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The Innovative Econometric Approaches for Predicting Myanmar's Central Region as a New Economic Hub

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Abstract

This quantitative study aims to develop a data-driven framework for optimizing infrastructure investments in Myanmar's Central Region, identified as a prospective economic hub. Integrating the Cobb-Douglas Production Function, Ridge Regression, and Composite Index Analysis, the framework systematically evaluates four key economic inputs: private capital, labor, transport infrastructure, and public infrastructure and GDP output. Ridge Regression addresses multicollinearity in government budget data, improving stability and reliability of coefficient estimates, while the Composite Index aggregates these inputs into a single metric of economic potential. Findings reveal that the Central Region scores highest, highlighting its readiness to become Myanmar's next economic hub through strategic infrastructure investments. This robust methodology surpasses traditional models by providing policymakers with a practical tool to reduce regional disparities and prioritize high-impact investments. The study's implications extend beyond Myanmar, offering a scalable model adaptable for other developing economies facing similar infrastructure and growth challenges.

INTRODUCTION

Myanmar faces significant regional economic disparities largely due to the absence of a systematic, data-driven approach to prioritize infrastructure investments (Chen & Li, 2021; Zuojun & Lynn, 2024). Without effective predictive models to guide policymakers, high-potential regions often remain underdeveloped while resources are inefficiently allocated (Ardiningrum et al., 2021; Nadhirah et al., 2023). This situation exacerbates regional disparities, making it difficult to achieve balanced national growth (Xu et al., 2021; Zergawu et al., 2020). This gap underscores the need for predictive frameworks that can accurately identify regions where investments will yield the most significant economic returns is thus pressing.

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Inadequate infrastructure planning has profound economic consequences, especially in developing countries like Myanmar, where regional imbalances hinder overall productivity, increase operational costs, and restrict connectivity (Crouch, 2017; Siatan et al., 2024; United Nations, 2003). While past studies have emphasized the benefits of transport infrastructure in driving regional economic growth by enhancing connectivity and facilitating trade, these frameworks often target developed economies. Consequently, do not fully address the unique requirements of countries like Myanmar (Parianom et al., 2024; Yang et al., 2019). This creates a gap in providing policymakers with actionable insights for effective infrastructure investments tailored to local conditions (Chen & Li, 2021; Ouattara & Zhang, 2019).

To address these challenges, this study introduces a predictive framework that integrates the Cobb-Douglas Production Function (Fagerberg & Verspagen, 2009; Miller et al., 2008), Ridge Regression (Lawrence, 2019; Nuryati & Suliadi, 2023), and Composite Index Analysis (Hryhoruk et al., 2020) to forecast regional economic performance. This approach allows for a nuanced assessment of how core inputs—private capital, labor, transport infrastructure, and other public infrastructure—contribute to GDP growth while addressing multicollinearity in budget data, a common issue in resource allocation models (Rodriguez-valez et al., 2005). Ridge Regression improves model reliability, while the Composite Index ranks regions based on economic potential, helping policymakers prioritize infrastructure investment (Nadhirah et al., 2023; Oppio et al., 2017).

In this study, Myanmar's 14 States and Regions are grouped into five distinct regional categories to better capture economic dynamics and growth potential as shown in figure 1: North-Eastern, Western, Southern, Central, and Delta regions (Hill & Menon, 2020). Specifically, the North-Eastern Region includes Kachin, Shan, and Sagaing; the Western Region Covers Chin and Rakhine; the Southern Region comprises Karen, Kayah, Mon, and Thanintaryi the Central Region encompasses Mandalay, Magwe, and Bago; and the Delta Region includes Yangon and Ayeyarwady. This aggregation allows for targeted policies and efficient resource allocation, ensuring that high-growth areas receive prioritized attention.

