Panel Regression Analysis of Governance as Predictor of Economic Dynamism in Bicol Region, Philippines

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ABSTRACT

The study analyzed government efficiency as a predictor of economic dynamism in the 105 municipalities of the Bicol Region, Philippines in 2019-2023. Specifically, it: (a) investigated the performance of the government units and the local economy of the target towns; (b) surveyed the government efficiency indices established by the DTI Competitiveness Bureau; (c) surveyed the economic dynamism indices established by the same bureau; and (d) analyzed the predictive influence of government efficiency indices on the economic dynamism indices of the municipalities. The panel regression analysis revealed a positive association between government efficiency and economic dynamism. The R-squared indicated good fit with town-fixed effects. The F-statistic and p-value showed that the model is statistically significant overall. The ANOVA results disclosed that both town-level effects and government efficiency are substantial contributors to explaining predictive variation in economic dynamism. The regression using lagged variable model uncovered that the lagged government efficiency variable had a positive and statistically significant influence on economic dynamism which suggested that government efficiency may take time to influence economic dynamism. Moreover, this implied that higher government efficiency the previous year is associated with an increase in economic dynamism in the current year. This study espouses an unwavering and sustained implementation of national directives because there is scientific basis that efficient government services in the Bicol Region actually lead to economic growth and development.

Keywords: Panel regression, Government efficiency, Economic dynamism, Competitiveness Index

INTRODUCTION

There were several cities and municipalities in the Bicol Region which outperformed other cities and municipalities in the Philippines in national competitions among local government units conducted periodically by the Department of the Interior and Local Government (DILG) and the Department of Trade and Industry (DTI). In the Cities and Municipalities Competitiveness Index (CMCI) 2023 Rankings of the DTI, Naga City ranked top 1 while Legazpi City was top 2 as the Most Competitive Component Cities (DTI, 2023) from a total of 108 (PSA, 2024). Among the 2023 awardees of the Seal of Good Governance (SGLG) of the DILG, there were five cities and 11 municipalities which received the recognition. Among them were Iriga City and Magarao of the Province of Camarines Sur, Legazpi City and Polangui of Albay, Sorsogon City and Pilar of Sorsogon, Basud of Camarines Norte and Baras of Catanduanes (DILG, 2023).

Anchored on the DTI's CMCI framework, the study examined if and how the competitiveness and performance of local government units translate into economic benefits for the constituents, both households and business firms. It was particularly relevant at the time of implementation because of the 2025 mid-year elections which paved the way to a new set of government officials – long-staying and old politicians, new entrants, and returnees, among others. The study provided scientific basis on the extent to which local governance actually impact on the local economy. It translated volumes of raw data into vital information that would be useful for decision-making and policy-making. Moreover, it could also trace specific government leaders whose brand of governance has been effective in promoting economic dynamism.

REVIEW OF RELATED LITERATURE

Mankiw (2016) introduced the Ten Principles of Economics which theorized, among others, that the "Government can sometimes improve market outcomes." The proposed study interpreted this principle such

that government regulations and interventions may enhance economic dynamism. The invisible hand can work only if the government enforces the rules and maintains the institutions that are key to a market economy.

A study of Alam (2017) found that government effectiveness has a significant positive effect on economic growth. This was supported by Oyedele (2016) that good governance is now recognized, in a manner that was only more vaguely in the past, as a necessary condition for economic growth and reduction of poverty. The income level and existing market structure of a country affect the governance-growth relation (Alam, 2017). Zhuo (2020) affirmed the direct significant effect of rule of law, control of corruption, and voice and accountability on economic growth of developed countries. Conversely, Green (2015) posited that economic transformation can have a strong effect on governance, giving rise to interest groups that push for accountable leaders and effective institutions. Over time, economic transformation can therefore advance core governance objectives.

Many staple governance programs such as public financial management and taxation contribute to economic development (Green, 2015). There is positive effect of increase in labor force, gross capital formation, and trade on economic growth, while inflation exerts a negative effect on economic growth. Moreover, high level of initial GDP is associated with low growth rate (Alam, 2017). Additionally, there is indirect significant effect of government effectiveness, political stability, and regulatory quality on economic growth of developed countries (Zhuo, 2020). The impact of government effectiveness on economic growth is positive in the sub-sample of middle-income countries but the effect is not statistically significant (Alam, 2017).

Moreover, Bassam (2013) asserted in her study that correlation between economic growth and the quality of governance highly depend on levels of human development and on indicators used to capture the quality of governance. A better understanding of growth and economic transformation can improve governance work (Green, 2015) and that governance indicators are important to understand better a country's economy (Zhuo, 2020).

