The Impact of Entropy Index as a Measure of Diversification Strategy on Firm Performance during Covid-19 Pandemic: Evidence from DIMO PLC

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ABSTRACT

Businesses in Sri Lanka experienced decreased performance as a direct result of the COVID-19 pandemic. This study is conducted to determine the effect that diversification strategies have on the overall performance of DIMO PLC, the largest automotive company in Sri Lanka pre and during the pandemic. It was found that the entropy index of related and unrelated diversification strategies had a perfect relationship with the company's accounting-based performance (ROA and ROE) and market-based performance (Tobin's Q) during the period 2012 to 2021, inclusive of the COVID-19 period starting in 2019. This was discovered after DIMO PLC had been expanding its operations into other alternative business sectors for several years. The unrelated diversification strategies implemented by DIMO PLC have positively exaggerated the company's performance while simultaneously maintaining the unexpected results that the COVID-19 pandemic has produced. According to DIMO PLC findings, there is a positive association between unrelated diversification and financial performance. Possible explanations include the ability to back up and justify the capital expenditure required for diversity, political connections in an emerging economy, and investor expectations, who view corporate diversification as a productive management activity. Furthermore, a negative link between firm size and performance was discovered. According to the findings of the VECM analysis, DIMO PLC results revealed that unrelated diversity is positively related to company long-run performance, whereas related diversification is negatively related to firm long-run performance. DIMO PLC is generally acknowledged as an automobile industry specialist and implements relevant diversification techniques. Despite the effects of the Covid-19 pandemic and import limitations, the company has been able to sustain stable overall performance. According to the study's findings, DIMO PLC may be able to achieve its objectives by overcoming unexpected challenges with efficient strategies such as testing their

operations into seemingly unrelated diversification strategies such as the agricultural, biomedical, construction, and material handling industries. Finally, it is suggested that diversification would have both positive and negative effects on firm performance and that businesses should prioritize developing appropriate approaches in order to effectively face challenges.

Keywords: Covid-19, diversification, entropy index, firm performance, Tobin's Q, firm size

INTRODUCTION

When the first COVID-19 case was detected in Sri Lanka in the middle of March 2020, the full scope of the epidemic became obvious, and schools were promptly closed. Lockdowns and curfews were then imposed in other locations to prevent the sickness from spreading. New quarantine facilities are being built, as is a self-quarantine system. Almost every aspect of the economy suffered as a result of the crisis. The COVID-19 health emergency has illustrated the susceptibility of enterprises to such exogenous disruptions. As a result, organizational resiliency is gaining significance as a competency that every business should seek to develop (Amaratunga et al., 2020). Diversification is one approach organizations use to remain competitive and manage market volatility when conditions are unclear (COVID-19: Adapting and Diversifying Your Business, 2021).

DIMO is a publicly traded business with major assets in multiple industries, and it is traded on the Colombo Stock Exchange. The DIMO PLC Group has seen revenue drop by 11%, from Rs. 34,385 million in 2019-2020 to Rs. 30,819 million in 2020-2021, as a result of the weak global economy. As a result of government import restrictions that are projected to remain for some time, the PLC's auto sales company, which was among the hardest hit, experienced a 48 percent decline in earnings, mirroring the 45 percent decline in new vehicle registrations throughout the industry (DIMO PLC, 2021). The Group enacted significant cost-cutting measures to ensure that costs associated with the automobile sales business would not negatively impact the revenues of other divisions. DIMO PLC has followed a comprehensive diversification plan for a number of years, incorporating specialized companies such as medical engineering, electricity generation and distribution, and agriculture. Consequently, it continued to diversify, including investments in the seed and fertilizer industries, throughout the pandemic.

The introduction of new products through manufacturing diversification

mitigates the risks created by a changing business environment for an organization (Darhovskyi, 2017). According to the resource-based perspective, the diversification of businesses into adjacent industries leads to increased rents (Montgomery, 1994). Gort was one of the first studies to examine the profitability of a variety of company performance metrics (1962). Contrary to earlier findings, there was no important cross-sectional association between diversity and profitability (Gort, 1962; Arnould, 1969). Markham (1973) states that diversification was not typically profitable in the United States between 1961 and 1970.

