D168	Sharpe Ratio	5.4756	8.2319

Variable Cells				
Cell	Name	Original Value	Final Value	Integer
C165	WEIGHT NESTLE (MALAYSIA)	0.0500	0.1000	Contin
D165	WEIGHT HAP SENG CONSOLIDATED	0.0500	0.1000	Contin
E165	WEIGHT HARTALEGA HOLDINGS	0.0500	0.1000	Contin
F165	WEIGHT PRESS METAL ALUMINIUM HOLDINGS	0.0500	0.0641	Contin
G165	WEIGHT TOP GLOVE CORPORATION	0.0500	0.0713	Contin
H165	WEIGHT FRASER & NEAVE HOLDINGS	0.0500	0.1000	Contin
I165	WEIGHT MYEG SERVICE	0.0500	0.0702	Contin
J165	WEIGHT HONG LEONG BANK	0.0500	0.1000	Contin
K165	WEIGHT DIALOG GROUP	0.0500	0.1000	Contin
L165	WEIGHT AMMB HOLDINGS	0.0500	0.0100	Contin
M165	WEIGHT PETRONAS GAS	0.0500	0.0100	Contin
N165	WEIGHT MALAYSIA AIRPORTS HDG	0.0500	0.0100	Contin
O165	WEIGHT ALLIANCE BANK MALAYSIA	0.0500	0.0100	Contin
P165	WEIGHT KUALA LUMPUR KEPONG	0.0500	0.0100	Contin
Q165	WEIGHT HONG LEONG FINL GP.	0.0500	0.0944	Contin
R165	WEIGHT GENTING	0.0500	0.0100	Contin
S165	WEIGHT PPB GROUP	0.0500	0.0100	Contin
T165	WEIGHT AIRASIA GROUP	0.0500	0.0100	Contin
U165	WEIGHT UMV HOLDINGS	0.0500	0.0100	Contin
V165	WEIGHT SP SETIA	0.0500	0.0100	Contin

Note: GRG Nonlinear undergoes 35 time of iteration with 53.5 seconds to find a solution that satisfied all the constraints and optimality. Option applied are Max Time unlimited, iterations unlimited, precision 0.000001,use Automatic Scaling, Show iteration results convergence 0.0001,population size 100, random seed 0, derivatives forward, require bounds, Max subproblem unlimited, Max integer Tolerance 1%, assume non negative.

In this study, Sharpe optimal model maintains a minimum portion of (0.01) and a maximum (0.10) to maintain the diversification effect. According to strategic asset allocation, Sharpe optimal can allocate the portion on the stock that has performed well in sample analysis. Thus, this may be the reason that supports the higher stock price. Furthermore, Bottom rating stocks perform better than Top rating stocks during the comparison period between both sets of portfolios by using the same model. See Tables A5 and A6 in the Appendix for further details. In Fig. 1 and Fig. 2, we show the differences between Bottom and High ratings Sharpe optimal models. From the perspective of the optimization process, the Bottom portfolio optimization process takes 53.5 second and 35 iterations to maximize 50.34% (from 5.4756 to 8.2319) of Sharpe Ratio value, while Top portfolio optimization process takes 4.45 second and 23 iterations to maximize 36.88% (from -1.4782 to -0.9330). All the results satisfied the constraints and reached their optimal level. In other words, these analyses confirm the optimality of our portfolios (refer to Tables 1 and 2 while detailed reports can be seen in Tables A9 and A10).

Table 2

Optimization report (High Rating portfolio 20)

Objective Cell (Max)				
Cell	Name	Original Value	Final Value	
E168	Sharpe Ratio	(1.4782)	(0.9330)	
Variable Cells				
Cell	Name	Original Value	Final Value	Integer
C163	WEIGHT MALAYAN BANKING	0.0500	0.0900	Contin
D163	WEIGHT TENAGA NASIONAL	0.0500	0.0100	Contin
E163	WEIGHT CIMB GROUP HOLDING	0.0500	0.0100	Contin
F163	WEIGHT GENTING MALAYSIA	0.0500	0.0100	Contin
G163	WEIGHT IOI CORPORATION	0.0500	0.1000	Contin
H163	WEIGHT BURSA MALAYSIA	0.0500	0.1000	Contin
I163	WEIGHT UEM SUNRISE	0.0500	0.1000	Contin
J163	WEIGHT BRIT.AMER.TOB.(MALAYSIA)	0.0500	0.0100	Contin
K163	WEIGHT TELEKOM MALAYSIA	0.0500	0.0100	Contin
L163	WEIGHT DIGI.COM	0.0500	0.0100	Contin
M163	WEIGHT AXIATA GROUP	0.0500	0.1000	Contin
N163	WEIGHT YTL CORPORATION	0.0500	0.0100	Contin
O163	WEIGHT RHB BANK BHD	0.0500	0.1000	Contin
P163	WEIGHT PUBLIC BANK	0.0500	0.1000	Contin
Q163	WEIGHT IJM CORPORATION	0.0500	0.0100	Contin
R163	WEIGHT GENTING	0.0500	0.1000	Contin
S163	WEIGHTYTL POWER INTERNATIONAL	0.0500	0.0100	Contin
T163	WEIGHT GAMUDA	0.0500	0.0100	Contin
U163	WEIGHT SIME DARBY	0.0500	0.1000	Contin
V163	WEIGHT MISC BHD	0.0500	0.0100	Contin

Note: GRG Nonlinear undergoes 23 time of iteration with4. seconds to find a solution that satisfied all the constraints and optimality. Option applied are Max Time unlimited, iterations unlimited, precision 0.000001, use Automatic Scaling, Show iteration results convergence 0.0001,population size 100, random seed 0, derivatives forward, require bounds, Max subproblem unlimited, Max integer Tolerance 1%, assume non negative.

It can be seen in Fig. 1 and Fig. 2 that the composition both portfolios is able to maintain the effect of diversification as it allocates a portion in each asset which is considered as well performing. However, Table 3 shows our results, which may indicate that the top rating stocks fail to withstand the financial impact of the pandemic.