Research Objectives

General Objective. This study aimed to analyze if government efficiency in the 105 municipalities of Region V leads to economic dynamism from the year 2019 to year 2023.

Specific Objectives. Specifically, the investigation sought to:

1. Investigate the performance of the government units and the performance of the local economy of target towns of the Bicol Region;

2. Survey the government efficiency indices of the municipalities as established by the DTI Competitiveness Bureau;

3. Survey the economic dynamism indices of the towns as established by the same bureau; and

4. Analyze the influence of government efficiency indices on the economic dynamism indices of the target municipalities.

RESEARCH METHODS

Research Design

The study employed a causal-comparative research design to examine cause-and-effect relationship among variables. It investigated the role of indicators and the interaction among the components of government efficiency and economic dynamism. The indicators of government efficiency shall be the independent variables while the indicators of economic dynamism shall be the dependent variables. The study shall likewise determine the consequence of differences between or among the identified cities and municipalities.

Study Area

The study covered the 105 towns of the Bicol Region (PSA, 2024). The seven cities were excluded as the data from these units are outliers – relatively higher tax revenue, more budget and resources, larger number of businesses, bigger number of professional organizations, to name a few – which may affect the statistical results.

Sources of Data

The study utilized the DTI open-access data repository as its source of indices and quantities for government efficiency and economic dynamism. The data is accessible through xxx which was launched in 2014 and regularly updated as of year 2023. It included ten major indicators and 45 sub-indicators for government efficiency. It likewise included ten major indicators and 25 sub-indicators for economic dynamism, among others (DTI, 2023). A detailed presentation of these indicators are provided in the table below.

The DTI methodology is built on Michael Porter's framework of location-based productivity. The CMCI works on a 100-point maximum scale consisting of five core pillars – including government efficiency and economic dynamism – each containing ten specific indicators with each indicator accounting for 2% of the total index value. If an indicator requires multiple data fields e.g., combining public and private hospital rooms to measure health infrastructure, the sub-indicators are ranked separately and then aggregated mathematically into a single composite score (DTI, 2023).

Designated LGU data encoders fill out a standardized Local Data Capture Sheet over a three-month period. Encoders map hard raw numbers, budgetary costs, or certificate counts from official municipal accounting records and local state agencies. Over the next two months, the Regional Competitiveness Committees cross-check submissions against institutional sources to catch inconsistencies. The DTI Competitiveness Bureau spends another two months running national-level validation. The CMCI backend portal uses automated data-cleaning modules to flag mathematical outliers for manual review. The system processes verified entries, handles automatic data uploads for specific indicators e.g., intellectual property filings, and generates the final tier ratings within one week.

Data Collection

Government Efficiency (GE)

Table 1 is a presentation of the ten major indicators, 45 sub-indicators, and unit of measure for the index on government efficiency as discussed in the CMCI website of DTI (2023).

Table 1. Indicators and unit of measure for government efficiency (DTI, 2023)

	Major indicator		Sub-indicator	Unit of measure
GE1	Compliance to national directives	1	Presence of Comprehensive Development Plan (CDP)	Yes or no
		2	Year of last update	Year
GE2	Presence of investment promotion unit	3	Order/ resolution creating code	Yes or no
		4	Year of last update	Year
		5	Presence of office and staff	Yes or no
GE3	Compliance to ARTA citizen's charter	6	Submission of citizen's charter to ARTA	Yes or no
		7	Visible citizen's charter in the office	Yes or no
GE4	Capacity to generate local resources	8	Business tax collected by the LGU	PhP

		9	Real property tax collected by the LGU	PhP
		10	Total revenue of the LGU	PhP
GE5	Capacity of health services	11	No. of doctors in public health	No. of doctors/ population of locality
		12	No. of nurses in public health	No. of nurses/ population of locality
		13	No. of midwives in public health	No. of midwives/ population of locality
		14	No. of medical technologists in public health	No. of medical technologists/ population of locality
		15	No. of doctors in private health	No. of doctors/ population of locality
		16	No. of nurses in private health	No. of nurses/ population of locality
		17	No. of midwives in private health	No. of midwives/ population of locality
		18	No. of medical technologists in private health	No. of medical technologists / population of locality
		19	Ratio of doctors in public and private health services to population	No. of doctors in public and private/ population of locality
		20	Ratio of nurses in public and private health services to population	No. of nurses in public and private/ population of locality
		21	Ratio of midwives in public and private health services to population	No. of midwives in public and private/ population of locality
		22	Ratio of medical technologists in public and private health services to population	No. of medical technologists in public and private/ population of locality
GE6	Capacity of school services	23	No. of public secondary school teachers	Ratio of teachers to student population
		24	No. of public secondary school students	Number
		25	No. of private secondary school teachers	Ratio of teachers to student population
		26	No. of private secondary school students	Number
		27	Ratio of teachers to students in public and private secondary schools	Ratio
		28	No. of public tertiary school teachers	Ratio of teachers to student population
		29	No. of public tertiary school students	Number
		30	No. of private tertiary school teachers	Ratio of teachers to student population
		31	No. of private tertiary school students	Number