According to Palepu (1985), one reason there is no link between diversification and performance is that it is impossible to distinguish between connected and disconnected diversification. Plans that are primarily linked or unconnected tend to underperform due to a lack of consistency between the two strategic parts. A company's performance correlates positively with its adoption of either a single/dominant strategy with low related and unrelated diversification or a high diversity strategy with high related and unrelated diversification. The entropy approach is utilized in diversification to assess how an activity is disseminated over numerous company sectors and to measure activity dispersion. The method calculates a company's diversity based on its entropy.

Problem Statement

Because of Covid-19 long-term company, strategies like as diversification may now be analysed in these perilous times to determine whether or not they will be able to endure. To deal with the economic uncertainties, it adopts a number of strategies, some of which are linked while others are not. As a result, the goal of this research is to look into and reflect on DIMO PLC's ability to develop organizational sustainability and resilience through diversity in the face of the COVID-19 pandemic, utilizing the entropy approach as a measure of diversification. The examination will centre on the firm's ability to do so. Thus, the research question of the study is,

What is the impact of the entropy index as a measure of diversification strategy on firm performance of DIMO Plc pre and during the Covid-19 Pandemic period?

LITERATURE REVIEW

The introduction of new products through manufacturing diversification aids a business in meeting the difficulties of a dynamic business environment

(Darhovskyi, 2017). Diversification is a more dramatic and risky strategy because it involves leaving existing items and marketplaces simultaneously. Diversification is the expansion and development of an organization into new industries and businesses (Michael, 2004). When appropriate at the corporate level, a company's corporate strategy may call for diversification into sectors outside the existing business unit's purview (Khanna, 2000).

On the one hand, resource-based theory says that related diversification would lead to higher performance since it is innately positioned to find, develop, and harness resources. Unrelated diversifications in emerging economies, on the other hand, are predicted to assist companies internalize market institutes and manage institutional interactions, according to considerations the institutional environment (Li, 2003). As a result, contrary to popular belief in developed economies that single/concentration strategies and related diversification strategies are more effective than unrelated diversification and high diversification strategies, (Li, 2003) discovered that firm performance is influenced by the combined effect of both related and unrelated diversification strategies.

Frequently, economic theory assumes that enterprises are organized around a single product and operate in a homogeneous market with homogenous factors. According to the market power perspective on diversity, a business may benefit from diversity at the expense of its competitors and clientele. Agency theorists take a more critical stance, emphasizing the advantages of diversification for firm management, frequently at the expense of shareholders. Firm-specific assets and abilities must be valuable, rare, and largely immobile in order to create a competitive advantage and generate rent. How successfully existing resources are used and exploited determines the efficacy of a company's plans. Businesses have unused assets that can be leveraged in firm-specific ways (Montgomery, 1994).

Businesses that use both single/dominant strategies (low in both related and unrelated diversification) and high diversity strategies (high in both related and unrelated diversification) outperform those that use only related and unrelated strategies, as studies on diversification show, because the latter lack "consistency" between the two strategic dimensions. According to Manikutty (2000), internal capital markets are significantly superior at regulating resource allocation when compared to their external counterparts. This thesis contends that organizations who can build substantial internal capital markets gain a distinct competitive advantage.

It is critical to establish the type of diversity that will be applied. The total

number of sections and their proportion distribution have been computed, an option is selected. However, the current entropy measure makes both dimensions equal (Raghunathan, 1985). The "entropy methodology," a method for assessing the distribution of a single activity across several segments, such as business or nation segments, can be used to examine activity dispersion. The phrase "entropy measure" refers to the method's basic entropy reflection while analyzing a company's diversity. Theil articulates this strategy and its driving premise in considerable detail (1967). This method has been widely used to evaluate various levels and types of variety.

Recently, it was found that the entropy measurement had greater validity than various other metrics (Blocher, 2017). The phrase has been variously defined as "a weighted average of segment shares" (Palepu, 1985), "a weighted average of sector diversification" (Berry, 1979), and "a weighted average of segment shares." The importance of each division is measured by its logarithmic share of the firm (Blocher, 2017). The current form of a company's total diversification appears to be as follows:

$$\text{Total Diversification (TD)} = \sum_{i=1}^{n} [P_i * \ln\left(\frac{1}{P_i}\right) \text{ such that } P_i \neq 0$$

Pi is the proportion of all actions contained by I if I is a segment. Because the sum of the weights is more than one, the equation represents a weighted score for each segment share. The entropy principle states that a measurement is a weighted average if the proportions themselves act as weights. When logarithms are employed as weights, the measure must be stated as a weighted score. Theil computes entropy using a weighted average with proportional rather than logarithmic weights (1967). The entropy measure, as stated in the explanation, provides information on "two aspects of diversification: (i) the number of segments in which a corporation works, and (ii) the proportional worth of each segment to overall revenue" (Palepu, 1985). The distribution illustrates how diverse the components of the total are. The overall diversity statistic is divided into two parts: the number of segments and their distribution.