Table 3

Summary of results

	Bottom				**High**			
	Naïve		**Sharpe**		**Naïve**		**Sharpe**	
	In -Sample	**Out Analysis**	**In -Sample**	**Out Analysis**	**In -Sample**	**Out Analysis**	**In -Sample**	**Out Analysis**
Portfolio return	1.44%	6.45%	1.97%	10.13%	(0.13%)	(2.10%)	(0.05%)	(1.59%)
Annualize	18.71%	111.78%	26.39%	218.36%	(1.55%)	(22.50%)	(0.55%)	(17.49%)
Portfolio risk	2.84%	10.02%	2.82%	13.62%	3.19%	4.90%	3.98%	4.85%
Sortino Ratio		24.73		15.91		(5.65)		(2.21)
Sharpe Ratio	5.48	10.84	8.23	15.80	(1.48)	(5.24)	(0.93)	(4.26)

One of the possible reasons could be due to the effectiveness of diversification and asset allocation. Firstly, Fig. 3 and Fig. 4 show the different industries that are involved and Bottom rating portfolios are invested in more variety industries than Top rating. Accordingly, the bottom rating portfolio has high effectiveness compared to the top rating portfolio as Bottom rating portfolios are invested in more variety industries compared to Top rating. Statistically, the bottom rating portfolio has an average

correlation of 0.1726 while the Top rating portfolio has an average correlation of 0.2569. Hence, the correlation results indicate all the constituents of a high rating portfolio move down together during the pandemic which worsens the financial performance.

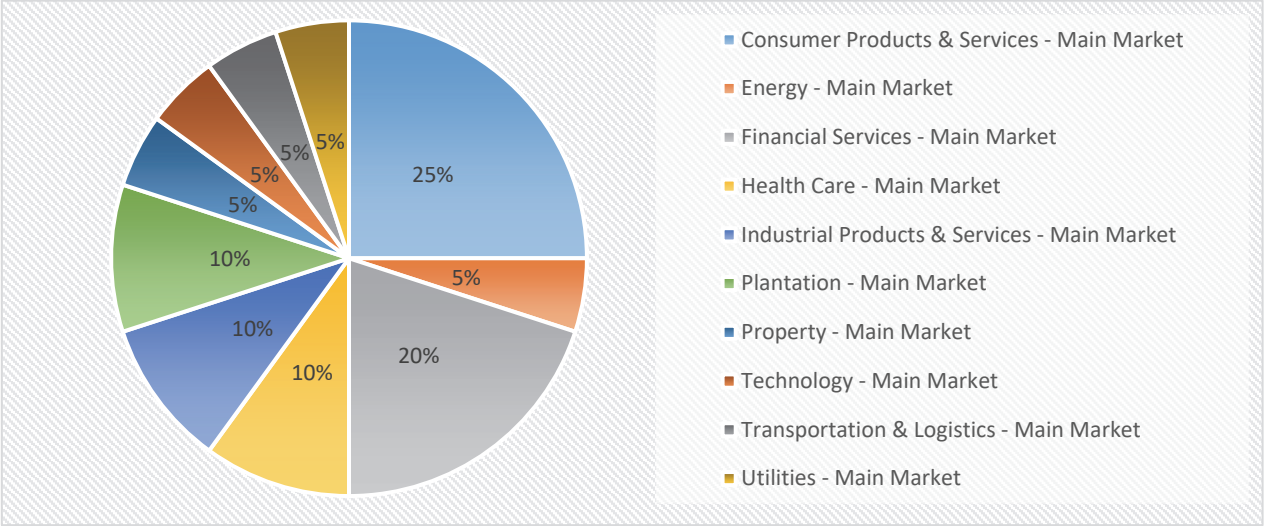


Fig. 3. Bottom rating portfolio constituents (Industry)

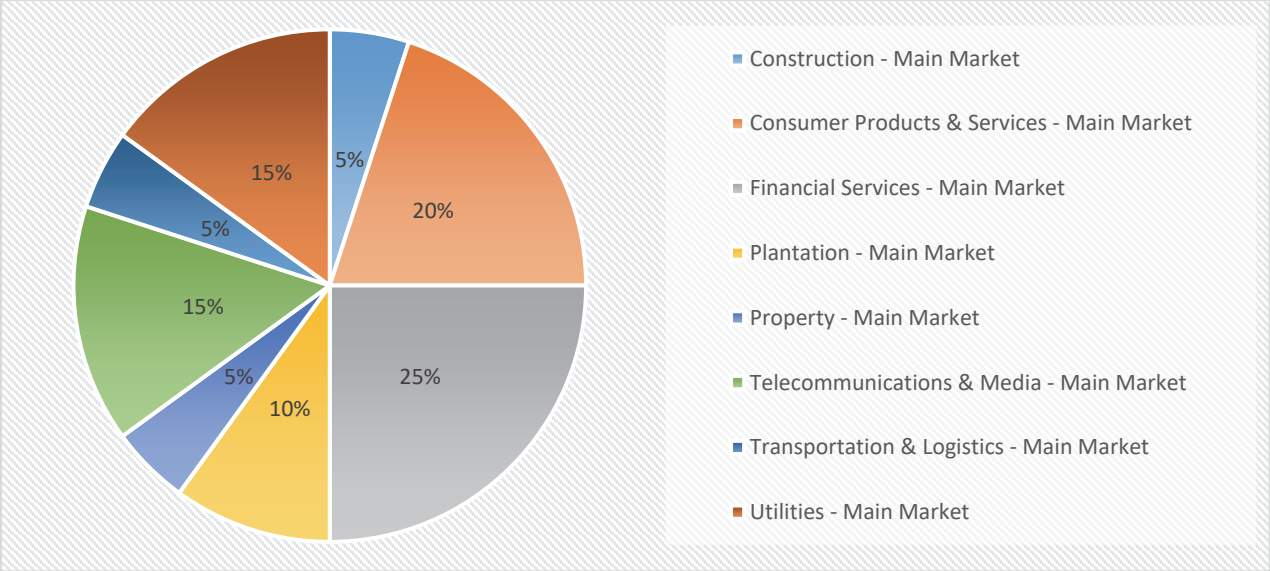
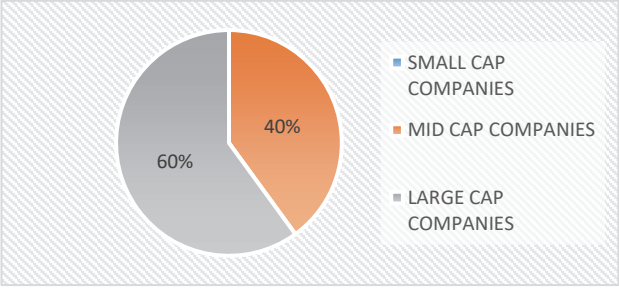


Fig. 4. Top rating portfolio constituents (Industry)



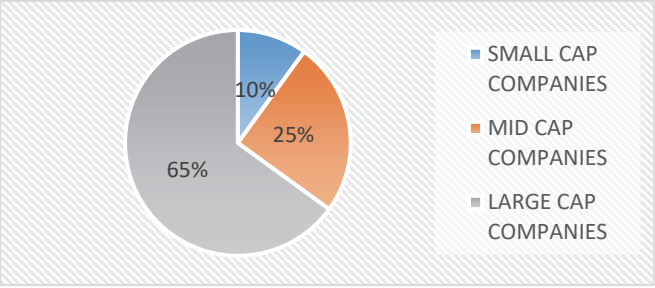


Fig. 5. ***Bottom rating portfolio constituents (Market Cap)***

Fig. 6. Top rating portfolio constituents (Market cap)

Secondly, Fig. 5 and Fig. 6 show the different constituents of the portfolio according to market capital. As Fig. 5 and Fig. 6 shows, a Bottom rating portfolio has better stability than Top rating as all of the asset allocation applied in bottom rating are in mid and large market capital firms. Usually, the stability of a firm is increased along with the market capital. Hence, it will suffer less impact during a pandemic situation. Table A3 and Table A4 summarize the specific firm's market capital and industries. Besides, Figure 7 shows the differences in the two portfolios over time.

