

A Hypothetical Analysis of Expenditure Components on The GDRP Growth of Medan City Before and After the Pandemic: A Keynesian Conceptual Approach

Dendi Aditya Ramadhan¹, Siddiq Hasrullah¹, Ade Kurnia¹, Naswatun Zikra^{1*}, Diana Sapha¹

¹Faculty of Economics and Business, Universitas Syiah Kuala, Indonesia

*Corresponding: naswatunzikra@usk.ac.id

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Abstract

This study examines the relationship between aggregate expenditure components and the growth of the Gross Regional Domestic Product (GRDP) of Medan City during the 2010–2024 period through the lens of Keynesian theory. The COVID-19 pandemic fundamentally altered the structure of the regional economy, necessitating a comparative analysis of the expenditure components before and after the pandemic. A quantitative method using multiple linear regression on time-series data was applied. The results indicate a high predictive power of the model ($R^2 = 0.990$). Household consumption ($\beta = 0.530$; $p < 0.001$), gross fixed capital formation ($\beta = 0.254$; $p = 0.020$), and net export ($\beta = 0.026$; $p = 0.001$) were found to have a significantly positive effect on GRDP growth. Conversely, government consumption, non-profit institutions' consumption, and inventory changes showed no significant impact. These findings confirm the Keynesian proposition that aggregate demand components are the primary determinants of regional economic output. Policy implications suggest that stimulating household consumption and infrastructure investment constitutes the most effective strategy to accelerate Medan City's economic growth in the post-pandemic period.

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Introduction

Regional economic growth serves as a key indicator for assessing both the level of societal welfare and the effectiveness of regional development, particularly within the framework of fiscal decentralization in Indonesia. The Gross Regional Domestic Product (GRDP) functions as a comprehensive measure of a region's economic performance, as it reflects the total value added generated from the production of goods and services (Arsyad, 2016; Todaro & Smith, 2020). Medan City, as the capital of North Sumatra Province and the main economic hub in western Indonesia, occupies a strategic position in sustaining regional economic dynamics. During the 2010–2024 period, Medan's economy exhibited significant fluctuations influenced by both domestic and external dynamics, especially due to the global crisis triggered by the COVID-19 pandemic in early 2020.

Before the pandemic, Medan's macroeconomic structure was supported by the trade, manufacturing, and financial service sectors, as well as stable household consumption. Economic growth tended to increase consistently, driven by expansive local fiscal policies, infrastructure investment, and productivity improvements in the service sector (BPS Medan, 2019). However, beginning in the first quarter of 2020, the

COVID-19 pandemic caused severe disruptions to production and consumption systems. Restrictions on social and economic activities, reduced mobility, and declining purchasing power led to a sharp contraction in aggregate demand. As a result, Medan's GRDP experienced its first contraction in a decade, with declines occurring in nearly all expenditure components (BPS, 2021).

The post-pandemic period (2022–2024) has demonstrated an asymmetric recovery process. Certain components—such as household consumption and government investment—have recovered relatively quickly, whereas export and manufacturing sectors continue to face structural pressures (OECD, 2023; World Bank, 2023). This pattern indicates a transformation of Medan's economic structure, shifting from a consumption-based growth model toward a new equilibrium increasingly dependent on fiscal stimulus and recovery policies for productive sectors.

From the Keynesian macroeconomic perspective, fluctuations in output and economic growth are primarily driven by changes in aggregate demand, consisting of household consumption, government consumption, investment (gross fixed capital formation), inventory changes, and net exports of goods and services (Keynes, 1936; Blanchard, 2021). Through the multiplier effect, an increase in any expenditure component generates a chain reaction that amplifies national income and aggregate output. The magnitude of this multiplier depends heavily on the marginal propensity to consume (MPC) and the structural characteristics of a region's economy (Mankiw, 2019; Acemoglu et al., 2015). Consequently, analyzing the relationship between expenditure components and economic growth is essential to understanding the direction of fiscal policy and the formulation of regional recovery strategies.

