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National Power Analysis of ASEAN Member States with Entropy-Weight-Based ARAS During 2017-2021

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Abstract
ASEAN is an important economy where aggregate gross domestic product of ten ASEAN Member States (AMSs) amounted to US$3.0 trillion and marked the union as the fifth-largest global economy. This study evaluated national power levels of all of the 10 AMSs and ranked them. National power is important to rank countries. This study evaluated national power of AMSs through using MCDM techniques entropy weight-based ARAS. Results show that in terms of national power Singapore and Indonesia are in the 1st group; Thailand in the 2nd group; Vietnam 3rd group; Malaysia and Philippines 4th group; Cambodia, Lao PDR, Brunei, and Myanmar are in the last group. This analysis shows that, each ASEAN member country contributed to the union an important added value in either finance, energy, infrastructure, education. This underlines that ASEAN is a powerful union strengthening the foundation for a prosperous and peaceful community of Southeast Asian nations by accelerating regional economic growth as officially aimed. In academic literature, there is limited number of comparative studies conducted on ASEAN countries where the comparisons have focused solely on only a single factor. Moreover, the literature does not contain any comparative analyses of ASEAN countries in terms of national power. This research constitutes pioneering research of the National Power of the ASEAN countries. Furthermore, it adds significant value to the existing body of literature by conducting a comprehensive analysis of 1586 indicators segmented into thirteen principal factors.

Keywords: ASEAN, MCDM Techniques, National Power, Entropy-Weight-Based ARAS

1. Introduction

In the last five years, several global crises, such as the Covid-19 pandemic, climate change, conflicts, food insecurity, economic inequality, and global refugee crisis, have had profound effects worldwide, with differing levels. The COVID-19 pandemic has emerged as a major worldwide crisis, resulting in many deaths and sicknesses, causing devastating impacts on national economies, and significant upheaval in social and cultural conventions. Climate change is currently gaining the utmost significance as an imminent global predicament which

is resulting in a proliferation of severe weather occurrences, including floods, droughts, and wildfires. These adverse conditions displace people, compromise livelihoods, and engender extensive destruction. Numerous conflicts still persist globally, including those in Syria, Yemen, Ukraine, and Afghanistan, which have resulted in significant loss of human lives, with many individuals being forced to migrate or flee their residences and experiencing extreme distress and agony. The issue of food insecurity is of considerable concern in numerous regions across the globe. The problem of insufficient food supply affects a sizeable populace, resulting in detrimental consequences such as malnourishment, hunger, and, ultimately, starvation. The issue of economic inequality has emerged as a pressing concern across global geographies. The worsening socioeconomic disparity between individuals with substantial financial resources and those with limited financial means is becoming increasingly pronounced, culminating in societal discord and instability. Last but not the least the escalating global refugee crisis constitutes a prominent issue of concern. The forced displacement of individuals from their habitual abodes, commonly referred to as refugees, is typically attributed to various circumstances ranging from armed conflicts to acts of violence or natural calamities. The number of global refugees is anticipated to grow in the subsequent years.

Like other nations globally, the member states of the Association of Southeast Asian Nations (ASEAN) have encountered diverse degrees of impact from the crises mentioned above. The ASEAN, currently with 10 members, was established in Bangkok, Thailand by a consortium of five original member nations: Indonesia, Thailand, Singapore, Malaysia, and the Philippines in 1967. From 1984 to 1999, Brunei, Vietnam, Lao PDR, Myanmar, and Cambodia became members of the ASEAN, resulting in ten member countries (Masilamani & Peterson, 2014). The ASEAN Declaration outlines the Association's objectives and aspirations, which include: (1) strengthening the foundation for a prosperous and peaceful community of Southeast Asian nations by accelerating regional economic growth, social advancement, and cultural development via collaborative efforts in the spirit of equality and partnership, and (2) promoting regional peace and stability through the observance of justice and the rule of law in inter-country relationships, as well as adherence to the principles embodied in the United Nations Charter (Mangku, 2017). The ASEAN's importance is it has garnered considerable success as a regional organization in attracting the attention of countries beyond its borders. Overall, the ASEAN has effectively cultivated collaboration in politics, economics, society, and culture, by implementing programs and initiatives to promote shared interests and develop exercise and research facilities (Keling et al., 2011). The ASEAN population is defined as the aggregate number of individuals currently residing within the geographic boundaries of the ten Member States, which collectively span an expansive land area measuring 4.5 million square kilometers. In 2020, ASEAN was home to the third-largest populace globally, with only China and India surpassing its population size. Between 1980 and 2020, the population of the Association of ASEAN demonstrated a significant incline, growing from 355.1 million to 661.8 million. According to statistical data, the aggregate gross domestic product (GDP) of ten ASEAN Member States (AMSs) amounted to US$3.0 trillion. This notable fact has enabled the ASEAN economy to ascend to the rank of the fifth-largest global economy. The nations comprising the world's highest GDP are the United States ($20.9 trillion), China ($14.7 trillion), Japan ($5.0 trillion), and Germany ($3.8 trillion). From 2000 to 2019, ASEAN demonstrated a salient inclination towards a good GDP performance, despite the adverse effects of the 2008–2009 global economic downturn. In the year 2020, the downward trajectory of the specified entity was attributable to the adverse effects of the COVID-19 pandemic (ASEAN Secretariat, 2021). The COVID-19 pandemic has significantly impeded the region's economic growth trajectory. The economic growth rate, which had witnessed a steady increase, peaking at 5.1 percent from 2009 to 2019, underwent a significant contraction in 2020, recording a negative rate of -3.2 percent, followed by a marginal increase of 3.4 percent in 2021. After having weathered the most devastating outcomes of the COVID-19 contagion, the economy of the ASEAN experienced a rapid resurgence, offering the potential for a 5.1% expansion in the current year. Notwithstanding, it must continue to execute the ASEAN Comprehensive Recovery Framework to fortify regional emergency readiness, reaction, and durability (ASEAN Secretariat, 2022).