METHODOLOGY

Diversification And Accounting-Based Measures of Performance:

Financial indicators indicate that diversification benefits businesses. However, data suggests that diversification may eventually result in a

decrease in output. According to the study Those studies that excluded high-diversification firms discovered a positive association between diversification and performance, whereas those that excluded low-diversification firms discovered a negative correlation. Using the study's findings, two models for diversity and accounting-based performance indicators can be built.

Model 01 - $ROA_{i,t} = \beta_0 + \beta_1 RE_{i,t} + \beta_2 UE_{i,t} + \beta_3 SIZE_{i,t} + \varepsilon_{i,t}$

Model 02 - $ROE_{i,t} = \beta_0 + \beta_1 RE_{i,t} + \beta_2 UE_{i,t} + \beta_3 SIZE_{i,t} + \varepsilon_{i,t}$

Diversification And Market-Based Measures Of Performance: Diversification has evident advantages for businesses, as proven by market performance statistics. It appears to have an effect on performance when it reaches a particular threshold. Due to data constraints, it is not possible to conduct a more comprehensive analysis that takes into account the diverse definitions of diversification and performance. Check diversification and performance using market-based criteria after model building.

Model 03 - $TQ_{i,t} = \beta_0 + \beta_1 RE_{i,t} + \beta_2 UE_{i,t} + \beta_3 SIZE_{i,t} + \varepsilon_{i,t}$

Hypotheses

Four research hypotheses (H) were defined based on the theoretical review done in this section and will be tested in the empirical part of this study:

$H1_0$: Related diversification does not have a significant relationship with the firm's performance

$H1_1$: Related diversification has a significant relationship with the firm's performance

$H2_0$: Unrelated diversification does not have a significant relationship with the firm's performance

$H2_1$: Unrelated diversification has a significant relationship with the firm's performance.

Sample And Data Collection

This study was conducted based on secondary data and the main figures extracted from the quarterly reports were net income, total assets, total revenue, total market value, shareholders' equity, and segment revenues. All the data was collected using the CSE database and Bloomberg database. The study's primary objective is to determine the effect of the entropy index as a measure of diversification strategy on the firm performance of DIMO PLC.

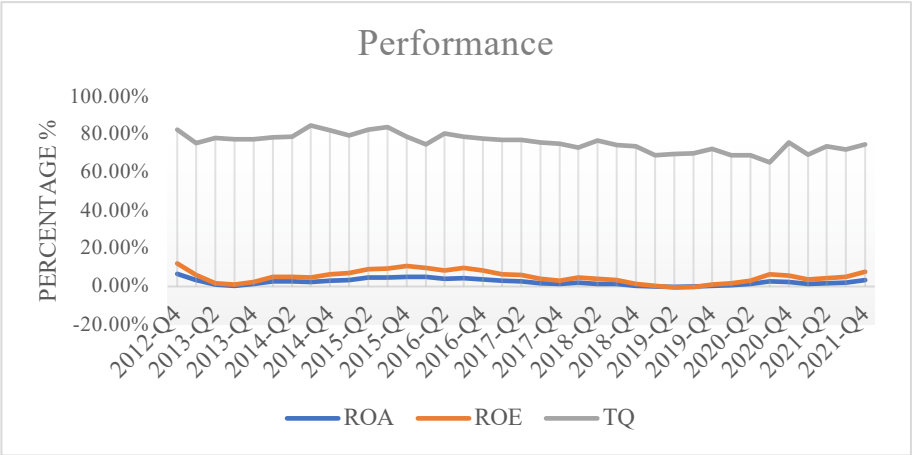
The modeling method will be used with an empirical data gap to analyze the relationship between the variables and evaluate the validity of the hypothesis prior to and during the Covid-19 Pandemic. The investigation was carried out between the years of 2012 and 2021. The nine-year period was selected because it allows for sufficient time to examine patterns and track the outcomes of the time series analysis. Furthermore, because the study was conducted over a period of more than a year, without restricting to the Covid-19 pandemic period. Due to time and resource constraints, a nine-year time span was selected despite the fact that a longer time period is normally advised for study. Every quarter for the following nine years, an analysis will be conducted. Due to the quarterly collection and analysis of data for all variables, a total of 40 quarters spanning the nine-year period were included, from the first quarter (January to March) of 2012 to the fourth quarter (October to December) of 2021.