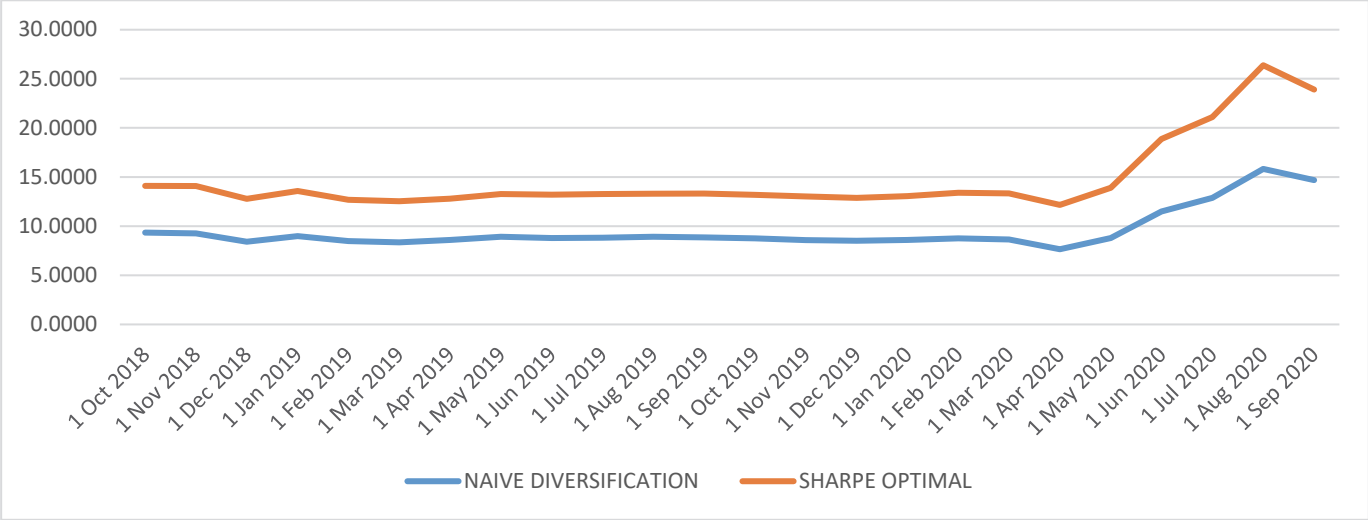


Fig. 7. Performance of Optimal Portfolio Over Time

To justify the difference between the performance, a simple hypothesis testing is carried out. The null hypothesis among the testing is that both portfolio performances (among different models or different ratings) do not have any significant differences, while the alternative hypothesis is vice versa. As the result shows, there is a significant difference between the comparison between high and low rating as value (0.0000) is less than the critical value (0.05) and the static value (20.9056, 18.0168) fall under rejection region (2.0687), this leads to the rejection of the null hypothesis. Besides, there exist significant differences during comparison among different portfolio models during different ratings. Accordingly, the null hypothesis cannot be accepted as value (0.0000) is less than critical value (0.05) and the static value (-5.9300,-3.7868) falls under the rejection region (-2.0301, -2.0141). Our results support the findings of El Ghoul and Karoui (2017) that expressed concern about the role CSR plays in stock screening and selection. Besides, the higher-than-average results in the Bottom rating portfolio represent that the bottom rating portfolio experiences high upside risk. This may support the investment performance as usually the higher the risk the higher the return provided the extra risk undertaken is compensated by extra return. Lastly, this study also finds that active management is encouraged to withstand the pandemic situation during the comparison between individual stock and portfolio constructed. This may be because during the epidemic investors tend to face the opportunity cost as they cannot rebalance the portion according to the market trend.

4. Conclusion and implications

Since 2018 Malaysia's economy has experienced recession due to global unstable economy issues as a result of rising interest rate, political instability, trade war, etc (Kok 2019). The emergence of COVID-19 exacerbated the already weak economy. The COVID-19 pandemic caused a market crash and inflicted financial hardships on most households. Hence, this brings out the topic of this study that Corporate Social Responsibilities and Modern Portfolio Model play a vital role during this pandemic situation. Having that in mind, this paper extends the studies from prior studies (Nakai, Yamaguchi and Takeuchi, 2016; Tan and Kalyebara, 2019) in terms of data sample coverage, portfolio size before and after COVID-19. The results of this study show that Sharpe optimal model dominates Naive diversification with significant differences over the scenario, as it can allocate more capital in the stock portfolio investment performing better. However, the Bottom rating dominates the Top rating portfolio over the period covered due to the effectiveness of diversification and its asset allocation strategies. This paper has a significant contribution in terms of the importance of optimal portfolio model, optimal asset screening, and the effect of CSR during a pandemic situation. Thus, future studies could explore the effect of CSR from the perspective of variable scoring and apply the portfolio model with practical constraints or elements. This is suggested because the model that uses past performance as input

suffers a gradual loss of its effectiveness with the changing economic inputs due to the advancement of technology. Since the world is now moving towards globalization, further research can also explore portfolios taking into account topical and current issues namely geopolitical risks and economic policy uncertainty, which can affect international portfolio diversification. Recent studies by Hasan et al. (2020a, 2020b) explore these important risks and uncertainty issues. Finally, it should also be noted that the success of stock portfolio diversification relies upon market efficiency. However, findings by Shahzad et al. (2017), Nor and Wickremasinghe (2014), Jassal and Dhiman (2016), Filipiak and Filipiak (2018), Nor and Zawawi (2019, 2020) and Ren and Ren (2017) indicate that efficiency may not hold in some stock markets, including developed ones. However, according to Nor and Wickremasinghe (2017), the Malaysian market is expected to become more efficient with the advancement of technology. Their finding suggests that the application of portfolio optimization has value in the future in such a market. All in all, it is undeniable that portfolio optimization is an important area that encompasses finance, mathematics, and information technology and has significant implications. With the current advancement in computer science and technology, as well as issues such COVID-19 pandemic, studies about investment have serious implications and potential for further research (both empirical and theoretical) by academics and practitioners.