Examining the effects of this and similar crises in the last five years on the ASEAN from a broad perspective is an important practical reference for policymakers. In international relations theory, national power holds significant importance as it serves as a widely adopted metric for comprehensively assessing and portraying a country's competitive and influential position at the global or regional level. In this respect, for conducting a comprehensive analysis and comparison of countries' national power and multi-criteria decision-making (MCDM)

techniques are valuable instruments since the utility degrees used in MCDM techniques are similar to National Power. To this aim, this study evaluated and ranked AMS in the context of national power using MCDM techniques.

The concept of power has been approached and comprehended by various disciplines. Mattos explicated the notion of national power through the lens of geopolitics by proffering that it constitutes the comprehensive manifestation of all the capacities a country possesses at a given time for facilitating the attainment of its domestic and international goals regardless of any impediments. The employed univariate measures possess the notable benefit of being uncomplicated. Single-variable approaches have intrinsic limitations as they solely focus on a singular aspect of national power, thereby failing to capture the diverse dimensions of countries. A composite indicator is necessary to evaluate nations' comprehensive competitiveness and influence (Liao et al., 2015). National power is the cohesive amalgamation and centralized manifestation of the multifaceted and intricate elements characterizing a nation's political, economic, societal, cultural, ecological, value-oriented, and historical aspects. Given the complex nature of national power and the subjective nature of assessment, building the concept of national power and assessment utilizing a multifaceted approach incorporating varying degrees of empirical insights is imperative (Li & Wang, 2022).

2. Research Background

The literature review found no studies comparing the national power of AMS using MCDM techniques. Despite this, MCDM methods are frequently used to compare AMSs on various topics. We can classify these studies as studies examining the national power of AMSs in one dimension. In this section, the primary studies in the literature in this field will summarize.

Alibeigi et al. (2021) conducted an assessment of ASEAN Electronic Commerce Laws (ECAs) as a concrete first step towards their harmonization. The Fuzzy Analytical Hierarchy Process (FAHP) was used to weigh criteria and evaluate alternatives. The recognition of the Electronic Message was the most important criterion, with a weight of 0.217 when evaluating ECAs. The Place of Dispatch was the least important, weighing 0.028. This study has the potential to increase online transactions and reduce litigation to harmonize ECAs between ASEAN countries. Wang et al. (2023) conducted a research to provide a comprehensive overview of the digital transformation in healthcare within the rapidly growing ASEAN by applying a bounded rational multi-criteria assessment method. The novel approach presented in this study is formulated considering established psychological behavior theories and the advantages of multi-criteria decision-making techniques that rely on distance computation and statistical parameters. Consequently, this approach cannot only objectively ascertain the weight of the criteria through distance correlations but also provide a comprehensive understanding of the decision maker's subjective psychology. The study makes theoretical advancements through an innovative approach while uncovering significant benchmarks and practical insights from successful digital transformation initiatives in the ASEAN region. The results indicate that factors such as infrastructure quality, information-communication technologies, and healthcare system responsiveness are paramount. The research additionally presents a thorough assessment of the efficacy exhibited by various nations. It identifies the leading countries in the ASEAN region that have undergone a digital transformation in the healthcare sector.

Wanke et al. (2016) evaluated the performance of 88 banks in ASEAN from 2010 to 2013. The researchers employed an integrated three-stage financial criteria approach, emulating the CAMELS (The term CAMELS represents an acronym that comprises six key factors, namely capital adequacy, assets, management capability, earnings, liquidity, and sensitivity) rating system. The study employs the fuzzy analytic hierarchy process as a means of initially evaluating the relative weights of various criteria about capital adequacy (C), asset quality (A), management quality (M), earnings (E), liquidity (L), and sensitivity to market risk (S). The opinions of 88 experts from ASEAN are utilized in this assessment. Subsequently, these weights are employed as a means of prioritization based on the similarity to the ideal solution inputs to evaluate their respective levels of effectiveness. Finally, integrating neural networks with similarity-based preference ordering techniques yields a banking performance model with robust predictive capabilities. The findings indicate that contextual factors exert a significant influence on operational effectiveness. Islamic financial institutions exhibit greater efficiency compared to their

conventional counterparts. As mentioned above, the phenomenon can be elucidated by the comparatively reduced utilization of leverage in the realm of Islamic finance. The higher efficiency levels observed in equity leveraging may be attributed to the principle of parsimony derived from Islamic finance principles.