DATA ANALYSIS AND DISCUSSION

This study includes information from the initial quarter of 2012 through the fourth quarter of 2021. It is essential to establish the pattern of accounting and market-based performance during the observation period in order to detect any important market changes. As depicted in the illustration, this is

Even though the trend line cannot address the primary research question of the study, it is essential to comprehend and concentrate on the big picture in order to avoid significant deviations. Neither the ROA nor the ROE have changed or increased significantly throughout this time period. Tobin's Q, on the other hand, dropped dramatically from the second to the fourth quarter of 2020, probably due to the Covid-19 pandemic, which shut down the whole stock market and caused the economy to collapse in this quarter. Other than this, the data indicates that there were no significant differences between the forty quarters included in the study.

Figure 7: Accounting & market-based Performances of DIMO (2012-2021)



Source: Compiled by the Author

Stationary Testing

In the time series, the variables are not stationary. If you attempt direct regression on this time series, you will run into the issue of false regression (Pseudo regression). This study utilized the Augmented Dickey-Fuller (ADF) unit root test to examine whether variables were stationary at the level and to prevent spurious regression. Using differencing, if it is not already stationary, the study makes it so. As a result, economists are increasingly employing differenced stationary time series to circumvent the problem of inaccurate results. Nonetheless, when comparing time series, this method often overlooks crucial long-term information. That would be an entirely distinct issue. Consequently, a cointegration test is necessary. Cointegration seeks to establish the stationarity of a non-stationary linear combination of variables. If there is cointegration between two or more variables with the same non-stationary characteristics, it is possible to do regression without obtaining erroneous results. Cointegration suggests that variables may fluctuate temporarily before returning to equilibrium. In this study, a cointegration test will be utilized to identify the variables' long-term associations. The presence of cointegration between two or more variables with the same non-stationary characteristics implies the consistency of the long-run coefficient estimate. To reconcile unpredictable long-run behavior with short-run responses, it is necessary to construct and estimate an error correction model (VECM).

According to the results of the ADF unit roots test, the six variables (ROA, ROE, Tobin's Q, Related Entropy Index, Unrelated Entropy Index, and Size factor) at the level are both stationary and non-stationary. All non-stationary

variables become stationary after a single differentiation, as shown in Table 5-2, because the critical values are all less than the ADF test statistics at the 5% significance level.

Table 12: ADF Test at Level

Variables	Level			
	Intercept	**Trend & Intercept**	**None**	**Result**
ROA	-7.521739 (0.0000)	-5.780515 (0.0000)	-7.001092 (0.0000)	Stationary
ROE	-7.495495 (0.0000)	-5.894746 (0.0001)	-6.908268 (0.0000)	Stationary
TQ	-2.827597 (0.0639)	-7.072063 (0.0000)	-1.240925 (0.1934)	Non-stationary
RE	-2.739267 (0.0772)	-2.435262 (0.3561)	0.287815 (0.7639)	Non-stationary
UE	-0.349455 (0.9075)	-4.925045 (0.0015)	2.118198 (0.9905)	Non-stationary
SIZE	-3.853954 (0.0053)	-4.196081 (0.0194)	-0.035591 (0.6646)	Non-stationary

Source: Compiled by the Author

Tobin's Q, the Related Entropy Index, the Unrelated Entropy Index, and Size are all stationary at the first order difference I(1), although Return on Assets and Return on Equity are stationary at the level I(0), indicating that they have unit roots at both I(0) and I(1) (Non-stationary). Because cointegration is required for the VECM model to work, at least two time series with unit roots are required. A time series is assumed to be stationary at some point in a cointegrating or equilibrium connection. There are no such things as independent or dependent variables in VAR/VECM; rather, all variables are presumed to be internally driven. As a result, if one of the variables is non-stationary at the level, the initial difference between all variables can be used, and the VECM can be used if there is at least one co-integration (Gujarati, 2004). According to ENDERS, models 01 and 02 have two stationary time series, ROA and ROE, while models 03 and 04 have three unit-root time

series, related entropy index, unrelated entropy index, and size (2015). Thus, at the initial difference I (1), the variables in this study can execute a cointegration test with all stationary variables and incorporate stationary variables into the VECM at the level I. (0) (Liyanaarachchi, 2015).