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Appendix

Table A1

Bottom Scoring portfolio correlation matrix

1.00																			
0.00	1.00																		
0.21	0.04	1.00																	
0.03	0.04	0.03	1.00																
0.10	(0.01)	0.14	(0.07)	1.00															
0.29	(0.03)	0.04	(0.02)	(0.06)	1.00														
0.10	0.08	0.10	(0.10)	0.12	0.11	1.00													
0.08	(0.02)	0.24	0.00	0.05	0.27	0.04	1.00												
0.08	0.07	0.08	0.21	0.09	0.01	(0.05)	0.14	1.00											
(0.05)	0.04	0.09	0.32	(0.03)	0.06	0.08	0.09	0.31	1.00										
(0.04)	(0.01)	0.04	(0.05)	(0.02)	(0.03)	0.08	(0.01)	0.20	0.22	1.00									
(0.03)	0.06	0.10	0.29	0.00	0.12	0.02	0.15	0.26	0.45	0.18	1.00								
0.09	(0.08)	0.06	0.31	0.09	(0.03)	(0.04)	0.02	0.27	0.50	0.23	0.25	1.00							
(0.09)	0.07	0.08	0.24	0.22	0.08	(0.06)	0.08	0.33	0.34	0.24	0.27	0.18	1.00						
0.04	(0.08)	0.01	0.25	0.22	(0.03)	(0.12)	0.25	0.23	0.31	0.23	0.40	0.36	0.36	1.00					
0.05	0.01	0.07	0.25	0.16	0.06	(0.02)	0.00	0.33	0.32	0.28	0.33	0.63	0.31	0.31	1.00				
(0.07)	0.17	(0.08)	0.21	0.17	0.07	(0.12)	(0.04)	0.25	0.27	0.10	0.25	0.28	0.27	0.27	0.39	1.00			
0.22	0.12	(0.01)	0.35	(0.14)	0.04	0.03	0.06	0.21	0.45	0.22	0.45	0.17	0.35	0.35	0.28	0.30	1.00		
(0.02)	(0.07)	(0.05)	0.27	0.13	(0.15)	0.09	0.03	0.13	0.34	0.19	0.08	0.13	0.24	0.24	0.09	0.02	0.19	1.00	
0.21	(0.03)	0.19	0.25	0.00	0.09	(0.09)	0.05	0.31	0.20	0.00	0.23	0.15	0.10	0.10	0.18	0.18	0.23	(0.06)	1.00

Table A2
Top Scoring portfolio correlation matrix

1.00																			
0.30	1.00																		
0.56	0.33	1.00																	
0.45	0.29	0.37	1.00																
0.19	0.08	0.11	0.12	1.00															
0.21	(0.00)	0.02	(0.04)	0.35	1.00														
0.30	0.05	0.12	0.08	0.44	0.57	1.00													
(0.06)	0.02	0.01	0.01	0.15	0.22	0.05	1.00												
0.04	0.08	0.05	0.16	0.16	0.02	0.23	(0.06)	1.00											
0.03	0.08	(0.04)	0.02	0.29	0.14	0.26	0.30	0.52	1.00										
0.34	(0.01)	0.07	0.17	0.26	0.31	0.30	0.03	0.36	0.38	1.00									
0.17	0.17	0.20	(0.07)	0.20	0.06	0.20	(0.07)	0.43	0.25	0.24	1.00								
0.17	(0.16)	0.09	(0.07)	0.29	0.46	0.33	0.12	0.13	0.22	0.42	0.22	1.00							
0.05	(0.19)	(0.10)	(0.15)	0.24	0.47	0.37	0.14	0.15	0.17	0.41	0.15	0.47	1.00						
0.25	0.05	0.17	0.07	0.36	0.33	0.56	(0.19)	0.48	0.17	0.22	0.41	0.23	0.23	1.00					
0.36	0.09	0.16	0.07	0.44	0.56	0.50	0.12	0.12	0.19	0.29	0.15	0.32	0.45	0.45	1.00				
0.24	0.09	0.20	0.14	0.18	0.21	0.20	0.09	0.17	0.13	0.16	0.53	0.09	0.33	0.33	0.25	1.00			
0.33	0.03	0.15	0.07	0.36	0.51	0.61	(0.07)	0.44	0.28	0.44	0.40	0.42	0.67	0.67	0.47	0.32	1.00		
0.12	(0.04)	0.04	(0.02)	0.49	0.41	0.41	0.04	0.22	0.24	0.36	0.27	0.37	0.43	0.43	0.43	0.17	0.41	1.00	
0.06	(0.00)	(0.05)	(0.04)	0.15	0.34	0.29	(0.03)	0.23	0.13	0.12	0.24	0.21	0.40	0.40	0.23	0.34	0.47	0.16	1.00

Table A3
Panel A: Bottom rating portfolio constituents (B20)

Company Name	Industy	Market cap	
Airasia Group Berhad	Consumer Products & Services	2,322.70	M
UMW Holdings Berhad	Consumer Products & Services	3,364.70	M
SP Setia Berhad	Property	3,711.90	M
Alliance Bank Malaysia Berhad	Financial Services	3,839.30	M
MY E.G. SERVICES BERHAD	Technology	7,050.10	M
Malaysia Airport Holdings Berhad	Transportation & Logistics	8,561.40	M
Genting Plantations Berhad	Plantation	8,713.30	M
AMMB Holdings Berhad	Financial Services	9,283.70	M
Fraser & Neave Holdings Berhad	Consumer Products & Services	11,700.20	M
Dialog Group	Energy	17,162.10	M
Hong Leong Financial Group Berhad	Financial Services	18,773.40	M
Hap Seng Consolidated Berhad	Industrial Products & Services	20,365.60	M
Kuala Lumpur Kepong Berhad	Plantation	25,122.90	M
PPB Group Berhad	Consumer Products & Services	26,318.10	M
Petronas Gas Berhad	Utilities	31,738.90	M
Nestle (Malaysia) Berhad	Consumer Products & Services	32,126.50	M
Press Metal Aluminium Holdings Berhad	Industrial Products & Services	32,264.50	M
Hong Leong Bank Berhad	Financial Services	37,414.80	M
HARTALEGA Holding Berhad	Health Care	44,079.00	M
Top Glove Corporation Berhad	Health Care	55,280.60	M