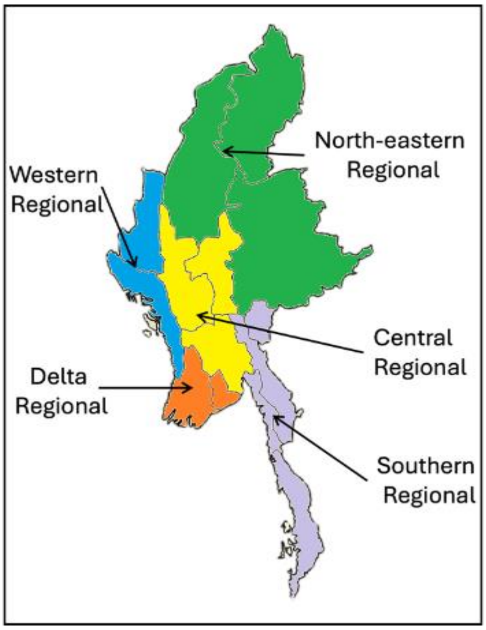

Fig 1. Regional Aggregation Map of Myanmar

The primary objective of this study is to support Myanmar's policymakers in optimizing resource allocation for balanced regional development, with a specific focus on the Central Region. This region shows strong potential to become an economic hub due to its favorable elasticities of key economic factors and Total Factor Productivity (TFP) (Beugelsdijk et al., 2018; ESCAP, 2018). While this framework is tailored to Myanmar, it also has broader applications in other developing countries facing similar regional growth challenges. This paper is organized as follows: the method section describes the data sources, analytical techniques, and model development; the results and discussions section presents the predictive analysis findings and explores their implications for Myanmar's regional planning strategies; and conclusions highlights key findings, contributions to literature, and recommendations for future research.

METHODS

This quantitative study employs a predictive econometric framework to identify Myanmar's next economic hub, focusing particularly on the Central Region. The study integrates three primary analytical tools: the Cobb-Douglas Production Function, Ridge Regression, and Composite Index Analysis, each contributing a unique perspective on how private capital, labor, transport infrastructure, and other public infrastructure drive regional GDP. The Cobb-Douglas Production Function is used to quantify the relationship between GDP and its inputs, represented as:

$$Y = A * K_C^{\alpha} * L^{\beta} * K_T^{\gamma} * K_G^{\delta} \qquad (1)$$

Where Y represents regional GDP, K_C denotes private capital, L is labor, K_T is transport infrastructure capital, K_G is other public infrastructure capital, and A stands for Total Factor Productivity (TFP) (Ishikawa, 2021; Smirnov et al., 2022). The parameters $a, \beta, \gamma,$ and δ capture the output elasticities of each input, quantifying their contribution to GDP. These elasticities are estimated through regression techniques, which offer insights into the scale of returns—whether constant, increasing, or decreasing—based on their sum values. Ridge Regression was then applied to address multicollinearity, a common issue in datasets with highly correlated variables, such as government budget data. This method introduces a penalty term to the regression coefficients, resulting in more stable estimates and reduced variance. The Ridge Regression model is formulated as:

$$\beta^{\wedge} = argmin_{\beta} \left(\sum_{i=1}^{n} (y_i - X_i \beta)^2 + \lambda \sum_{j=1}^{p} \beta_j^2 \right) \qquad (2)$$

Where $\beta^{\wedge}$ denotes the estimated coefficients, X_i represents input variables (capital, labor, infrastructures), y_i is regional GDP, and λ is the penalty parameter that controls the degree of shrinkage (Chand & Kibria, 2024; Firinguetti et al., 2024). Ridge Regression is particularly valuable for this study, as it minimizes inflated coefficient variances due to multicollinearity, enhancing the model's reliability (Mermi et al., 2024).

The dataset used spans from 2011 to 2018 sourced from various Myanmar government ministries. Data on Gross Regional Domestic Product (GRDP) and private capital data were obtained from the Ministry of Planning and Finance, while data on infrastructure investments data—including transport infrastructure (highways, railways, inland water transport, and aviation) and public infrastructure (healthcare, education, irrigation, and energy)—came from the Ministry of Construction and the Ministry of Transport and Communication (Construction, 2020; Ministry of Labor, 2020). Labor statistics were provided by the Ministry of Labor, Immigration, and Population (Labor & P., 2020). To ensure consistency, all monetary values were adjusted to 2010 constant dollar using the Consumer Price Index (CPI) (Roger, 2009).

A Composite Index Analysis was conducted to rank Myanmar's regions by their economic potential, combining Total Factor Productivity (TFP) and the output elasticities derived from Ridge Regression. The Composite Index, calculate as:

$$CI = TFP + \alpha * K_C + \beta * L + \gamma * K_T + \tau * K_G \qquad (3)$$

Where *CI* represents the Composite Index score (Chakrabartty, 2024), provides a multidimensional measure of each region's growth potential. The highest score in this index, indicates readiness to become Myanmar's next economic hub. This Composite Index serves as a valuable tool for resource allocation by comparing growth potential across regions. To ensure robustness, normality tests (Shapiro-Wilk and Kolmogorov-Smirnov) were conducted on economic indicators, and the Variance Inflation Factor (VIF) was used to confirm the suitability of Ridge Regression (Cardoso et al., 2023). Ridge Regression was implemented using Python's 'scikit-learn' library, with data preprocessing in Pandas and visualizations in Matplotlib, enhancing the clarity of results (Lotfi et al., 2023). This integrated methodology represents a novel framework for regional prediction modeling, particularly for developing economies dealing with complex data structures and resource allocation challenges (Xu et al., 2021).