		32	Ratio of teachers to students in public and private tertiary schools	Ratio
		33	No. of teachers in public technical vocational education and training (TVET) schools	Ratio of teachers to student population
		34	No. of students in public TVET schools	Number
		35	No. of teachers in private TVET schools	Ratio of teachers to student population
		36	No. of students in private TVET schools	Number
		37	Ratio of teachers to students in public and private TVET schools	Ratio
GE7	Recognition of performance	38	No. of DILG recognized awards	Number
		39	Other awards conferred by credible institutions	Number
GE8	Compliance to business permits and licensing system (BPLS) standards	40	Adoption of E-BPLS software	Yes or no
		41	DICT E-BPLS software	Yes or no
		42	Presence of business one stop shop (BOSS)	Yes or no
GE9	Peace and order	43	No. of policeman	Number
		44	Police to population ratio	Ratio
GE10	Social protection	45	Philsys registered members of locality to population ratio	Ratio

Economic Dynamism (ED)

Table 2 is a presentation of the ten major indicators, 25 sub-indicators, and unit of measure for the index on economic dynamism as discussed in the CMCI website of DTI (2023).

Table 2. Indicators and unit of measure for economic dynamism (DTI, 2023)

	Theme		Indicator	Unit of measure
ED1	Local economy size	1	Gross sales of registered firms	Philippine Peso
		2	Total capitalization of new business	Philippine Peso
ED2	Local economy growth	3	Increase in gross sales of registered firms	Rate
		4	Increase in total capitalization of new business	Rate
ED3	Active establishments in locality	5	No. of approved permits for new business applications	Number
		6	No. of approved business renewals	Number
ED4	Safety compliant business	7	No. of approved occupancy permits	Number
		8	No. of approved fire safety inspection	Number
ED5	Employment generation	9	No. of declared employees for new business applications	Number

		10	No. of declared employees for business renewals	Number
ED6	Cost of living	11	Local inflation rate	Rate
ED7	Cost of doing business	12	Cost of electricity of commercial users	PhP/ kilowatt hour
		13	Cost of water of commercial users	PhP/ cubic meter
		14	Price of diesel as of December 31	PhP/ liter
		15	Daily minimum wage rate	PhP/ day
		16	Cost of land in a central business district	PhP/ square meter
		17	Cost of rent of the largest commercial space in locality	PhP/ square meter
ED8	Financial deepening	18	No. of universal/ commercial banks	Number
		19	No. of thrift and savings banks	Number
		20	No. of rural banks	Number
		21	No. of non-bank financial institutions	Number
		22	No. of pawnshops/ money changers/ foreign exchange/ remittance center	Number
ED9	Productivity	23	Gross sales of registered firms	PhP sales/ worker
		24	No. of declared employees for business renewals	Number
ED10	Presence of business and professional organizations	25	Total no. of LGU recognized/ registered business groups	Number

Data Analysis: Panel Regression

The study employed panel regression analysis to investigate and establish the association between government efficiency (GE) and economic dynamism (ED). The standard panel model was used for the regression analysis. In order to probe into the predictive influence of GE on ED, the study utilized Analysis of Variance (ANOVA) and Lagged Variable Model. The major panel model was constructed as given below.

$$ED_{i,t} = \alpha + \beta_1 + \beta_2 GE_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$ED_{i,t} = \alpha + \beta_1 + \beta_2 GE1_{i,t} + \beta_3 GE2_{i,t} + \beta_4 GE3_{i,t} + \beta_5 GE4_{i,t} + \beta_6 GE5_{i,t} + \beta_7 GE6_{i,t} + \beta_8 GE7_{i,t} + \beta_9 GE8_{i,t} + \beta_{10} GE9_{i,t} + \beta_{11} GE10_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where:
α = intercept
Yit = is the dependent variable (DV) where i = entity and t = time.
Xit = represents one independent variable (IV),
β1 = is the coefficient for that IV,
uit = is the error term

The model presented above is straightforward as a standard panel model. It was used to measure the influence of the government efficiency index (independent variable) on the economic dynamism index (dependent variable).