Table A4
Panel B: Top rating portfolio constituents (T20)

Company Name	Industy		Market cap
IJM Plantations Berhad	Plantation	1,532.20	M
UEM Sunrise Berhad	Property	1,896.90	M
British American Tobacco (Malaysia) Berhad	Consumer Products & Services	3,740.40	M
YTL Power International	Utilities	5,343.60	M
YTL Corporation Berhad	Utilities	7,109.70	M
Bursa Malaysia Berhad	Financial Services	7,580.60	M
GAMUDA Berhad	Construction	8,294.60	M
Genting Malaysia Berhad	Consumer Products & Services	14,607.60	M
Sime Darby Berhad	Consumer Products & Services	14,965.60	M
Genting Berhad	Consumer Products & Services	15,430.00	M
RHB Bank Berhad	Financial Services	20,451.20	M
Telekom Malaysia Berhad	Telecommunications & Media	23,963.00	M
IOI Corporation Berhad	Plantation	26,523.50	M
MISC Berhad	Transportation & Logistics	26,604.20	M
Digi.com Berhad	Telecommunications & Media	29,467.30	M

Axiata Group Berhad	Telecommunications & Media	30,534.60	M
CIMB Group Holdings Berhad	Financial Services	38,104.20	M
Tenaga Nasional Berhad	Utilities	55,049.90	M
Public Bank Berhad	Financial Services	81,330.80	M
Malayan Banking Berhad	Financial Services	89,143.30	M

Table A5

Hypothesis Testing between Bottom rating and High Rating (Naive diversification)

t-Test: Two-Sample Assuming Unequal Variances

	LOW	*HIGH*
Mean	9.5394	0.7564
Variance	4.2320	0.0041
Observations	24.0000	24.0000
Hypothesized Mean Difference	0.0000	
df	23.0000	
t Stat	20.9056	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.7139	
P(T<=t) two-tail	0.0000	
t Critical two-tail	2.0687	

Table A6

Hypothesis Testing between Bottom rating and High Rating (Sharpe-optimal model)

t-Test: Two-Sample Assuming Unequal Variances

	LOW	*HIGH*
Mean	14.7536	0.8322
Variance	14.3237	0.0055
Observations	24.0000	24.0000
Hypothesized Mean Difference	0.0000	
df	23.0000	
t Stat	18.0168	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.7139	
P(T<=t) two-tail	0.0000	
t Critical two-tail	2.0687	

Table A7

Hypothesis Testing among Bottom Rating Portfolio

t-Test: Two-Sample Assuming Unequal Variances		
	NAIVE DIVERSIFICATION	*SHARPE OPTIMAL*
Mean	9.5394	14.7536
Variance	4.2320	14.3237
Observations	24.0000	24.0000
Hypothesized Mean Difference	0.0000	
df	35.0000	
t Stat	-5.9300	
P(T<=t) one-tail	0.0000	
t Critical one-tail	1.6896	
P(T<=t) two-tail	0.0000	
t Critical two-tail	2.0301	

Table A8

Hypothesis Testing among High Rating Portfolio

t-Test: Two-Sample Assuming Unequal Variances

	NAIVE DIVERSIFICATION	*SHARPE OPTIMAL*
Mean	0.7564	0.8322
Variance	0.0041	0.0055
Observations	24.0000	24.0000
Hypothesized Mean Difference	0.0000	
df	45.0000	
t Stat	-3.7868	
P(T<=t) one-tail	0.0002	

t Critical one-tail	1.6794
P(T<=t) two-tail	0.0004
t Critical two-tail	2.0141

Table A9
Optimization report for Bottom Rating portfolio 20

Worksheet: Low Rating Portfolio [20]

Report Created: 19/2/2021 2:37:58 pm

Result: Solver found a solution. All Constraints and optimality conditions are satisfied.

Solver Engine

Engine: GRG Nonlinear

Solution Time: 53.5 Seconds.

Iterations: 35 Subproblems: 0

Solver Options

Max Time Unlimited, Iterations Unlimited, Precision 0.000001, Use Automatic Scaling, Show Iteration Results. Convergence 0.0001, Population Size 100, Random Seed 0, Derivatives Forward, Require Bounds. Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

Objective Cell (Max)

Cell	Name	Original Value	Final Value
D168	SHARPE RATIO	5.4756	8.2319

Variable Cells

Cell	Name	Original Value	Final Value	Integer
C163	WEIGHT NESTLE (MALAYSIA)	0.0500	0.1000	Contin
D163	WEIGHT HAP SENG CONSOLIDATED	0.0500	0.1000	Contin
E163	WEIGHT HARTALEGA HOLDINGS	0.0500	0.1000	Contin
F163	WEIGHT PRESS METAL ALUMINIUM HOLDINGS	0.0500	0.0641	Contin
G163	WEIGHT TOP GLOVE CORPORATION	0.0500	0.0713	Contin
H163	WEIGHT FRASER & NEAVE HOLDINGS	0.0500	0.1000	Contin
I163	WEIGHT MY EG SERVICES	0.0500	0.0702	Contin
J163	WEIGHT HONG LEONG BANK	0.0500	0.1000	Contin
K163	WEIGHT DIALOG GROUP	0.0500	0.1000	Contin
L163	WEIGHT AMMB HOLDINGS	0.0500	0.0100	Contin
M163	WEIGHT PETRONAS GAS	0.0500	0.0100	Contin
N163	WEIGHT MALAYSIA AIRPORTS HDG.	0.0500	0.0100	Contin
O163	WEIGHT ALLIANCE BANK MALAYSIA	0.0500	0.0100	Contin
P163	WEIGHT KUALA LUMPUR KEPONG	0.0500	0.0100	Contin
Q163	WEIGHT HONG LEONG FINL.GP.	0.0500	0.0944	Contin
R163	WEIGHT GENTING	0.0500	0.0100	Contin
S163	WEIGHT PPB GROUP	0.0500	0.0100	Contin
T163	WEIGHT AIRASIA GROUP	0.0500	0.0100	Contin
U163	WEIGHT UMW HOLDINGS	0.0500	0.0100	Contin
V163	WEIGHT SP SETIA	0.0500	0.0100	Contin