RESULT AND DISCUSSION

This study applied innovative econometric framework to identify Myanmar's next economic hub, standing apart from traditional regression-based studies by addressing multicollinearity through Ridge Regression and Composite Index Analysis. These methods provide a holistic view of each regional's economic potential, allowing policymakers to make informed decisions about resource allocation (Firinguetti et al., 2024; Upendra et al., 2023). Ridge Regression offers insights into Total Factor Productivity (TFP) and the elasticities of key inputs, including private capital, labor, transport infrastructure, and other public infrastructure. Meanwhile, the Composite Index ranks regions based on economic potential, emphasizing distinctions from conventional approaches (Banister & Berechman, 2001; Nuryati & Suliadi, 2023).

The input data—including Gross Regional Domestic Product GRDP, private capital, labor, and infrastructure investments—were collected from Myanmar's government ministries for the period from 2011 to 2018. These datasets, shown in table 1 through 5, form the foundation for Ridge Regression and Composite Index, which are essential for analyzing complex datasets in developing economies.

Table 1. North-Eastern Regional Input Data (2010 Constant Dollars)

Year	GRDP Million MMK	Private Capital (KC) Million MMK	Labor (L) Million	Transport Infra Capital (KT) Million MMK	Other Infrastructure Capital (KC) Million MMK
2011	9002178.70	94928.83	7.29	58301.69	23068.58
2012	9447880.90	93869.34	6.70	1568.86	79662.55
2013	10077987.00	144125.02	6.16	226122.57	134320.22
2014	10689222.00	193852.02	5.66	404966.22	303537.54

2015	11211988.00	210227.29	5.60	572793.65	572397.09
2016	11704095.00	233516.64	5.83	652366.61	1057946.20
2017	12562245.00	199782.74	5.81	699636.76	1190050.20
2018	13137398.00	167199.88	6.11	766153.54	1442344.00

Table 2. Central Regional Input Data (2010 Constant Dollars)

Year	GRDP Million MMK	Private Capital (PC) Million MMK	Labor (L) Million	Transport Infra Capital (KT) Million MMK	Other Public Infra Capital (KG) Million MMK
2011	12326886.00	442413.39	10.48	8886110.50	2683372.60
2012	13425450.00	328921.61	10.69	9886554.20	4424133.90
2013	14479162.00	404481.42	10.91	10966325.00	6651416.30
2014	16519527.00	541604.94	11.13	12340980.00	8726829.40
2015	19336010.00	707265.51	11.36	13908512.00	13060695.00
2016	24104983.00	811557.46	11.59	15336617.00	13060695.00
2017	28957191.00	974480.34	11.83	14841315.00	22255496.00
2018	34993538.00	1202604.3	12.08	16275480.00	29809579.00

Table 3. Delta Regional Input Data (2010 Constant Dollar)

Year	GRDP Million MMK	Private Capital (KC) Million MMK	Labor (L) Million	Transport Infra Capital (KT) Million MMK	Other Infrastructure Capital (KG) Million MMK
2011	14902034.00	468429.66	7.07	9759539.20	24123.55
2012	16639210.00	501766.3	6.50	11023424.00	59511.24
2013	17623645.00	619009.13	5.97	12139204.00	103693.27
2014	19257637.00	769812.01	5.49	13140926.00	219844.72
2015	20314686.00	749933.31	5.72	14206401.00	321244.73
2016	21293178.00	549295.42	5.65	14946145.00	438510.72
2017	23546217.00	409708.07	5.50	16552414.00	526274.56
2018	25501663.00	403048.36	5.78	17978753.00	697088.18

Table 4. Southern Regional Input Data (2010 Constant Dollar)

Year	GRDP Million MMK	Private Capital (KC) Million MMK	Labor (L) Million	Transport Infra Capital (KT) Million MMK	Other Infrastructure Capital (KG) Million MMK
2011	5235427.40	19420.26	2.33	34085.00	3038.53
2012	5880012.30	33844.61	2.14	66892.08	12802.00
2013	6152588.40	41259.34	1.97	122249.12	24025.69
2014	6303010.90	54051.04	1.81	216820.32	64787.63
2015	6083429.30	73242.16	1.85	267849.19	126596.72