Table 13: ADF Test - First order difference

Variables	First-order Difference			
	Intercept	**Trend & Intercept**	**None**	**Result**
TQ	-4.204495 (0.0022)	-4.215635 (0.0105)	-12.80821 (0.0000)	Stationary
RE	-7.112396 (0.0000)	-7.113117 (0.0000)	-7.131161 (0.0000)	Stationary
UE	-9.625806 (0.0000)	-5.063987 (0.0012)	-8.790666 (0.0000)	Stationary
SIZE	-10.33585 (0.0000)	-10.19790 (0.0000)	-10.47822 (0.0000)	Stationary

Source: Compiled by the Author

Cointegration Testing

Four variables are first-order differential stationary sequences, indicating a co-integration relationship, as determined by the unit root test. In this study, the Johansen cointegration test and a Vector Autoregressive (VAR) analysis were employed to determine whether or not time series data were cointegrated. Choosing the appropriate cointegration test type and lag sequence is critical for obtaining a trustworthy result. The work of Johnsen (1988) and Juselius (1988) is commonly used to investigate the cointegration connection between variables in a VAR model (1990). The trace or maximal eigenvalue tests are often used in Johansen cointegration tests. At the 5% level of significance, both the maximum eigenvalue technique and the trace statistic require a P value less than 0.05 to reject the null hypothesis of no co-integration.

Model 01 – Results of the Johansen cointegration test: In Model 1, both the trace statistic and the Maximum Eigenvalue reject the null hypothesis that variables are not co-integrated. According to the linear deterministic trend, the Trace Statistic and Maximum Eigenvalue values are significant (0.0448 and 0.0259) and greater than the Critical Value at 5%, indicating a cointegration relationship between Return on Assets (ROA), Related Entropy Index (REI), Unrelated Entropy Index (UEI), and Size.

Table 3: Johansen Cointegration Test - MODEL 01

Sample (adjusted): 2012Q4 2021Q4				
Included observations: 37 after adjustments				
Trend assumption: Linear deterministic trend				
Series: ROA RE UE SIZE				
Lags interval (in first differences): 1 to 2				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.552574	48.36283	47.85613	0.0448
At most 1	0.289659	18.60582	29.79707	0.5215
At most 2	0.142875	5.951431	15.49471	0.7013
At most 3	0.006656	0.247096	3.841466	0.6191
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.552574	29.75701	27.58434	0.0259

At most 1	0.289659	12.65439	21.13162	0.4845
At most 2	0.142875	5.704335	14.26460	0.6514
At most 3	0.006656	0.247096	3.841466	0.6191

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: E-views estimation of co-integration vectors

Model 02 – Results of the Johansen cointegration test: In Model 2, both the trace statistic and the greatest eigenvalue refute the null hypothesis that the variables are not co-integrated. There is a cointegration association between the ROE, related entropy index, unrelated entropy index, and size because the trace statistic and maximum eigenvalue values are more than the 5% critical value and significant (0.0003 and 0.0003, respectively).

Table 4: Johansen Cointegration Test - MODEL 02

Included observations: 38 after adjustments

Trend assumption: No deterministic trend (restricted constant)

Series: ROE RE UE SIZE

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.684182	74.87144	54.07904	0.0003
At most 1	0.438653	31.07309	35.19275	0.1301
At most 2	0.144811	9.131272	20.26184	0.7240
At most 3	0.080444	3.186836	9.164546	0.5464

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.684182	43.79835	28.58808	0.0003
At most 1	0.438653	21.94182	22.29962	0.0560
At most 2	0.144811	5.944436	15.89210	0.7941
At most 3	0.080444	3.186836	9.164546	0.5464
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: E-views estimation of co-integration vectors

Model 03 – Results of the Johansen cointegration test: In Model 3, both trace statistics and Maximum Eigenvalue reveal that the null hypothesis that the variables are not co-integrated is untrue. Because the trace statistic and maximum eigenvalue values are statistically significant and more than the crucial value of 5%, the analysis concludes that Tobin's Q, related entropy index, unrelated entropy index, and size are cointegrated (0.0087 and 0.0086).

We find that the maximum and trace eigenvalue tests for each model reject the null hypothesis at the 5% level after employing the Johansen cointegration test (no cointegration). This indicates that the correlations between the variables are strong and persistent. If it is assumed that all models have cointegration relationships, VECM modeling can continue.