Constraints

Cell	Name	Cell Value	Formula	Status	Slack

C163	WEIGHT NESTLE (MALAYSIA)	0.1000	C163>=0.01	Not Binding	0.0900
D163	WEIGHT HAP SENG CONSOLIDATED	0.1000	D163>=0.01	Not Binding	0.0900
E163	WEIGHT HARTALEGA HOLDINGS	0.1000	E163>=0.01	Not Binding	0.0900
F163	WEIGHT PRESS METAL ALUMINIUM HOLDINGS	0.0641	F163>=0.01	Not Binding	0.0541
G163	WEIGHT TOP GLOVE CORPORATION	0.0713	G163>=0.01	Not Binding	0.0613
H163	WEIGHT FRASER & NEAVE HOLDINGS	0.1000	H163>=0.01	Not Binding	0.0900
I163	WEIGHT MY EG SERVICES	0.0702	I163>=0.01	Not Binding	0.0602
J163	WEIGHT HONG LEONG BANK	0.1000	J163>=0.01	Not Binding	0.0900
K163	WEIGHT DIALOG GROUP	0.1000	K163>=0.01	Not Binding	0.0900
L163	WEIGHT AMMB HOLDINGS	0.0100	L163>=0.01	Binding	0.0000
M163	WEIGHT PETRONAS GAS	0.0100	M163>=0.01	Binding	0.0000
N163	WEIGHT MALAYSIA AIRPORTS HDG.	0.0100	N163>=0.01	Binding	0.0000
O163	WEIGHT ALLIANCE BANK MALAYSIA	0.0100	O163>=0.01	Binding	0.0000
P163	WEIGHT KUALA LUMPUR KEPONG	0.0100	P163>=0.01	Binding	0.0000
Q163	WEIGHT HONG LEONG FINL.GP.	0.0944	Q163>=0.01	Not Binding	0.0844
R163	WEIGHT GENTING	0.0100	R163>=0.01	Binding	0.0000
S163	WEIGHT PPB GROUP	0.0100	S163>=0.01	Binding	0.0000
T163	WEIGHT AIRASIA GROUP	0.0100	T163>=0.01	Binding	0.0000
U163	WEIGHT UMW HOLDINGS	0.0100	U163>=0.01	Binding	0.0000
V163	WEIGHT SP SETIA	0.0100	V163>=0.01	Binding	0.0000
C164	RISK NESTLE (MALAYSIA)	0.0440	C164>=0.01	Not Binding	0.0340
D164	RISK HAP SENG CONSOLIDATED	0.0830	D164>=0.01	Not Binding	0.0730
E164	RISK HARTALEGA HOLDINGS	0.0801	E164>=0.01	Not Binding	0.0701
F164	RISK PRESS METAL ALUMINIUM HOLDINGS	0.1297	F164>=0.01	Not Binding	0.1197
G164	RISK TOP GLOVE CORPORATION	0.0933	G164>=0.01	Not Binding	0.0833
H164	RISK FRASER & NEAVE HOLDINGS	0.0483	H164>=0.01	Not Binding	0.0383
I164	RISK MY EG SERVICES	0.1259	I164>=0.01	Not Binding	0.1159
J164	RISK HONG LEONG BANK	0.0437	J164>=0.01	Not Binding	0.0337
K164	RISK DIALOG GROUP	0.0728	K164>=0.01	Not Binding	0.0628
L164	RISK AMMB HOLDINGS	0.0557	L164>=0.01	Not Binding	0.0457
M164	RISK PETRONAS GAS	0.0404	M164>=0.01	Not Binding	0.0304
N164	RISK MALAYSIA AIRPORTS HDG.	0.0692	N164>=0.01	Not Binding	0.0592
O164	RISK ALLIANCE BANK MALAYSIA	0.0544	O164>=0.01	Not Binding	0.0444
P164	RISK KUALA LUMPUR KEPONG	0.0438	P164>=0.01	Not Binding	0.0338
Q164	RISK HONG LEONG FINL.GP.	0.0510	Q164>=0.01	Not Binding	0.0410
R164	RISK GENTING	0.0474	R164>=0.01	Not Binding	0.0374
S164	RISK PPB GROUP	0.0507	S164>=0.01	Not Binding	0.0407
T164	RISK AIRASIA GROUP	0.1148	T164>=0.01	Not Binding	0.1048
U164	RISK UMW HOLDINGS	0.0680	U164>=0.01	Not Binding	0.0580
V164	RISK SP SETIA	0.0675	V164>=0.01	Not Binding	0.0575
W163	WEIGHT Return	1.0000	W163=1	Binding	0
C163	WEIGHT NESTLE (MALAYSIA)	0.1000	C163<=0.1	Binding	0
D163	WEIGHT HAP SENG CONSOLIDATED	0.1000	D163<=0.1	Binding	0

E163	WEIGHT HARTALEGA HOLDINGS	0.1000	E163<=0.1	Binding	0
F163	WEIGHT PRESS METAL ALUMINIUM HOLDINGS	0.0641	F163<=0.1	Not Binding	0.03595
G163	WEIGHT TOP GLOVE CORPORATION	0.0713	G163<=0.1	Not Binding	0.02865
H163	WEIGHT FRASER & NEAVE HOLDINGS	0.1000	H163<=0.1	Binding	0
I163	WEIGHT MY EG SERVICES	0.0702	I163<=0.1	Not Binding	0.02981
J163	WEIGHT HONG LEONG BANK	0.1000	J163<=0.1	Binding	0
K163	WEIGHT DIALOG GROUP	0.1000	K163<=0.1	Binding	0
L163	WEIGHT AMMB HOLDINGS	0.0100	L163<=0.1	Not Binding	0.09
M163	WEIGHT PETRONAS GAS	0.0100	M163<=0.1	Not Binding	0.09
N163	WEIGHT MALAYSIA AIRPORTS HDG.	0.0100	N163<=0.1	Not Binding	0.09
O163	WEIGHT ALLIANCE BANK MALAYSIA	0.0100	O163<=0.1	Not Binding	0.09
P163	WEIGHT KUALA LUMPUR KEPONG	0.0100	P163<=0.1	Not Binding	0.09
Q163	WEIGHT HONG LEONG FINL.GP.	0.0944	Q163<=0.1	Not Binding	0.00558
R163	WEIGHT GENTING	0.0100	R163<=0.1	Not Binding	0.09
S163	WEIGHT PPB GROUP	0.0100	S163<=0.1	Not Binding	0.09
T163	WEIGHT AIRASIA GROUP	0.0100	T163<=0.1	Not Binding	0.09
U163	WEIGHT UMW HOLDINGS	0.0100	U163<=0.1	Not Binding	0.09
V163	WEIGHT SP SETIA	0.0100	V163<=0.1	Not Binding	0.09