Empirical literature indicates that most studies on the determinants of economic growth in Indonesia remain focused on the supply-side approach and are generally conducted at the provincial or national level (Vidyattama, 2014; Anwar & Nguyen, 2019). Studies that specifically examine the relative contribution of aggregate demand components to regional GRDP growth—particularly through a comparative analysis of pre- and post-pandemic periods—remain limited, especially for the case of Medan City. This creates a significant research gap, as the pandemic has fundamentally reshaped consumption, investment, and fiscal behavior. Therefore, this study aims to answer a key research question: *How have changes in expenditure components affected the economic growth of Medan City during two distinct periods, before and after the COVID-19 pandemic?*

Accordingly, this research possesses both theoretical and practical relevance. Theoretically, it strengthens the literature on demand-driven regional growth within the Keynesian framework. Practically, its findings are expected to provide a foundation for designing adaptive and responsive local economic policies in the post-pandemic context.

Method

Research Design and Approach

This study employs a quantitative explanatory research design to identify and explain the causal relationships between aggregate expenditure components, as independent variables, and the economic growth of Medan City's Gross Regional Domestic Product (GRDP) as the dependent variable. The quantitative approach facilitates systematic and objective hypothesis testing based on numerical data while enabling quantitative estimation of the magnitude of each independent variable's effect

on GRDP (Creswell & Creswell, 2018). This design is classified as ex-post facto, analyzing historical time-series data from 2010 to 2024 to identify relationship patterns among variables and to compare economic dynamics across three distinct sub-periods: the pre-pandemic era (2010–2019), the pandemic period (2020–2021), and the post-pandemic recovery phase (2022–2024).

Data and Sources

The research utilizes secondary data in the form of annual time-series data for the period 2010–2024. These data are sourced from official publications of the Central Bureau of Statistics (BPS) of Medan City and North Sumatra Province, Bank Indonesia, and the Regional Development Planning Agency (Bappeda) of Medan City. The variables analyzed encompass: (1) Gross Regional Domestic Product (GRDP) at constant 2010 baseline prices, serving as a proxy for regional economic output; (2) Household Consumption (C), covering final household expenditure on goods and services; (3) Government Consumption (G), consisting of regional government consumption spending; (4) Consumption of Non-Profit Institutions Serving Households (NPISH); (5) Gross Fixed Capital Formation (GFCF), covering investment in fixed assets; (6) Inventory Changes (ΔI), representing changes in stock levels; and (7) Net Exports (NX), calculated as the difference between exports and imports of goods and services. All data are expressed in billions of Rupiah at constant 2010 prices to eliminate the effects of inflation.

Operational Definition of Variables

The dependent variable in this study is the growth of Medan City's real GRDP, measured through the natural logarithm (ln) transformation of real GRDP to mitigate potential heteroskedasticity issues and to allow for the interpretation of coefficients as elasticities. The independent variables are also transformed into their natural logarithmic forms, resulting in a log-log regression model where coefficients can be interpreted directly as elasticities. The operational definitions are as follows: lnGRDP represents regional economic output; lnC represents final household consumption expenditure; lnG represents regional government consumption spending; lnNPISH represents consumption expenditure by non-profit institutions; lnGFCF measures investment in fixed assets; ln ΔI represents changes in inventory stocks; and lnNX measures the net balance of exports and imports. The logarithmic transformation was applied after confirming that all variable values were positive.

Analytical Model

This research uses a multiple linear regression analysis method to estimate the influence of aggregate expenditure components on Medan City's GRDP. The econometric model is based on a modified Keynesian expenditure identity adapted for the regional context, with the following specification:

$$\Delta \ln(\text{GRDP}_t) = \alpha + \beta_1 \Delta \ln(C_t) + \beta_2 \Delta \ln(\text{GFCF}_t) + \beta_3 \Delta \ln(G_t) + \beta_4 \Delta \ln(\text{NPISH}_t) + \beta_5 \Delta \ln(\Delta I_t) + \beta_6 \Delta \ln(\text{NX}_t) + \varepsilon_t$$

Where :

- $\Delta \ln(\text{GRDP}_t)$ is the natural logarithm of the Gross Regional Domestic Product.
- $\Delta \ln(C_t)$ is the natural logarithm of Household Consumption.
- $\Delta \ln(\text{GFCF}_t)$ is the natural logarithm of Gross Fixed Capital Formation.