VECM For A Long-Run Relationship

Table 5: Johansen Cointegration Test - MODEL 03

Sample (adjusted): 2012Q3 2021Q4
Included observations: 38 after adjustments
Trend assumption: Linear deterministic trend
Series: TQ RE UE SIZE
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.582339	55.24652	47.85613	0.0087
At most 1	0.281567	22.06923	29.79707	0.2947
At most 2	0.147550	9.503286	15.49471	0.3209
At most 3	0.086476	3.436947	3.841466	0.0637

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.582339	33.17728	27.58434	0.0086
At most 1	0.281567	12.56595	21.13162	0.4929
At most 2	0.147550	6.066339	14.26460	0.6047
At most 3	0.086476	3.436947	3.841466	0.0637

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: E-views estimation of co-integration vectors

Using the VECM estimation output study can derive the cointegration equations (Long-run model) as follows.

Table 6: Cointegration Equation (Long-run Model) - MODEL 01

ROA	C	RE	UE	SIZE
1.000000	-0.479054	0.310165	-0.048113	0.036069
		(0.05714)	(0.02083)	(0.00971)
		[5.42807]	[-2.31030]	[3.71566]

(Standard errors in parentheses) [t statistics in brackets]

Source: Compiled by the Author

It can be said that a stable equilibrium relationship exists since the study has recognized the existence of one cointegrating equation. The results are normalized on ROA. The signs are inverted as a result of the normalization process, allowing for accurate interpretation as follows (Daniel Della Maggiora, 2009).

$$\mathbf{ROA}_{t-1} = \mathbf{0.479054} - \mathbf{0.310165RE}_{t-1} + \mathbf{0.048113UE}_{t-1} - \mathbf{0.036069SIZE}_{t-1}$$

RE and UE have the expected signs and are statistically significant according to the t values at 5% of the significance level shown. This study interprets the coefficients as follows:

Related entropy index increased by 1 lead to 0.310165 decreases in ROA in the long run.

Unrelated entropy index increased by 1 leading to 0.048113 increase in ROA in the long run.

A 1% increase in size leads to a 0.036069 decrease in ROA in the long run.

Table 7: Cointegration Equation (Long-run Model) - MODEL 02

ROE	C	RE	UE	SIZE
1.000000	-0.495704	0.427157	-0.072516	0.030153
		(0.08963)	(0.03565)	(0.01904)
		[4.76559]	[-2.03439]	[1.58346]

(Standard errors in parentheses) [t statistics in brackets]

Source: Compiled by the Author

It can be said that a stable equilibrium relationship exists in model 02 since the study have recognized the existence of one cointegrating equation. The results are normalized on ROE. The signs are inverted as a result of the normalization process, allowing for accurate interpretation as follows.

$ROE_{t-1} = 0.495704 - 0.427157RE_{t-1} + 0.072516UE_{t-1} - 0.030153SIZE_{t-1}$

RE and UE have the expected signs and are statistically significant according to the t values at 5% of the significance level shown. This study interprets the coefficients as follows:

Related entropy index increased by 1 lead to 0.427157 decreases in ROE in the long run.
Unrelated entropy index increased by 1 leading to 0.072516 increase in ROE in the long run.
Size has a negative relationship with the ROE but is statistically not significant according to the t value at 5% of significance level (1.96 > 1.58)

Table 8: Cointegration Equation (Long-run Model) - MODEL 03

TQ	C	RE	UE	SIZE
1.000000	-1.820384	0.730200	-0.014486	0.075397
		(0.11371)	(0.04593)	(0.02440)
		[6.42156]	[-0.31541]	[3.09024]

(Standard errors in parentheses) [t statistics in brackets]

Source: Compiled by the Author

In the last model, it is apparent that a stable equilibrium relationship exists since the study has recognized the existence of one cointegrating equation. The results are normalized on TQ. The signs are inverted as a result of the

normalization process, allowing for accurate interpretation as follows.

$TQ_{t-1} = 1.820384 - 0.730200RE_{t-1} + 0.014486UE_{t-1} - 0.075397SIZE_{t-1}$

RE and UE have the expected signs but statistically one of both not significant according to the t values at 5% of significance level shown. Therefore, it is possible to interpret the coefficients as follows:

Related entropy index increased by 1 lead to 0.730200 decreases in TQ in the long run.
Unrelated entropy index has a positive relationship with Tobin's Q but is statistically not significant according to the t value at 5% of significance level (1.96 > 0.31).
A 1% increase in size leads to a 0.075397 decrease in Tobin's Q in the long run.