Microsoft Excel 16.0 Sensitivity Report

Worksheet: [PORTFOLIO 20 (1) (1).xlsx]low

Report Created: 19/2/2021 2:38:00 pm

Variable Cells

Cell	Name	Final Value	Reduced Gradient
C163	WEIGHT NESTLE (MALAYSIA)	0.1	1.375981254
D163	WEIGHT HAP SENG CONSOLIDATED	0.1	2.94350737
E163	WEIGHT HARTALEGA HOLDINGS	0.1	4.905703782
F163	WEIGHT PRESS METAL ALUMINIUM HOLDINGS	0.064051071	0
G163	WEIGHT TOP GLOVE CORPORATION	0.071346012	0
H163	WEIGHT FRASER & NEAVE HOLDINGS	0.1	1.24871875
I163	WEIGHT MY EG SERVICES	0.070185637	0
J163	WEIGHT HONG LEONG BANK	0.1	0.366397401
K163	WEIGHT DIALOG GROUP	0.1	0.107519249
L163	WEIGHT AMMB HOLDINGS	0.01	0
M163	WEIGHT PETRONAS GAS	0.01	0
N163	WEIGHT MALAYSIA AIRPORTS HDG.	0.01	0
O163	WEIGHT ALLIANCE BANK MALAYSIA	0.01	0
P163	WEIGHT KUALA LUMPUR KEPONG	0.01	0
Q163	WEIGHT HONG LEONG FINL.GP.	0.09441728	0
R163	WEIGHT GENTING	0.01	0
S163	WEIGHT PPB GROUP	0.01	0
T163	WEIGHT AIRASIA GROUP	0.01	0
U163	WEIGHT UMW HOLDINGS	0.01	0
V163	WEIGHT SP SETIA	0.01	0

Cell	Name	Final Value	Lagrange Multiplier
C163	WEIGHT NESTLE (MALAYSIA)	0.1	0
D163	WEIGHT HAP SENG CONSOLIDATED	0.1	0
E163	WEIGHT HARTALEGA HOLDINGS	0.1	0
F163	WEIGHT PRESS METAL ALUMINIUM HOLDINGS	0.064051071	0
G163	WEIGHT TOP GLOVE CORPORATION	0.071346012	0
H163	WEIGHT FRASER & NEAVE HOLDINGS	0.1	0
I163	WEIGHT MY EG SERVICES	0.070185637	0
J163	WEIGHT HONG LEONG BANK	0.1	0

K163	WEIGHT DIALOG GROUP	0.1	0
L163	WEIGHT AMMB HOLDINGS	0.01	-5.479916942
M163	WEIGHT PETRONAS GAS	0.01	-0.364136279
N163	WEIGHT MALAYSIA AIRPORTS HDG.	0.01	-2.505696664
O163	WEIGHT ALLIANCE BANK MALAYSIA	0.01	-2.270658915
P163	WEIGHT KUALA LUMPUR KEPONG	0.01	-1.547127077
Q163	WEIGHT HONG LEONG FINL.GP.	0.09441728	0
R163	WEIGHT GENTING	0.01	-1.988603806
S163	WEIGHT PPB GROUP	0.01	-1.659138979
T163	WEIGHT AIRASIA GROUP	0.01	-7.461147573
U163	WEIGHT UMW HOLDINGS	0.01	-4.486413265
V163	WEIGHT SP SETIA	0.01	-5.73367376
C164	RISK NESTLE (MALAYSIA)	0.043973431	0
D164	RISK HAP SENG CONSOLIDATED	0.083033023	0
E164	RISK HARTALEGA HOLDINGS	0.080074035	0
F164	RISK PRESS METAL ALUMINIUM HOLDINGS	0.129687827	0
G164	RISK TOP GLOVE CORPORATION	0.093313459	0
H164	RISK FRASER & NEAVE HOLDINGS	0.04831176	0
I164	RISK MY EG SERVICES	0.125914775	0
J164	RISK HONG LEONG BANK	0.043732058	0
K164	RISK DIALOG GROUP	0.072787352	0
L164	RISK AMMB HOLDINGS	0.055744223	0
M164	RISK PETRONAS GAS	0.040405607	0
N164	RISK MALAYSIA AIRPORTS HDG.	0.069243702	0
O164	RISK ALLIANCE BANK MALAYSIA	0.054426445	0
P164	RISK KUALA LUMPUR KEPONG	0.043845539	0
Q164	RISK HONG LEONG FINL.GP.	0.050964795	0
R164	RISK GENTING	0.047355287	0
S164	RISK PPB GROUP	0.050713181	0
T164	RISK AIRASIA GROUP	0.11475241	0
U164	RISK UMW HOLDINGS	0.068022898	0
V164	RISK SP SETIA	0.06746725	0
W163	WEIGHT Return	1	1.400553722

Table A10

Optimization report for Top Rating portfolio 20

Microsoft Excel 16.0 Answer Report

Worksheet: High Rating portfolio [20]

Report Created: 19/2/2021 2:43:30 pm

Result: Solver found a solution. All Constraints and optimality conditions are satisfied.

Solver Engine

Engine: GRG Nonlinear

Solution Time: 4.453 Seconds.

Iterations: 23 Subproblems: 0

Solver Options

Max Time Unlimited, Iterations Unlimited, Precision 0.000001 Convergence 0.0001, Population Size 100, Random Seed 0, Derivatives Forward, Require Bounds Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

Objective Cell (Max)

Cell	Name	Original Value	Final
E168	SHARPE RATIO TENAGA NASIONAL	(1.4782)	(0.9330)

Variable Cells

Cell	Name	Original	Final	Integer
D163	WEIGHT MALAYAN BANKING	0.0500	0.0900	Contin
E163	WEIGHT TENAGA NASIONAL	0.0500	0.0100	Contin
F163	WEIGHT CIMB GROUP HOLDINGS	0.0500	0.0100	Contin
G163	WEIGHT GENTING MALAYSIA	0.0500	0.0100	Contin
H163	WEIGHT IOI CORPORATION	0.0500	0.1000	Contin

I163	WEIGHT BURSA MALAYSIA	0.0500	0.1000	Contin
J163	WEIGHT UEM SUNRISE	0.0500	0.1000	Contin
K163	WEIGHT BRIT.AMER.TOB.(MALAYSIA)	0.0500	0.0100	Contin
L163	WEIGHT TELEKOM MALAYSIA	0.0500	0.0100	Contin
M163	WEIGHT DIGI.COM	0.0500	0.0100	Contin
N163	WEIGHT AXIATA GROUP	0.0500	0.1000	Contin
O163	WEIGHT YTL CORPORATION	0.0500	0.0100	Contin
P163	WEIGHT RHB BANK BHD	0.0500	0.1000	Contin
Q163	WEIGHT PUBLIC BANK	0.0500	0.1000	Contin
R163	WEIGHT IJM CORPORATION	0.0500	0.0100	Contin
S163	WEIGHT GENTING	0.0500	0.1000	Contin
T163	WEIGHT YTL POWER INTERNATIONAL	0.0500	0.0100	Contin
U163	WEIGHT GAMUDA	0.0500	0.0100	Contin
V163	WEIGHT SIME DARBY	0.0500	0.1000	Contin
W163	WEIGHT MISC BHD.	0.0500	0.0100	Contin