Wanke et al. (2017) evaluated the banking efficiency of 88 banks in the ASEAN region from 2010 to 2013. The researchers employed probabilistic weighting and the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) in their analysis. The study placed particular emphasis on evaluating the influence of Islamic banking while also examining various other types of financial institutions. This paper makes three significant contributions. Firstly, this study presents a novel approach by integrating the variables that simulate the CAMELS rating system for evaluating bank performance with the joint probabilistic weighting of these variables. Consequently, this study deviates from prior research endeavors using the Analytical Hierarchy Process (AHP) to estimate weights. Secondly, the present study utilizes TOPSIS to compute efficiency scores. This approach possesses the exceptional discriminatory capability, given that the efficiency scores tend to cluster around 0.50 and diverge from 1.0. Thirdly, the bank's classification based on its type, ownership, and origin is employed in a rigorous regression methodology, with outcomes being verified through Tobit and Beta regressions. The findings indicate that Islamic principles play a significant role in enhancing the efficiency of banking operations. To be more precise, these advantageous outcomes are observed in cases where financial institutions are privately owned. The outcomes of this study may be utilized to formulate suggestions for policy development.

Wanke et al. (2022) conducted a research to provide a new perspective that was achieved by utilizing the CAMELS rating system as a proxy and considering the aspect of information reliability on the performance of banks in the ASEAN region. A comprehensive MCDM approach has been formulated, which is founded on alternative techniques to address uncertainties in expert preferences pertaining to ideal performance levels in banking and the relative efficiency of CAMELS variables. Structured interviews are utilized to gather expert preferences. At the same time, Fuzzy TOPSIS is employed to establish partial bank rankings based on primary relative efficiency weights derived from Stepwise Weight Assessment Ratio Analysis (SWARA). Z-numbers are employed to account for the inherent imprecision in the relationship between banking performance and financial distress, as well as the reliability of information pertaining to positive-ideal banking performance and CAMELS variables' efficiency functions. These functions are derived from expert preferences or perceptions. The study's empirical results indicate that utilizing information reliability methodologies on the CAMELS rating system proxy can effectively address the uncertain impact of ASEAN banking performance on financial distress. Utilizing a singular MCDM or probability method yielded outcomes that significantly deviated from those obtained through implementing hybrid MCDM methods, which incorporate uncertainty measures to assess data reliability. Utilizing these novel amalgamation techniques results in a higher level of precision for the model compared to alternative methods.

Karimi et al. (2010) conducted research to ascertain the optimal ASEAN member states for attracting foreign direct investment inflows using TOPSIS. The proposed approach additionally furnishes a relatively uncomplicated instrument for resolving this strategic decision-making predicament. Within the framework, ten distinct indicators have been delineated as fundamental determinants that impact the inflow and attraction of foreign direct investment. The application of the TOPSIS methodology has facilitated the assessment of the potential and allure of the member states comprising the ASEAN region, thereby leading to the determination of their respective ultimate positions within a ranking system pertinent to the 2000-2005 span of time. The findings suggest that Singapore is the preeminent target for investment within the ASEAN bloc, notwithstanding that the rankings of certain other jurisdictions have changed over the intervening period.

Purnomo et al. (2011) conducted an assessment of the competitiveness of the Halal-based Agro-Industry among six ASEAN nations. The researchers employed quantitative SWOT and MCDM analyses to ascertain details of each country's intrinsic and extrinsic factors. The findings indicate that Malaysia and Thailand are the most developed nations within the ASEAN region. In contrast, Indonesia ranks fifth due to its inadequacies in crucial intrinsic and extrinsic factors.

Yu (2022) conducted an assessment of the progress made in promoting road safety throughout Southeast Asia. The assessment was conducted utilizing the entropy-TOPSIS-Rank-sum Ratio (RSR) methodology. In the study conducted, a total of 20 indicators were utilized that were drawn from 11 Southeast Asian countries. Through this approach, a ranking and classification of the nations mentioned above according to their level of traffic safety was attained. The obtained findings may offer valuable insights for formulating and implementing policies or programs in the AMS context. Moreover, the presented approach has the potential to offer a fundamental structure for forthcoming evaluations of road safety advancements within the ASEAN region.

Erdin and Özkaya (2022) conducted an assessment of ranking ASEAN countries and Türkiye using the sustainable development index in the World Bank 2016 Report and other similar development indicators in the report by the TOPSIS method. The present study utilized a comprehensive set of 58 indicators distributed across three distinct factors, namely sustainable environment (consisting of 15 indicators), sustainable economy (comprising 25 indicators), and sustainable social development (comprising 18 indicators). Singapore secured the top position in the country ranking, with a considerably substantial margin from other nations, scoring at 0.620. Malaysia, Türkiye, and Thailand secured the second, third, and fourth positions, respectively, with closely proximate values of 0.465, 0.461, and 0.548. Despite their prominent positions in the sustainable economy ranking, these countries are found to be positioned among the bottom five nations in terms of their performance in the sustainable environment assessment. The findings of this study reveal the necessity for heightened efforts to safeguard the environment during a country's pursuit of economic expansion.

Liao et al. (2011) conducted an assessment that discloses a novel viewpoint on Sustainable National Power (SNP) by emphasizing the conventional framework of Comprehensive National Power (CNP) alongside social and environmental sustainability considerations. A novel metric aimed at quantifying the impact of SNPs through a comprehensive analysis of national power and a sustainable adjusted index was proposed. Furthermore, implementing density-equalizing maps is a valuable tool in delineating and illustrating the sustainable national power of various nations. This approach allows for a comprehensive assessment of the existing conditions and the potential prospects for future growth, presented through a cartographic lens. China and its adjoining nations (encompassing seven AMS) have been chosen as case study areas. The findings demonstrate that China performs better than others across most CNP dimensions. However, the country experiences subpar results in multiple SNP-adjusted dimensions within the study region. According to the composite score analysis, China has attained the most elevated regional SNP, pursued by Japan, Russia, South Korea, and India.