2016	6404784.80	82331.03	1.87	312933.85	199520.83
2017	6763506.40	81631.03	1.80	372734.30	314922.98
2018	7076816.20	101190.52	1.95	407257.11	415360.91

Table 5. Western Regional Input Data (2010 Constant Dollar)

Year	GRDP Million MMK	Private Capital (KC) Killion MMK	Labor (L) Million	Transport Infra Capital (KT) Million MMK	Other Infrastructure Capital (KG) Million MMK
2011	1810219.70	3257.14	1.55	43408.47	2706.82
2012	1899542.00	4470.54	1.42	72991.98	15142.90
2013	2239149.90	6212.64	1.31	109225.38	23611.19
2014	2769844.60	9778.65	1.20	154895.79	127120.74
2015	2908940.40	18581.72	0.98	246161.77	188362.03
2016	2817949.60	20289.26	1.24	309220.50	243876.44
2017	2957474.40	20100.55	1.17	368766.83	299771.66
2018	3250811.20	21441.50	1.43	431765.20	382036.29

Using Ridge Regression, the study examines the relationships between economic inputs and regional GDP, with results presented in table 6. Findings reveal statistically significant elasticities across most regions, supporting the theoretical basis of the Cobb-Douglas Production Function (Colther & Doussoulin, 2024; Khatun, 2016). The Central Region stands out, with high elasticities for both transport and public infrastructure, indicating their critical role in driving regional GDP growth (Cantos et al., 2005; Fraga & Ferreira-Filho, 2023). In contract, the Southern Region, with a moderate TFP of 14.9822, shows low and statistically insignificant elasticities for key inputs like private capital and labor, suggesting limited potential for growth through traditional capital and labor investments (Meka'a et al., 2024).

Table 6. Ridge Regression Results (Aggregate Regional)

Regional	TFP	Elasticity of Private Capital (K_C)	Elasticity of Labor (L)	Elasticity of Transport Infra Capital (K_T)	Elasticity of Other Public Infra Capital (K_G)	p-value Model
North-Eastern / P-value	15.0470	0.01245	0.0037	0.0142	0.0887	0.0015
		0.0447	0.0002	0.0001	0.0001	
Western/ p-value	13.0161	0.0373	-0.0039	0.0383	0.0824	0.0048
		0.0554	0.6867	0.0236	0.0007	
Central/ p-value	15.0993	0.0186	0.0037	0.0157	0.0887	0.0000
		0.0020	0.0002	0.0001	0.0001	
Southern / p-value	14.9822	0.0086	0.0002	0.0146	0.0352	0.0337
		0.1282	0.9399	0.05629	0.0018	
Delta/ p-value	15.3294	-0.0374	-0.0038	0.0278	0.1238	0.0026
		0.0949	0.2687	0.0019	0.0000	

The Composite Index was calculated by combining TFP with the elasticities from Ridge Regression, yielding a single score that synthesizes each region's economic potential (Chen & Li, 2021). Data for TFP and elasticities were standardized, enabling direct comparison across regions. Standardization involved subtracting the mean and dividing by the standard deviation for each input across regions:

$$Standardized\ Value = \frac{Actual\ Value - Mean}{Standard\ Deviation} \qquad (4)$$

Using these standardized values, the Composite Index (CI) for each region was calculated by summing the scores weighted by their respective Ridge Regression elasticities. The formula is as follows:

$$\begin{aligned} CI = TFP + \alpha * Standardized\ K_C\ + \beta * Standardized\ L + \gamma \\ * Standardize\ K_T\ + \tau * Standardize\ K_G \end{aligned}$$

Where α, β, γ, and δ represent the elasticities of each factor. For simplicity, equal elasticities were assumed, resulting in:

$$\begin{aligned} CI = Standardized\ TYP + Standarized\ K_C\ + Standarized\ L \\ + Standarized\ K_T\ + Standarized\ K_G \end{aligned}$$

In the Central Region, for example, the standardized values were TFP (0.427), private capital elasticity (0.388), labor elasticity (0.984), transport infrastructure elasticity (-0.060), and other public infrastructure elasticity (0.156). Summing these values, as display in Table 7, Central Region achieved the highest Composite Score (approximately 1.895), highlighting its strong economic potential. A t-test further confirmed a statistically significant difference between the Composite Index for the Central Region and that of the North-Eastern Region (t-statistic = 5.172, p = 0.000), reinforcing the Central Region's potential as Myanmar's next economic hub.