Cell	Name	Cell Value	Formula	Status	Slack
X163	WEIGHT expectec return	1.0000	X163=1	Binding	0
D163	WEIGHT MALAYAN BANKING	0.0900	D163<=0.1	Not Binding	0.01
E163	WEIGHT TENAGA NASIONAL	0.0100	E163<=0.1	Not Binding	0.09
F163	WEIGHT CIMB GROUP HOLDINGS	0.0100	F163<=0.1	Not Binding	0.09
G163	WEIGHT GENTING MALAYSIA	0.0100	G163<=0.1	Not Binding	0.09
H163	WEIGHT IOI CORPORATION	0.1000	H163<=0.1	Binding	0
I163	WEIGHT BURSA MALAYSIA	0.1000	I163<=0.1	Binding	0
J163	WEIGHT UEM SUNRISE	0.1000	J163<=0.1	Binding	0
K163	WEIGHT BRIT.AMER.TOB.(MALAYSIA)	0.0100	K163<=0.1	Not Binding	0.09
L163	WEIGHT TELEKOM MALAYSIA	0.0100	L163<=0.1	Not Binding	0.09
M163	WEIGHT DIGI.COM	0.0100	M163<=0.1	Not Binding	0.09
N163	WEIGHT AXIATA GROUP	0.1000	N163<=0.1	Binding	0
O163	WEIGHT YTL CORPORATION	0.0100	O163<=0.1	Not Binding	0.09
P163	WEIGHT RHB BANK BHD	0.1000	P163<=0.1	Binding	0
Q163	WEIGHT PUBLIC BANK	0.1000	Q163<=0.1	Binding	0
R163	WEIGHT IJM CORPORATION	0.0100	R163<=0.1	Not Binding	0.09
S163	WEIGHT GENTING	0.1000	S163<=0.1	Binding	0
T163	WEIGHT YTL POWER INTERNATIONAL	0.0100	T163<=0.1	Not Binding	0.09
U163	WEIGHT GAMUDA	0.0100	U163<=0.1	Not Binding	0.09
V163	WEIGHT SIME DARBY	0.1000	V163<=0.1	Binding	0
W163	WEIGHT MISC BHD.	0.0100	W163<=0.1	Not Binding	0.09
D163	WEIGHT MALAYAN BANKING	0.0900	D163>=0.01	Not Binding	0.080
E163	WEIGHT TENAGA NASIONAL	0.0100	E163>=0.01	Binding	0.000
F163	WEIGHT CIMB GROUP HOLDINGS	0.0100	F163>=0.01	Binding	0.000
G163	WEIGHT GENTING MALAYSIA	0.0100	G163>=0.01	Binding	0.000
H163	WEIGHT IOI CORPORATION	0.1000	H163>=0.01	Not Binding	0.090
I163	WEIGHT BURSA MALAYSIA	0.1000	I163>=0.01	Not Binding	0.090
J163	WEIGHT UEM SUNRISE	0.1000	J163>=0.01	Not Binding	0.090
K163	WEIGHT BRIT.AMER.TOB.(MALAYSIA)	0.0100	K163>=0.01	Binding	0.000
L163	WEIGHT TELEKOM MALAYSIA	0.0100	L163>=0.01	Binding	0.000
M163	WEIGHT DIGI.COM	0.0100	M163>=0.01	Binding	0.000
N163	WEIGHT AXIATA GROUP	0.1000	N163>=0.01	Not Binding	0.090
O163	WEIGHT YTL CORPORATION	0.0100	O163>=0.01	Binding	0.000
P163	WEIGHT RHB BANK BHD	0.1000	P163>=0.01	Not Binding	0.090
Q163	WEIGHT PUBLIC BANK	0.1000	Q163>=0.01	Not Binding	0.090
R163	WEIGHT IJM CORPORATION	0.0100	R163>=0.01	Binding	0.000
S163	WEIGHT GENTING	0.1000	S163>=0.01	Not Binding	0.090
T163	WEIGHT YTL POWER INTERNATIONAL	0.0100	T163>=0.01	Binding	0.000
U163	WEIGHT GAMUDA	0.0100	U163>=0.01	Binding	0.000
V163	WEIGHT SIME DARBY	0.1000	V163>=0.01	Not Binding	0.090
W163	WEIGHT MISC BHD.	0.0100	W163>=0.01	Binding	0.000

Microsoft Excel 16.0 Sensitivity Report

Worksheet: [PORTFOLIO 20 (1) (1).xlsx]high

Report Created: 19/2/2021 2:43:32 pm

Variable Cells

Cell	Name	Final Value	Reduced Gradient
D163	WEIGHT MALAYAN BANKING	0.09	0
E163	WEIGHT TENAGA NASIONAL	0.01	-0.173675686
F163	WEIGHT CIMB GROUP HOLDINGS	0.01	-0.415447153
G163	WEIGHT GENTING MALAYSIA	0.01	-0.889825433
H163	WEIGHT IOI CORPORATION	0.1	0.147765577
I163	WEIGHT BURSA MALAYSIA	0.1	0.649320006
J163	WEIGHT UEM SUNRISE	0.1	1.231262207
K163	WEIGHT BRIT.AMER.TOB.(MALAYSIA)	0.01	-0.993397593
L163	WEIGHT TELEKOM MALAYSIA	0.01	-1.892093062
M163	WEIGHT DIGI.COM	0.01	-0.294541866
N163	WEIGHT AXIATA GROUP	0.1	0.453522801
O163	WEIGHT YTL CORPORATION	0.01	-0.230058312
P163	WEIGHT RHB BANK BHD	0.1	0.363027394
Q163	WEIGHT PUBLIC BANK	0.1	0.635874867
R163	WEIGHT IJM CORPORATION	0.01	-1.113224983
S163	WEIGHT GENTING	0.1	0.312878788
T163	WEIGHT YTL POWER INTERNATIONAL	0.01	-0.579054952
U163	WEIGHT GAMUDA	0.01	-0.2673392
V163	WEIGHT SIME DARBY	0.1	0.039397538
W163	WEIGHT MISC BHD.	0.01	-0.507545542

Constraints

Cell	Name	Final Value	Lagrange Multiplier
X163	WEIGHT expected return	1	0.486295104