3. Method

MCDM is a branch of operational research dealing with finding optimal results in complex scenarios, including various indicators, conflicting objectives, and criteria. MCDM originated from operations research involving various methodologies with a rational foundation in other disciplines. MCDM techniques have been widely applied in the public and private-sector decisions on agriculture resource management, immigration, education, transport, investment, environment, defense, health care, etc. (Kumar et al., 2017). The MCDM process consists of two stages: obtaining the criterion weights and ranking the alternatives. Criteria are required to be weighed in MCDM processes. Employs two distinct methodologies for assigning weights to criteria: the objective and subjective weight systems. Subjective weights may be obtained through the collection of decision-makers opinions, as is common in many other MCDM processes. The objective weights may be determined by various methodologies, including the Entropy Weight method and the Criteria Importance Through Inter-criteria Correlation (CRITIC) method (Shemshadi et al., 2011).

The initial step in any MCDM technique involves the development of a decision-making matrix. This matrix serves as a means to evaluate the performance of various alternatives based on specific criteria that have been selected by the decision-makers. A decision-making matrix with m alternatives and n criteria is presented in Eq.(1).

$$DM = \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix}_{m \times n} \tag{1}$$

The rows represent alternatives, and the columns represent criteria.

3.1 Entropy Weight Method

The thermodynamic concept of entropy was introduced in 1865 by Clausius (Tsallis, 2009). The concept of entropy has been employed to elucidate the phenomenon of irreversible motion that manifests in the domain of thermodynamics. Shannon introduced the entropy concept in 1948 within the realm of communication theory to address the issues of uncertain information and incomplete data. Subsequently, the notion of entropy was discovered to be efficacious in tackling dilemmas related to decision-making. The entropy weight method is widely acknowledged as one of the most prevalent techniques among the various objective weighting methods. Decision-makers frequently utilize the entropy weight methodology to ascertain the relative importance of criteria. The method employed for determining the relative significance of each criterion is contingent upon the numerical data collated by decision-makers. The entropy weight method is an objective approach utilized for determining the criteria weights, an extension of Shannon's entropy. The procedural framework of the entropy weight method can be delineated through the following procedural steps (El-Araby et al., 2022):

Step 1. The decision-making matrix is normalized by using Weitendorf's linear normalization. $R = [r_{ij}]_{m \times n}$
For benefit criteria Eq. (2):

$$y_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \tag{2}$$

For cost criteria Eq. (3)

$$y_{ij} = \frac{\max_i x_{ij} - x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \tag{3}$$

$$r_{ij} = \frac{y_{ij}}{\sum_{i=1}^{m} y_{ij}} \tag{4}$$

Where i=1,2, …,m and j=1,2,…, n

Step 2. Calculating entropy values for criteria. $E = [e_j]_n$

$$e_j = -(\ln(m))^{-1} \times \sum_{i=1}^{m} (r_{ij} \ln(r_{ij})) \left\{ if\ (r_{ij} = 0)\ \Rightarrow \left((r_{ij} \ln(r_{ij})) = 0\right) \right\} \tag{5}$$

Where i=1,2, …,m and j=1,2,…, n
Step 3. Calculating the weight of criteria. $W = [w_j]_n$

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{n} (1 - e_j)} \tag{6}$$

Where j=1,2,…, n

3.2 Apply the Additive Ratio Assessment (ARAS) Method

The ARAS method was introduced in 2010 and developed by Zavadskas and Turskis (YIL) and is one of the most widely used MCDM methods. The most distinguishing characteristic of the ARAS methodology, as compared to other MCDMs, is the comparison of utility degree values of alternatives with those of the optimal state, not the maximum value. The ARAS method is the most appropriate approach for proportional rating among MCDMs, owing to its distinctive characteristics. The procedural framework of the ARAS method can be delineated through the following procedural steps (Bakır & Atalık, 2022):

The decision-making matrix to which the optimal alternative is added with m+1 alternatives and n criteria is presented in Eq.(7).

$$DM = \begin{bmatrix} x_{01} & \cdots & x_{0j} & \cdots & x_{0n} \\ x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & \cdots & x_{ij} & \cdots & x_{in} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix}_{(m+1) \times n} \tag{7}$$

$$\begin{cases} if\ the\ j-th\ criterion\ is\ the\ benefit\ criteria \Rightarrow x_{0j} = \max_i x_{ij} \\ if\ the\ j-th\ criterion\ is\ the\ cost\ criteria \Rightarrow x_{0j} = \min_i x_{ij} \end{cases}$$

The rows represent alternatives, and the columns represent criteria.