Because the coefficient (C1) is significant and negative according to the VECM test, it is possible that the variables have a long-term relationship. A p-value of less than 5% should indicate that the long-run link coefficient is negative (Al-Masbhi, 2021). In this study, the system equations of each model are utilized to calculate the cointegration coefficient C (1), which can then be used to evaluate the model's diagnostic and gain insight into both long-term and short-term causalities. Each model's VECM findings relating to the coefficient of cointegration equations are detailed in Table 5-10.

Table 9: Summary of Long-run Causality

Model	C(1) Coefficient	Std.Error	t-Statistic	Probability	Long-run Causality
Model 01	-0.287156	0.072484	-3.961648	0.0005	Yes
Model 02	-0.382180	0.055808	-6.848151	0.0000	Yes
Model 03	-0.300357	0.120471	-2.493168	0.0180	Yes

Source: Compiled by the Author

Every model has negative or between 0 and -1 cointegration equation coefficients (also known as error correction term, or ETC). However, their p values are below 5%, indicating a substantial association. To correct the deviation of the quarter from long-run equilibrium, the rates of adjustment

for models 01, 02, and 03 are, respectively, 28.71%, 38.22%, and 30%. This suggests that there are numerous long-term causal connections between size, related entropy index, and unrelated entropy index that impact ROA, ROE, and Tobin's Q models.

VECM Short-Run Causality (Wald Test)

To investigate the short-run relationship between the variables, the Wald test was used. Each model's short-run causalities are summarized in the table below.

Table 10: Summary of Short-run Wald Test

Model	Variable (Coefficient)	Test statistic	Value	Probability	Short-run causality
Model 01	RE H_0;C(4)=C(5)=0	Chi-square	10.56594	0.0051	Yes Reject H_0
	UE H_0;C(6)=C(7)=0	Chi-square	1.043148	0.5936	No Fail to reject H_0
	SIZE H_0;C(8)=C(9)=0	Chi-square	1.834437	0.3996	No Fail to reject H_0
Model 02	RE H_0;C(3)=0	Chi-square	4.092372	0.0431	Yes Reject H_0
	UE H_0;C(4)=0	Chi-square	1.619953	0.2031	No Fail to reject H_0
	SIZE H_0;C(5)=0	Chi-square	0.642708	0.4227	No Fail to reject H_0

Model 03	RE H_0;C(3)=0	Chi-square	4.399175	0.0360	Yes Reject H_0
	UE H_0;C(4)=0	Chi-square	0.338466	0.5607	No Fail to reject H_0
	SIZE H_0;C(5)=0	Chi-square	6.205164	0.0127	Yes Reject H_0

Source: Compiled by the Author

According to Model 01, there is a causal relationship between the connected entropy index and ROA in the short run. Due to the fact that the p-values of the other two variables above the 5% significance level, it can be concluded that there is no short-run correlation between "ROA" and "unrelated entropy index and size." In Model 02, the connected entropy index and ROE exhibit a short-run causal relationship. In addition, there is no association between ROE and the unrelated entropy index or size over the near term. According to Model 3, there is no association between unrelated entropy index and Tobin's Q in the short run, but there is a relationship between related entropy index and size and Tobin's Q.

Testing Hypotheses

This study was established based on 2 main null hypotheses and the results can be concluded as follows relating to VECM using the long-run causality and the short-run causality based on the above analysis.

$H1_0$: Related diversification does not have a significant relationship with the firm's performance;

$H1_1$: Related diversification has a significant relationship with the firm's performance;

$H2_0$: Unrelated diversification does not have a significant relationship with the firm's performance;

$H2_1$: Unrelated diversification has a significant relationship with the firm's performance.

Table 11: Summary of Long-run and Short-run Causality

Model	Hypothesis	Significant Relationship	
		Long-run Causality C(1)	**Short-run Causality (Wald Test)**
Model 01	$H1_0$	Yes (Reject $H1_0$)	Yes (Reject $H1_0$)
	$H2_0$	Yes (Reject $H2_0$)	No (Do not Reject $H2_0$)
Model 02	$H1_0$	Yes (Reject $H1_0$)	Yes (Reject $H1_0$)
	$H2_0$	Yes (Reject $H2_0$)	No (Do not Reject $H2_0$)
Model 03	$H1_0$	Yes (Reject $H1_0$)	Yes (Reject $H1_0$)
	$H2_0$	No (Do not Reject $H2_0$)	No (Do not Reject $H2_0$)

Source: Compiled by the Author

Model 01 identifies a significant relationship between "ROA" and "related and unrelated diversifications" in the phenomenon of long-term causality. However, there is only a short-term correlation between related diversification and ROA that is meaningful. In model 02, only the short-term association between "related diversification" and ROE is statistically significant, although the long-term relationship between "ROE" and "related and unrelated diversifications" is significant. According to Model 03, Tobin's Q and the accompanying diversification have a substantial long- and short-term relationship.