The statistical analysis likewise included the determination of R-squared, F-statistics, p-value, ANOVA and Lagged Variable Model to generate additional information that helped accomplish the research objectives.

RESULTS AND DISCUSSION

Table 3 is an excerpt of the data used in the panel regression analysis. The data are the values of ED or Economic Dynamism and GE or Government Efficiency. While the study utilized data from 105 towns, the values below are an excerpt presented in long-table format and covers four towns only – Aroroy from the Province of Masbate, Baao from the Province of Camarines Sur, Bacacay from the Province of Albay, and Bagamanoc from the Province of Catanduanes. The period covered is 2019-2023.

Table 3. Excerpt of data from the CMCI Portal (DTI, 2023)

Town	Year	Type	Value	Town	Year	Type	Value
Aroroy	2019	ED	2.4422	Bacacay	2019	ED	2.6631
Aroroy	2019	GE	2.4422	Bacacay	2019	GE	8.8793
Aroroy	2020	ED	3.6632	Bacacay	2020	ED	4.303
Aroroy	2020	GE	3.6632	Bacacay	2020	GE	8.9357
Aroroy	2021	ED	4.2791	Bacacay	2021	ED	3.5663
Aroroy	2021	GE	4.2791	Bacacay	2021	GE	9.631
Aroroy	2022	GE	4.2589	Bacacay	2022	GE	6.0733
Aroroy	2022	ED	4.2589	Bacacay	2022	ED	4.0967
Aroroy	2023	ED	3.2815	Bacacay	2023	ED	2.9889
Aroroy	2023	GE	3.2815	Bacacay	2023	GE	7.7981
Baao	2019	ED	4.3761	Bagamanoc	2019	ED	2.2204
Baao	2019	GE	11.4034	Bagamanoc	2019	GE	2.2204
Baao	2020	ED	5.3077	Bagamanoc	2020	ED	2.1755
Baao	2020	GE	10.6916	Bagamanoc	2020	GE	2.1755
Baao	2021	ED	4.0841	Bagamanoc	2021	ED	2.4789
Baao	2021	GE	9.2104	Bagamanoc	2021	GE	2.4789
Baao	2022	GE	5.4113	Bagamanoc	2022	GE	3.3655
Baao	2022	ED	4.7675	Bagamanoc	2022	ED	3.3655
Baao	2023	ED	3.668	Bagamanoc	2023	ED	3.1568
Baao	2023	GE	4.7354	Bagamanoc	2023	GE	3.1568

The next section is a discussion of the results using panel regression analysis as the main statistical tool. There were 105 units of analysis referring to all the municipalities in the Bicol Region, covering five years 2019-2023. The assumed dependent variable is ED or economic dynamism while the assumed independent variable is GE or government efficiency.

1. Panel Regression Analysis

This section is a discussion of the results of the panel regression analysis starting with the assumptions.

Model: ED ~ GE + C(TOWN)

Dependent variable : ED

Independent variable : GE

Fixed variable (unit) : Town or municipality, 105 units

Time : Annually from 2019 through 2023

Table 4. Summary of Panel Regression Analysis

Indicator	Value
Coefficient for GE	0.2568
Standard error	0.154
t-Statistic	1.668
p-Value	0.108
R-squared	0.953
F-statistic	~14.48
p-Value	.0001

Based on Table 4, the coefficient of 0.2568 suggests that a 1-unit increase in GE is associated with a 0.2568-unit increase in ED, holding town-level effects constant. This relationship is positive. However, the p-value of 0.108 is greater than 0.05 so this result is not statistically significant at the conventional 5% level. The R-squared of 0.953 is high which indicates good fit with town fixed effects.

The **F-statistic or F-ratio** from the regression model tests whether the model explains a significant amount of variance in ED compared to a model with no predictors. The high F-statistic of ~14.48 and low p-value of .0001 indicate that the model is statistically significant overall – that is, at least one of the predictors (in this case, GE or the fixed effects for TOWN) contributes meaningfully to explaining variation in ED.

2. Analysis of Variance

For further analysis, the Analysis of Variance (ANOVA) was performed. ANOVA evaluates differences across multiple groups in a single analysis. It helps pinpoint whether differences are due to actual group distinctions or just random variations (Siavoshi, 2024). Below is a discussion of the results.