Table 7. Results of Composite Index Analysis

Region	Composite Index
North-Eastern	0.9334
Western	-0.2589
Central	1.8957
Southern	-1.2612
Delta	-0.1758

The integration of Cobb-Douglas Production Function, Ridge Regression, and Composite Index Analysis in this study provides a robust framework for predicting economic hubs in developing countries (Lawrence, 2019). Ridge Regression's effectiveness in managing multicollinearity, a common issue in setting with correlated inputs like infrastructure and capital investments in developing countries, enhances model stability (Mermi et al., 2024). The Composite Index, aggregating these inputs into a single metric, serves as a practical tool for policymakers to prioritize regions by economic potential and optimize resource allocation (Chakrabartty, 2024).

This combined approach yields both theoretical and practical insights. Theoretically, it advances regional economic modeling by using Ridge Regression and Composite Index Analysis in conjunction with the Cobb-Douglas model to offer a more precise method of identifying economic hubs in resource-constrained environments. Practically, it underscores the importance of prioritizing regions with high infrastructure elasticities, like the Central Region, see Fig.2, where strategic investments can generate substantial economic returns, reduce regional disparities, and support Myanmar's sustainable development goals (Hnin & Swe, 2019; Escap, 2018).

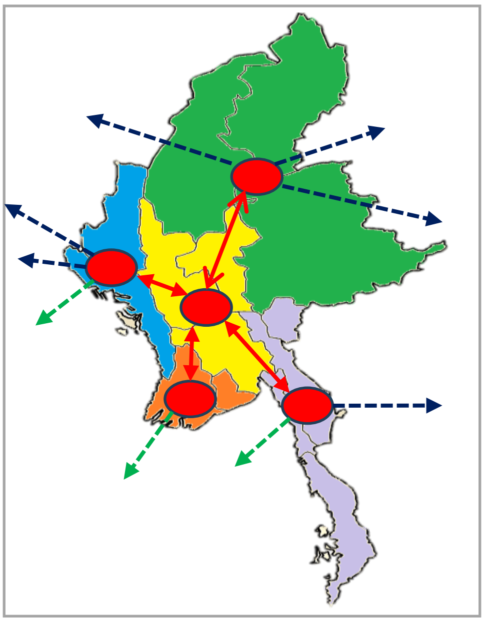

Fig 2. Map of Central Region Myanmar

Compared to previous studies, this methodology addresses the critical issue of multicollinearity in regional growth assessments. For instance, while (Ke et al., 2020) employed GMM analysis to assess economic growth in China's Central Region, they did not adjust for multicollinearity—a crucial factor when analyzing infrastructure investments in developing countries. Similarly, Yu et al., (2012) explored transport infrastructure's impact on GDP but did not focus on the aggregating multiple inputs into a unified measure. By combining Ridge Regression with a Composite Index, this study provides a scalable, precise tool for evaluating economic potential in regions across developing economies.

The high Composite Index score of Central Region underscores its suitability as a focal point for targeted infrastructure investment. This data-driven approach not only supports regional economic growth but also promote balanced national development. The Ridge Regression and Composite Index Analysis validate the Central Region's economic potential, with significant elasticities across private capital, labor, and infrastructure factors. The framework proposed here has broader implications, offering a practical tool adaptable for evaluating economic potential in resource-limited developing economies. By integrating multiple econometric techniques, this study addresses key challenges in regional planning, establishing the Central Region as a priority for future infrastructure investment and policy support.

CONCLUSION

This study identifies Myanmar's Central Region as a promising economic hub using advanced econometric methods that integrating the Cobb-Douglas Production Function, Ridge Regression, and Composite Index Analysis. By evaluating the roles of private capital, labor, transport infrastructure, and public infrastructure in regional GDP growth, this framework addresses limitations in traditional models, specifically issues with multicollinearity and model simplicity. Ridge Regression effectively mitigates these complexities, delivering stable and reliable results that highlight the Central Region's significant potential for growth, largely driven by infrastructure investments. These findings fill a gap in existing literature, where traditional models often fail to capture the unique economic dynamics of developing countries like Myanmar. This innovative methodology provides a robust framework for policymakers to optimize resource allocation and target infrastructure investments effectively. Furthermore, this study offers a foundation for future research that could refine this model by incorporating factors such as environmental sustainability and technological advancements, enhancing the precision of economic predictions. This approach serves as a practical tool for supporting policies aimed at reducing regional disparities, fostering inclusive growth, and promoting economic resilience in Myanmar.

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