If one or more cointegrating vectors are identified for a group of variables, a VECM (Vector Error Correction Model) that accounts for both short-run changes in variables and departures from equilibrium is an effective estimation technique (Andreia, 2015). This study's data analysis allowed for the determination that models have cointegrating vectors and that VECM was

required to continue the work. VECM is suitable for determining both the long-term and short-term relationships between diversity and business success. Manchun, Sanghyo, & Jaeeun conducted a 2019 VECM study on company diversification and the success of construction firms. According to the findings, businesses with higher diversity indices benefited the most from the strategy. To preserve the benefits of diversification, it is essential to anticipate market shifts in advance, which is short-run causality, and to continuously adapt business portfolios, which is long-run causality. In addition, construction businesses have identified several strategies for applying the business diversification plan to improve business performance. In other words, businesses with lower levels of diversification tended to concentrate on their specialized industries in order to improve business performance, whereas businesses with higher levels of diversification actively employed the diversification strategy by leveraging a variety of business networks (Han, 2019).

Prior to explaining the results, it is essential to compare the results to those of earlier studies. Frequently, a substantial amount of capital is required for a company to diversify into new products, industries, or market segments. In other words, the asset profile of a diversified firm is significantly more asset-heavy than that of an undiversified organization. A diversified firm has a lower return on assets than an undiversified firm, even though its absolute return is bigger. This is because the company's returns do not always follow the preceding undiversified profile. In this study, connected diversification has a considerable impact on corporate success, according to hypothesis 1. According to common wisdom, related diversification enables a company with expertise in one area of an input to apply those skills in several industries where the same factor influences performance, hence increasing the company's financial success. This study found that linked diversification has a negative connection with accounting-based and market-based performance for a variety of reasons. For instance, a company's performance could be negatively impacted by "new section" (yet related) expenses such as rent, labor, laws, and economic consequences. According to Berger and Ofek, excessive investment and cross-subsidization may limit the value of diversity (Berger, 1995). The tax advantages of diversification may mitigate a portion of this value loss. There could be a variety of causes underlying the occurrence, making it a potentially intriguing topic for further study.

CONCLUSION

This study tested diversification and how it affects firm performance and their businesses during the Covid-19 pandemic. The study goal is to

determine impact of the entropy index as a measure of diversification strategy on firm performance of DIMO PLC pre and during the Covid-19 Pandemic period. In this study, a preliminary investigation of the theoretical foundations of diversification was conducted. This study also explored the numerous forms, approaches, justifications, enterprises, programs, and efficiency examples of diversification. This study reviewed the literature on the relationships between diversification and performance, which assisted us in formulating our early assumptions and drawing preliminary results. The second component of the study was an empirical examination of the effect of variety on performance. Overinvestment and cross-subsidization are likely to blame for the unfavorable association between linked diversification and business success, as determined by the study. This loss of value can be avoided due to the tax advantages of diversification. There are several possible explanations for the phenomenon, making it an attractive topic for further research.

However, DIMO PLC statistics indicate that unrelated diversification and financial performance are positively correlated. Several potential causes include political ties in a developing nation, the capacity to sustain and justify the capital expenditures necessary for diversification, and investor expectations that view business diversification as a positive management activity. Moreover, a negative correlation was shown between company performance and size. The evidence from DIMO PLC demonstrates that, in the long run, unrelated diversification is positively related to a company's success, but related diversification is negatively related to a company's performance. However, only the relevant diversification influences DIMO PLC's performance immediately. In light of this, DIMO PLC's diversification strategies have proven more successful over time. DIMO PLC is an expert in the automotive industry and employs relevant diversification strategies. Despite the effects of the Covid-19 outbreak and import limitations, the company's overall performance has remained consistent. According to the findings of this study, DIMO PLC could achieve its goals by increasing its activities in the agricultural, biomedical, construction, and material handling sectors, which are all considered unrelated diversification techniques, in order to face unforeseen problems.

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