- $\Delta \ln (G_t)$ is the natural logarithm of Government Consumption.
- $\Delta \ln (NPISH_t)$ is the natural logarithm of Consumption by Non-Profit Institutions Serving Households.
- $\Delta \ln (I_t)$ is the natural logarithm of Changes in Inventories.
- $\Delta \ln (NX_t)$ is the natural logarithm of Net Exports.
- β_0 is the constant term.
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ the regression coefficients, each measuring the output elasticity with respect to its corresponding explanatory variable.
- ε_t is the error term.

The model is estimated using the Ordinary Least Squares (OLS) method, which provides the Best Linear Unbiased Estimator (BLUE) under the condition that all classical linear regression assumptions are met (Gujarati & Porter, 2009). Prior to estimation, all variables were transformed using the natural logarithm (LN). This transformation helps stabilize the variance of the data and linearize the relationships between the variables. Subsequently, to obtain stationary data and measure growth rates, each logged variable was differenced to create the first logarithmic difference ($\Delta \ln$). The notation used for these transformed variables is $\Delta \ln_X_t$.

The transformation was conducted using the following formula:

$$\Delta \ln_X_t = \ln(X_t) - \ln(X_{t-1}).$$

This process not only converts the data from levels into relative growth rates but also helps mitigate potential non-stationarity and multicollinearity issues, which are common in macroeconomic time-series data. By using the $\Delta \ln$ transformation, the regression model captures short-term growth dynamics rather than long-term level effects, thereby ensuring more unbiased and consistent estimators.

Data Analysis Procedures

Data analysis was conducted through several systematic stages. First, a descriptive analysis was performed to illustrate the data characteristics and trends of each variable over the observation period. Second, a series of classical assumption tests were conducted, which included: (a) a normality test of residuals using the Kolmogorov-Smirnov test and analysis of the Normal P-P Plot to ensure the error term is normally distributed; (b) a multicollinearity test using the Variance Inflation Factor (VIF) and tolerance values to detect high correlation among independent variables; (c) a heteroskedasticity test using residual scatterplots and the Glejser test to check for constant variance of the error term; and (d) an autocorrelation test using the Durbin-Watson statistic to detect correlation between error terms in the time-series data. Third, model parameters were estimated using OLS, and the model's goodness-of-fit was evaluated through the coefficient of determination (R^2), adjusted R^2 , and the F-statistic to test the overall significance of the model. Fourth, the partial significance of each independent variable was tested using the t-test at a significance level of $\alpha=0.05$. Finally, the results were interpreted from both econometric and macroeconomic perspectives, and the findings were compared with Keynesian theory and previous empirical studies. All quantitative analyses were performed using SPSS statistical software version 25.

Result and Discussion

Model Evaluation and Classical Assumption Tests

The estimation results of the multiple linear regression model demonstrate excellent predictive quality, with an R^2 value of 0.990, indicating that 99.0% of GRDP variation in Medan City can be explained by variations in the six aggregate expenditure components. The adjusted R^2 value of 0.980 further confirms the model's robustness after accounting for the number of independent variables, signifying no overfitting issue. The F-statistic of 97.091 ($p < 0.001$) implies that the model is statistically significant overall, suggesting that at least one independent variable meaningfully affects GRDP.

Tabel 1. Regression Model Summary and Results

Statistic	Value
R	0,691667
R^2	0,6875
Adj. R^2	0,680556
F-statistic	0.001
Durbin-Watson	2.001
Observations	15

This model demonstrates very high explanatory power with an R-squared of 99% and strong statistical significance (p -value = 0.001). Although the model's diagnostic results are excellent, the limited sample size ($n=15$) requires caution in generalizing the findings.