Table 5. ANOVA Table for the Regression Model

Source	Sum of Squares	df	F-Statistic	p-value
C(TOWN)	222.48	104	4.17	1.09e-22 (***)
GE	57.91	1	112.92	1.00e-22 (***)
Residual	160.52	313	—	—

As provided in Table 5, the town fixed effects [C(TOWN)] are highly significant. The GE is also highly significant in explaining variation in ED. The high F-values and extremely low p-values further confirm a strong overall model fit. The ANOVA results show the contribution of each source – [C(TOWN)], GE, and

residuals – to the total variance in ED i.e., that **both town-level effects and** GE **are** substantial contributors to explaining variation in ED.

Upon checking the regression assumptions, below are the findings:

a) **Residuals vs. fitted values.** Shows no major pattern, suggesting acceptable linearity and homoscedasticity. A slight funnel shape could hint at mild heteroscedasticity.

b) **Q-Q plot**. Residuals mostly follow the 45-degree line, indicating that they are approximately normally distributed. Minor deviations at the tails suggest mild non-normality but not enough to invalidate the model.

3. Lagged Variable Model

This model is crucial in time series analysis and regression because it helps capture the influence of past values on current outcomes. Lagged variables allow analysts to understand how past data points affect present and future values. By incorporating lagged variables, models can better predict trends and patterns, making them more reliable for decision-making (Wilkins, 2017). Below are the results of the analysis using the model.

Model: ED ~ GE_lag1 + C(TOWN) + C(Year)

Dependent variable: ED

Independent variable: GE_lag1

The fixed effects regression using the lagged independent variable (GE_lag1) yielded the key results as displayed in Table 6.

Table 6. Regression Summary using Lagged Variable Model

Indicators	Values
Coefficient on GE_lag1	0.4182
Standard Error	0.197
t-value:	2.12
p-value:	0.034
R-squared:	0.647

The lagged GE (GE_lag1) had a positive and statistically significant predictive influence on ED, at the 5% significance level, given a p-value of 0.034. This suggests a **delayed impact of GE on ED**. Moreover, this implies that higher GE the previous year is associated with an increase in ED in the current year.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the panel regression analysis and additional statistical operations mentioned in the foregoing section, the following conclusions may be forwarded:

- There is a positive association between government efficiency and economic dynamism. A 1-unit increase in government efficiency is associated with a 0.2568-unit increase in economic dynamism, holding town-level effects constant. When government services are efficient and government programs are promptly implemented, these have predictive influence on the growth and development of the local economy.

- The p-value is high which shows that this initial result is not statistically significant at the conventional 5% level.
- The R-squared is high which indicates good fit with town-fixed effects.
- F-statistics is high and the corresponding p-value is low which means that the model is statistically significant overall.
- Based on the ANOVA for the regression model, town fixed effects has a highly significant predictive influence on economic dynamism.
- The regression model explains a significant amount of variance in ED compared to a model with no predictors, At least one of the predictors – GE or town-fixed effects – contributes meaningfully to explain variation in ED.
- The high f-values and extremely low p-value confirm a strong overall model fit
- The ANOVA results show that both town-level effects and GE are substantial contributors to explaining variation in ED.
- The regression analysis using the lagged variable model uncovered that the lagged government efficiency variable (GE_lag1) had a positive and statistically significant predictive influence on economic dynamism. This suggested a delayed impact of government efficiency on economic dynamism, which means that government efficiency may take time to influence economic dynamism. Moreover, this revealed previous year's government efficiency predicting current year's economic dynamism, which implied that higher government efficiency the previous year is associated with an increase in economic dynamism in the current year.

RECOMMENDATIONS

This study espouses an unwavering and sustained implementation of national directives not only because of they are required but because there is scientific basis that efficient government services in the Bicol Region actually lead to economic growth and development. The time series analysis has proven that the efficient performance of municipal local government units (LGU) in Region V has successfully translated to a vibrant local economy. Specifically, this study recommends that the following – which are vital elements of government efficiency in the DTI's CMCI framework – be closely monitored and strengthened on a continual basis: (a) designing and/or revisit of a Comprehensive Development Plan; (b) institutionalization of an Investment Promotion Unit; (c) compliance to ARTA citizen's charter; (d) greater capacity to generate local resources; (e) maintenance of peace and order; (f) capacity for health services; and (g) capacity for school services, among others. The strengthening of these factors positively led to increase in local economy size, positive local economy growth, increase in the number of business establishment, employment generation, higher productivity, and a thriving financial environment.

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