Step 1. The decision-making matrix is normalized by using Sum-based linear normalization. $R = [r_{ij}]_{(m+1) \times n}$

For benefit criteria Eq. (8):

$$r_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \tag{8}$$

For cost criteria Eq. (9)

$$r_{ij} = \frac{1/x_{ij}}{\sum_{i=1}^{m} 1/x_{ij}} \tag{9}$$

Where i=0,1, …,m and j=1,2,…, n

Step 2. Calculating weighted decision-making matrix. $Y = [y_{ij}]_{(m+1) \times n}$

$$y_{ij} = w_j r_{ij} \tag{10}$$

Where i=0,1, …,m and j=1,2,…, n

Step 3. Calculating the optimal value of alternatives. $S = [s_i]_{m+1}$

$$s_i = \sum_{j=1}^{n} y_{ij} \tag{11}$$

Where i=0,1, …,m

Step 4. Calculating the utility degree of alternatives. $K = [k_i]_{m+1}$

$$k_i = \frac{s_i}{s_0} \tag{12}$$

Where i=0,1, …,m

Ranking the utility degree of the alternatives in descending order is equivalent to arranging the alternatives in order of decreasing preference, from the most favorable to the least favorable.

4. Data

The study utilized the World Bank's World Development Indicators (WDI) database, widely regarded as the most comprehensive database in this domain, to accurately depict the countries' capacities and corresponding outcomes. WDI is the primary World Bank collection of development indicators, compiled from officially recognized international sources. It presents the most current and accurate global development data available, and includes national, regional and global estimates (World Bank, 2023). In practical applications, two distinct approaches exist for addressing the issue of missing data. In cases where the missing data are limited in scope, typically involving only a select number of years or countries, techniques such as interpolation and regression analysis are commonly employed. Conversely, in situations where the quantity of missing data is extensive, recording such values as zero may be necessary, owing to disparities in the temporal constraints applied to the report writing process (Li & Wang, 2022). Supplementing some of the missing indicators in WDI was used Stockholm International Peace Research Institute (SIPRI) Military Expenditure Database (SIPRI, 2023) and U.S. Energy Information Administration (EIA)'s International Energy Statistics Database (EIA, 2023). All relevant information about AMS for the last five years has been gathered from these databases. As the data about the year 2022 has not been incorporated into the system, the study relied on data from 2017–2021. Furthermore, the Energy factor was added, adhering to the 12 factors in WDI. The utilized dataset for the application comprises five years and encompasses ten distinct countries. It encompasses a total of 1586 indicators and is divided into thirteen fundamental factors, which are outlined as follows: Economic Policy & Debt (309), Education (151), Energy (162), Environment (125), Financial Sector (56), Gender (19), Health (259), Infrastructure (39), Military (16), Poverty (32), Private Sector & Trade (177), Public Sector (78) and Social Protection & Labor (163).

5. Results and Discussion

In the preliminary analysis, the weight values of the Economic Policy & Debt, consisting of 309 indicators, and the health factors, comprising 259 indicators, were suspiciously high. This result shows that in the case of heterogeneity of the number of indicators in the factors, there is a bias in the weight values of the criteria. The analysis was performed in a hierarchical structure similar to Structural equation modeling (SEM) to avoid this bias. Initially, the utility degrees of the factors were calculated, followed by the computation of the utility degrees of the countries. The weight values reported in the findings were derived during the computation of the utility degrees of the countries. A country's utility degrees indicate its proportionate contribution to national power. While scrutinizing the analysis results, it should be noted that the ARAS method has included an optimal country in the AMSs.

The weights of each factor were computed through the weights of the individual indicators within each factor by utilizing the entropy weight method. Table 1 illustrates the allocation of weights obtained to the factors across different years.

Table 1: Entropy Weights for Factors During 2017-2021

Factor	*Mean*	2017	2018	2019	2020	2021
Economic Policy & Debt	*0.080*	0.080	0.080	0.078	0.080	0.081
Education	*0.072*	0.072	0.072	0.072	0.072	0.073
Energy	*0.117*	0.116	0.117	0.117	0.117	0.119
Environment	*0.073*	0.073	0.073	0.073	0.073	0.073
Financial Sector	*0.072*	0.072	0.072	0.072	0.073	0.073
Gender	*0.089*	0.090	0.089	0.091	0.088	0.089
Health	*0.072*	0.072	0.072	0.072	0.072	0.073
Infrastructure	*0.105*	0.106	0.105	0.104	0.103	0.104
Military	*0.089*	0.089	0.092	0.090	0.085	0.088
Poverty						
Private Sector & Trade	*0.075*	0.076	0.075	0.074	0.074	0.075
Public Sector	*0.083*	0.081	0.081	0.084	0.088	0.079
Social Protection & Labor	*0.073*	0.073	0.073	0.073	0.073	0.073

Owing to the missing value in all indicators related to the Poverty factor, it has been unfeasible to derive the weight value for this factor in any year. The results obtained from the analysis conducted using Repeated Measures ANOVA indicate that no statistically significant difference was observed when comparing the variances between the years evaluated (p-value = 0. 996). Upon conducting a One-Way Analysis of Variance, it was observed that a statistically significant difference was evident among the factors examined (p-value < 0. 01). To identify the factors that have the most significant effects, a series of Games-Howell Post Hoc Tests were conducted. The findings of these tests are presented in detail in Table 2.