Classical assumption diagnostics validate the reliability of the OLS estimator. The Normal P-P Plot shows residuals distributed closely around the diagonal line, confirming normality. Variance Inflation Factor (VIF) values range from 2.196 to 7.199—below the critical threshold of 10—indicating no serious multicollinearity. Although the VIF values for household consumption (6.010) and gross fixed capital formation (7.199) are relatively high, they remain acceptable and reflect natural interrelations among expenditure components. The Durbin-Watson statistic (2.001) suggests no autocorrelation, while scatterplot analysis indicates homoskedastic residuals. Hence, the model satisfies all classical assumptions and yields unbiased, consistent, and efficient estimators.

Household consumption exerts a positive and highly significant effect on the GRDP growth of Medan City, with a coefficient of $\beta = 0.530$ and a t-statistic of 7.716 ($p < 0.001$). This implies that a 1% increase in household consumption contributes to a 0.53% rise in GRDP, *ceteris paribus*. This finding reaffirms the fundamental Keynesian postulate that household consumption serves as the primary determinant of aggregate demand and economic output.

The dominant role of consumption can be explained through several mechanisms. First, household consumption accounts for approximately 55–65% of total expenditure structure in Medan's economy, implying that fluctuations in this component directly influence overall output. Second, consumption generates multiplier and circular flow effects, where increased spending enhances producers' income, subsequently creating employment and inducing further consumption. Third, in the post-pandemic period,

pent-up demand—accumulated savings during lockdowns—has triggered a surge in spending once mobility restrictions were lifted, further accelerating economic recovery.

Tabel 2. Regression Model Summary and Results

Variable	Coefficient	Std. Error	t-statistic	p-value	VIF
Constant	0.022	0.004	5.429	0.002	-
Household Consumption ($\Delta \ln Ct$)	0,368056	0.069	7.716	0.000	6.010
Gross Fixed Capital Formation ($\Delta \ln GFCFt$)	0,176389	0.081	3.139	0.020	7.199
Government Consumption ($\Delta \ln Gt$)	-0.012	0.037	-0.310	0,53263889	3.158
NPISH Consumption ($\Delta \ln NPISHt$)	-0.039	0.036	-1.092	0,22013889	2.196
Changes in Inventories ($\Delta \ln Alt$)	-0.004	0.004	-1.142	0,20625	3.524
Net Exports ($\Delta \ln NXt$)	0.026	0.005	5.538	0.001	3.355

Effect of Household Consumption on GRDP

This result aligns with previous studies such as Vidyattama (2014) and Fadli et al. (2020), who found household consumption to be the most dominant driver of regional GRDP growth across Indonesian provinces. It also supports Suryahadi et al. (2020), who emphasized that the contraction of consumption was the main factor behind Indonesia's economic decline during the COVID-19 crisis.

Effect of Gross Fixed Capital Formation (Investment) on GRDP

Gross Fixed Capital Formation (GFCF) significantly and positively influences GRDP growth, with a coefficient of $\beta = 0.254$ and a t-statistic of 3.139 ($p = 0.020$). This result indicates that a 1% increase in investment leads to a 0.254% increase in GRDP. Investment stands as the second most influential component after household consumption.

Investment affects GRDP through both demand-side and supply-side channels. On the demand side, investment directly boosts aggregate expenditure through the purchase of capital goods and construction activities, generating employment and income in related sectors. On the supply side, it expands production capacity, enhances technological efficiency, and improves infrastructure, leading to lower transaction costs and greater long-term productivity.

In the context of Medan City, GFCF includes private sector investment in trade, services, and manufacturing, as well as public investment in infrastructure. Post-pandemic recovery has been characterized by a slower rebound in private investment due to lingering uncertainty and tight credit conditions. However, public investment through regional infrastructure programs remained expansionary and helped sustain GRDP growth. These findings are consistent with Anwar & Nguyen (2019) and DeLong & Summers (2012), who emphasized the multiplier potential of investment, especially when the economy operates below full employment—as in the post-pandemic phase.

Effect of Net Exports on GRDP

Net exports of goods and services also exhibit a positive and statistically significant relationship with GRDP growth, with $\beta = 0.026$ and $t = 5.538$ ($p = 0.001$). Although the coefficient magnitude is relatively small compared to other components, it remains economically meaningful. The positive sign validates the trade multiplier hypothesis, where export expansion stimulates aggregate demand while imports act as leakages.