Table 2: Games-Howell Post Hoc Test's p-values of Factors During 2017-2021

Factor	Energy	Infrastructure	Gender	Military
Economic Policy & Debt	*< .001*	*< .001*	*< .001*	*0.010*
Education	*< .001*	*< .001*	*< .001*	*0.001*
Energy	—	*< .001*	*< .001*	*< .001*
Environment	*< .001*	*< .001*	*< .001*	*0.002*
Financial Sector	*< .001*	*< .001*	*< .001*	*0.001*
Gender	*< .001*	*< .001*	—	*.999*
Health	*< .001*	*< .001*	*< .001*	*0.001*
Infrastructure	*< .001*	—	*< .001*	*< .001*
Military	*< .001*	*< .001*	0.999	—
Private Sector & Trade	*< .001*	*< .001*	*< .001*	*0.002*

| Public Sector | < .001 | < .001 | 0.122 | 0.218 |
| Social Protection & Labor | < .001 | < .001 | < .001 | 0.002 |

Only the Energy factor (0. 117) and Infrastructure factor (0. 104) exhibited significant differences compared to all other factors. The results indicate that the two factors mentioned above exhibit a markedly superior potency in calculating the utility degrees among nations when juxtaposed with other factors.

The utility degrees of each AMSs were computed using the ARAS technique after obtaining their weightings through the entropy approach. The graphical representation of the allocation of benefit levels across time is depicted in Figure 1.
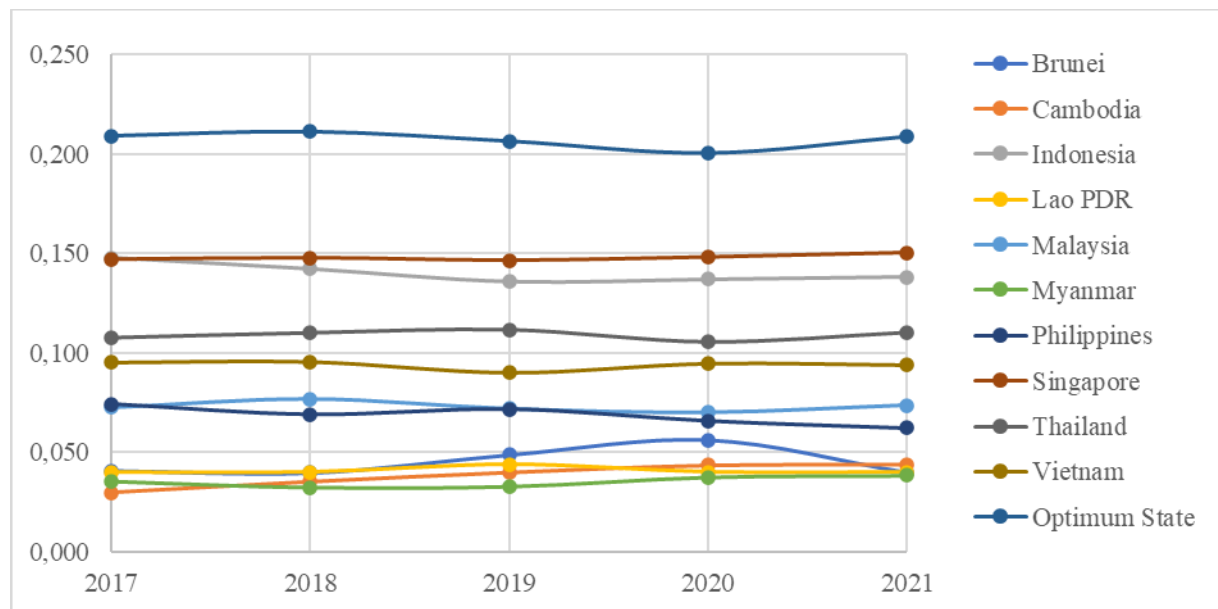

Figure 1: Utility Degrees for AMS and Optimum State During 2017-2021

The results of the Repeated Measures ANOVA indicate a lack of statistically significant differences when comparisons were made between years (p-value = 0. 901). A statistically significant difference was observed upon conducting One-Way ANOVA to assess the dissimilarities among the countries (p-value < 0. 01). Table 3 displays the outcomes of the Games-Howell Post Hoc Tests conducted to assess pairwise comparisons. Based on the findings acquired, it can be observed that the countries have been categorized into five distinct clusters.

Table 3: Games-Howell Post Hoc Test's p-values of Countries During 2017-2021

Countries	Opt S	SG	ID	TH	VN	MY	PH	KH	LA	BN	MM
Optimum State	—	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001
Singapore (SG)		—	0.230	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001
Indonesia (ID)			—	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001
Thailand (TH)				—	< .001	< .001	< .001	< .001	< .001	< .001	< .001
Vietnam (VN)					—	< .001	0.001	< .001	< .001	< .001	< .001
Malaysia (MY)						—	0.710	< .001	< .001	0.006	< .001
Philippines (PH)							—	< .001	< .001	0.009	< .001
Cambodia (KH)								—	0.997	0.855	0.987
Lao PDR (LA)									—	0.920	0.192
Brunei (BN)										—	0.348
Myanmar (MM)											—

Singapore and Indonesia in the 1st group, according to the size of the AMS national power; Thailand in the 2nd group; Vietnam in group 3; Malaysia and Philippines in group 4; Cambodia, Lao PDR, Brunei, and Myanmar in group 5. It is very beneficial for ASEAN that Optimum State is included in a separate group, where the Optimum

State is an imaginary country that consists of the best features of each AMS, its position above other countries show the high synergy of the group.

Descriptive statistics for the utility degrees of AMSs are presented in Table 4.

Table 4: Descriptive Statistics of Utility Degrees for AMS and Optimum State

Countries	Arithmetic Mean (M)	Standard Deviation (S)	Coefficient of Variation (CV)
Optimum State	0.207	0.004	2.0
Brunei (BN)	0.045	0.007	16.2
Cambodia (KH)	0.039	0.006	15.5
Indonesia (ID)	0.140	0.005	3.5
Lao PDR (LA)	0.041	0.002	4.3
Malaysia (MY)	0.073	0.002	3.3
Myanmar (MM)	0.035	0.003	7.9
Philippines (PH)	0.069	0.005	6.9
Singapore (SG)	0.148	0.002	1.0
Thailand (TH)	0.109	0.002	2.1
Vietnam (VN)	0.094	0.002	2.3

As seen in Table 4, the countries' fluctuating national power between 2017 and 2021 can be categorized into three groups. Based on the intensity of fluctuations, Brunei and Cambodia are categorized in the first group, while the second group comprises Myanmar and the Philippines. The third group encompasses Lao PDR, Indonesia, Malaysia, Vietnam, Thailand, and Singapore. A noteworthy advancement in promoting stability within the ASEAN region is the inclusion of Singapore and Indonesia, both of which belong to the top tier of national power in terms of size, within the group that exhibits the slightest fluctuations. Furthermore, it can be posited that the interplay of internal and external factors about the coefficient of variation value of AMSs from 2017 to 2021 did not significantly influence the internal dynamics of ASEAN in relation to national power.

Figure 2 and Figure 3 depict the distribution of utility degrees over the years to analyze the internal dynamics of Brunei and Cambodia, which are in the first group according to the intensity of fluctuations.
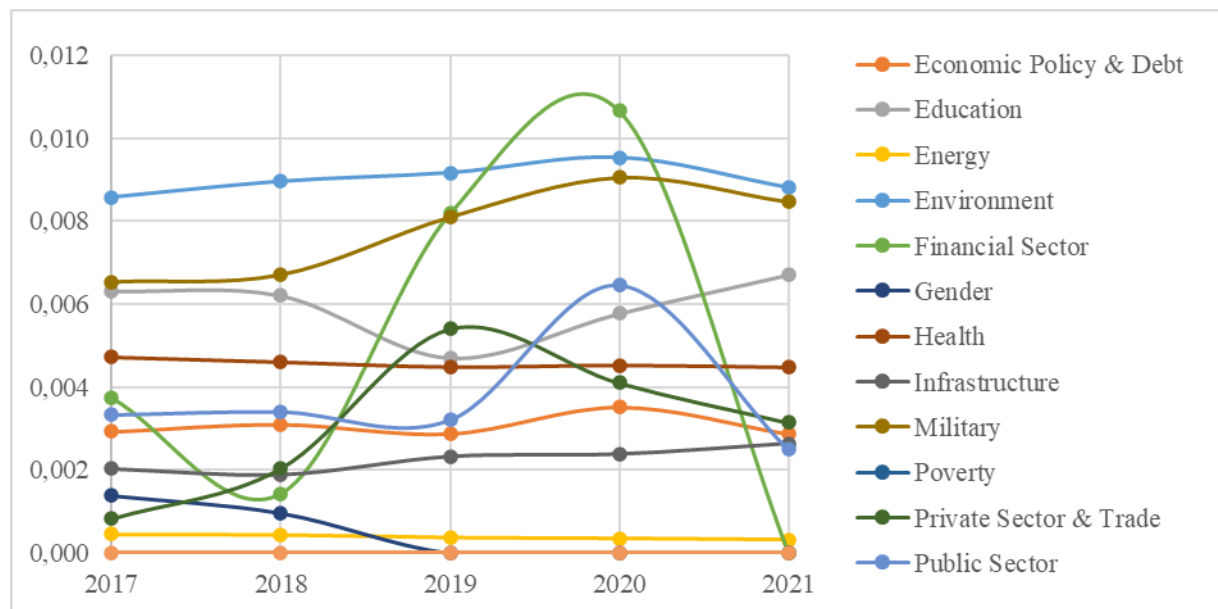

Figure 2: Utility Degrees for Brunei During 2017-2021

The most significant variation in Brunei was observed within the realm of finance. After a rise in the financial industry commencing in 2018, a considerable downturn occurred in 2021, ostensibly attributable to the COVID-