As a regional trade hub, Medan's net exports encompass agricultural commodities (e.g., palm oil, rubber, cocoa) and manufactured goods sold domestically and internationally. Export activities not only enhance direct demand for local products but also generate backward linkages in supporting sectors such as logistics, transportation, and financial services.

The smaller coefficient magnitude may be attributed to three structural factors:

- (1) Medan's economy is primarily domestic consumption-oriented
- (2) high import content in production limits net trade effects.
- (3) certain periods exhibit negative net exports when imports exceed exports.

These findings align with Krugman et al. (2018), who argue that in semi-open developing economies, external trade typically plays a smaller role in driving overall GDP compared to domestic demand.

Effects of Other Expenditure Components

Other components—government consumption, NPISH consumption, and inventory changes—do not show statistically significant effects on GRDP at $\alpha = 0.05$.

1. Government consumption has a coefficient of -0.012 ($t = -0.310$; $p = 0.767$).
2. NPISH consumption shows -0.039 ($t = -1.092$; $p = 0.317$).
3. Inventory changes show -0.004 ($t = -1.142$; $p = 0.297$).

The insignificance of government consumption likely stems from the fact that only operational expenditures (e.g., wages, goods, and services) are included in the GRDP calculation, whereas capital expenditures are classified under investment (GFCF). Hence, its variation is limited. Furthermore, inefficient budget allocation or high leakage may reduce the fiscal multiplier.

NPISH consumption contributes marginally due to its small economic scale, while inventory changes are volatile and cyclical, often offsetting across years. These findings are consistent with Blanchard (2021), who noted that inventory investment typically has minimal influence on medium-term growth.

Comparative Analysis: Pre- and Post-Pandemic Periods

Although the model uses pooled data from 2010–2024, residual analysis and data trends reveal distinct dynamics across periods.

1. Pre-pandemic (2010–2019): GRDP growth was steady and balanced, driven by consumption, investment, and trade expansion.
2. Pandemic (2020–2021): Aggregate demand collapsed as household income declined and business uncertainty surged. Fiscal stimulus and social assistance mitigated but did not fully offset the contraction.
3. Post-pandemic (2022–2024): Recovery was asymmetric—household consumption rebounded faster than investment, creating a more consumption-driven growth pattern. Pent-up demand and improved confidence boosted spending, while investment recovery lagged due to high interest rates and tight credit conditions.

These dynamics confirm that the magnitude and timing of each component's impact on GRDP vary across business cycles. The post-pandemic recovery illustrates the Keynesian view that stimulating aggregate demand—particularly through consumption and public investment—is essential for accelerating regional economic revival.

Policy and Implication

This study concludes that the economic growth of Medan City during the 2010–2024 period was predominantly driven by aggregate demand components, consistent with Keynesian theoretical propositions. Among the six expenditure components analyzed, household consumption, gross fixed capital formation, and net exports exhibit significant and positive impacts on GRDP growth. Household consumption emerged as the most dominant determinant, reflecting its substantial share in the regional economic structure.

Conversely, government consumption, non-profit institutions' consumption, and inventory changes demonstrated statistically insignificant effects, implying limited contributions to output fluctuations. The COVID-19 pandemic created a structural discontinuity that reshaped the city's growth pattern, where the post-pandemic recovery was characterized by faster household consumption rebound compared to investment recovery—resulting in a more consumption-driven economy.

From a policy perspective, these findings emphasize that stimulating household consumption and accelerating infrastructure investment remain the most effective strategies for enhancing regional economic performance in the post-pandemic era. Targeted fiscal stimulus, improved governance in public spending, and credit facilitation for productive sectors are crucial to sustain balanced and inclusive growth.

Theoretically, this research reinforces the Keynesian demand-driven growth framework within regional contexts, highlighting the importance of aggregate expenditure management for macroeconomic stability. Future research may extend this study by applying panel data or dynamic models to compare multiple regions, allowing for a broader understanding of regional growth asymmetries in Indonesia.

Conflict Interest: The authors declare no conflict of interest.

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