19 pandemic. A comparable phenomenon to that observed in the financial sector factor has also been witnessed within the military factor. Furthermore, a reduction was observed in the public sector in 2021.
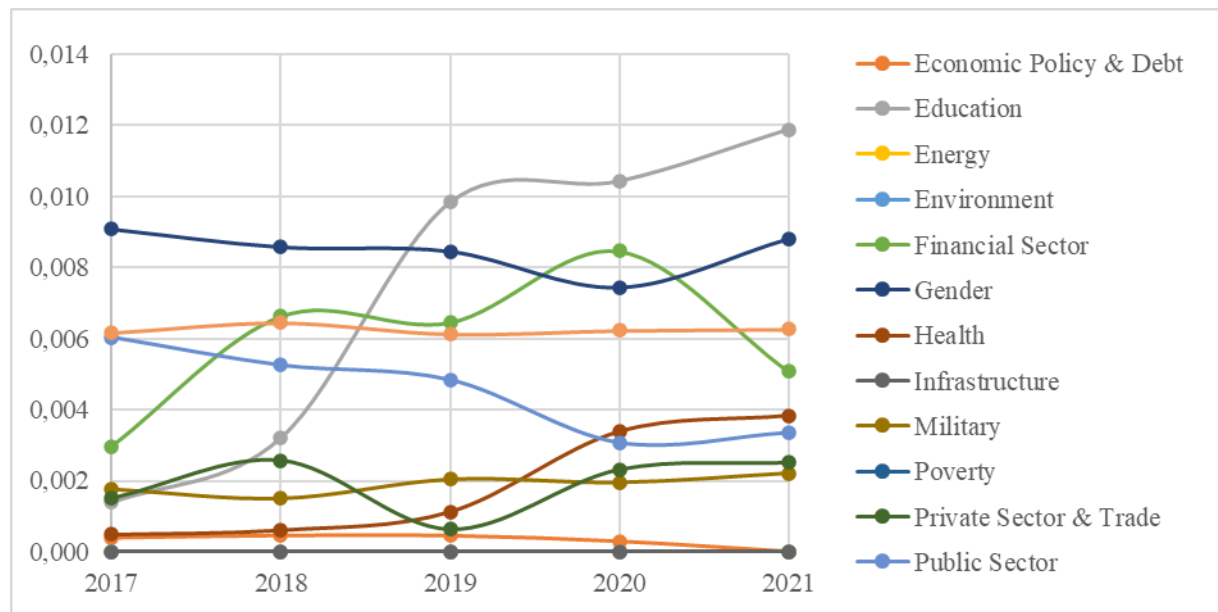

Figure 3: Utility Degrees for Cambodia During 2017-2021

In Cambodia, like Brunei, the most substantial variation occurred within finance. Following an upsurge in the financial industry in 2017, a significant downturn occurred in 2021, plausibly attributable to the COVID-19 pandemic. In Cambodia, the financial sector was the only negatively impacted factor in 2021, with no other discernible adverse effects. Despite the ongoing COVID-19 pandemic, the upward trend in 2017, particularly in Education, has persisted. Furthermore, noteworthy advancements have been achieved in health during this timeframe. Due to these factors mentioned above and others alike, Cambodia experienced a gradual ascent from the 10th to the seventh position within the AMSs rankings during the period spanning from 2017 to 2021. Figure 4 displays the rankings of ASEAN member countries.
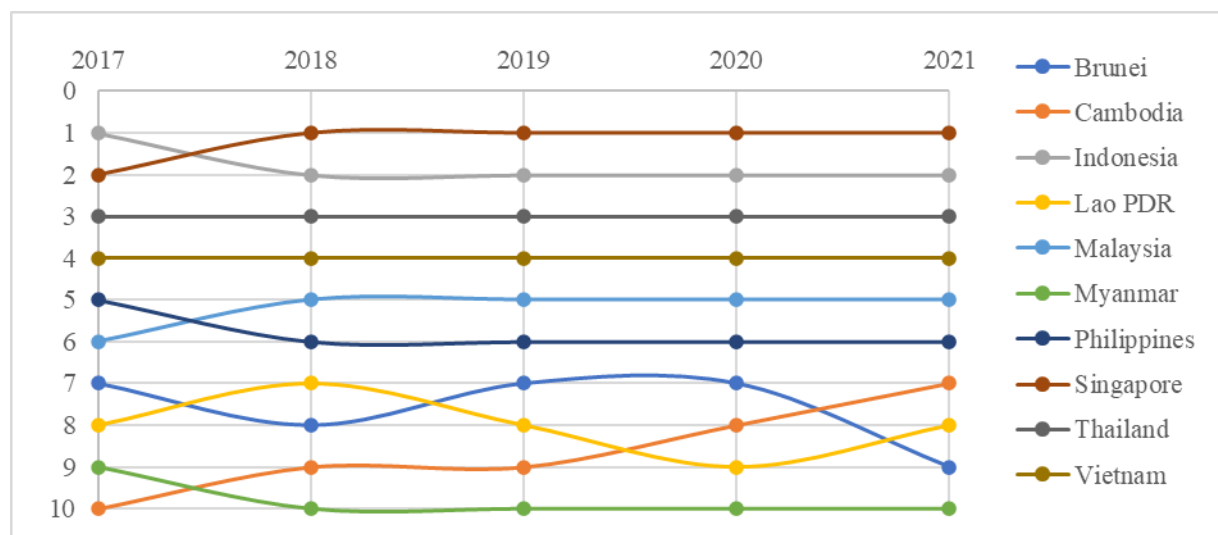

Figure 4: Ranking of AMSs for the Period 2017-2021

In academic literature, there is limited number of comparative studies conducted on ASEAN countries where the comparisons have focused solely on only a single factor. Moreover, the literature does not contain any comparative analyses of ASEAN countries in terms of national power. This research constitutes pioneering research of the National Power of the ASEAN countries. Furthermore, it adds significant value to the existing body of literature

by conducting a comprehensive analysis of 1586 indicators segmented into thirteen principal factors. This research inquiry delves into the ASM's assessment in the discourse on National Power by leveraging the regional and national factors of internal dynamics while utilizing many relevant indicators.

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