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Analysis of the Influence of Economic Factors on Household Consumption using Panel Data Regression in Central Java Province

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Abstract: Household consumption is a crucial indicator reflecting the level of societal welfare and serves as a primary component in the formation of Gross Regional Domestic Product (GRDP). According to data from Statistics Indonesia (BPS, 2021), household consumption in Central Java Province contributes significantly to the total GRDP, although it has shown fluctuations over the years. Therefore, identifying the macroeconomic factors that influence household consumption in the region is essential. This study aims to analyze the influence of macroeconomic variables on household consumption in Central Java Province. The method used is panel data regression by combining cross-sectional data from 35 districts/cities and time series data from 2019 to 2023. The data were obtained from official publications of BPS Central Java. The independent variables analyzed include GRDP, population, open unemployment rate, and poverty rate. Three panel data regression models are used in this study: the common effect model, the fixed effect model, and the random effect model. Classical assumption tests including normality, multicollinearity, and heteroscedasticity were conducted to ensure model validity. The results show that GRDP, population, unemployment, and poverty significantly influence household consumption. The best-fitting model is the Fixed Effect Model (FEM) with a coefficient of determination of 88.86 percent.

Keywords: Household Consumption, Panel Data, Fixed Effect Model, Central Java Province.

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A. INTRODUCTION

Household consumption is an economic activity that involves the use of goods and services by households to meet daily needs. As one of the main components of the economy, household consumption contributes significantly to a region's Gross Domestic Product (GDP), including in Central Java Province. Central Java, as one of the most populous provinces in Indonesia, has a relatively high level of household consumption. Based on data from the Central Bureau of Statistics (2021), the province's Gross Regional Domestic Product (GRDP) reached Rp 1,000 trillion, with the household consumption sector contributing around 55% of the total GDP. However, despite the significant role of household consumption in the economy, purchasing power still faces challenges, such as the open unemployment rate of 5.95% and the poverty rate of 11.25%. This condition indicates that

certain economic factors still affect the level of consumption and the welfare of the community in the region.

Mankiw (2007) explains that household consumption is influenced by income, wealth, and future expectations. He emphasized that when income increases, consumption tends to increase as well, showing a positive relationship between the two. Therefore, it is important to understand the economic factors that influence household consumption in order to formulate appropriate policies to improve community welfare. Several key factors that affect household consumption include GRDP, population size, open unemployment rate (OUR), and poverty rate. GRDP reflects the total value of goods and services produced in a region during a certain period, where an increase in GRDP generally has an impact on increasing household consumption in line with rising incomes. The population size also plays a role in determining consumption levels, as a large population tends to increase the demand for goods and services. However, without sufficient purchasing power, a large population can also pose its own challenges. The open unemployment rate (OUR) reflects the percentage of the labor force that has not obtained employment and can affect purchasing power, ultimately reducing household consumption levels. Meanwhile, the poverty rate indicates the number of people living below the poverty line, which directly limits their access to goods and services.

Previous studies conducted by Tyas et al. (2021) and Minta et al. (2022) have examined household consumption and its determinants. The study by Tyas et al. (2021) analyzed household consumption in Central Java Province during the 2015–2018 period using a panel data estimation model and the Statistical Software for Data Science (STATA). The study identified the influence of GRDP, inflation, minimum wage (UMK), and population size on household consumption. The results showed that GRDP and UMK had a positive and significant effect on household consumption, while inflation and population size had no significant effect. Furthermore, the study by Minta et al. (2022) analyzed the effect of GRDP and population size on household consumption in Aceh Province for the period 2015–2019 using the panel data regression model with the Fixed Effect Model (FEM). The results showed that GRDP and population size had a positive and significant effect on household consumption, both partially and simultaneously.

Based on the above explanation, this study analyzes the influence of economic factors on household consumption in Central Java Province using panel data regression. Panel data is a method that combines time-series and cross-sectional data, allowing researchers to observe dynamic changes in variables over time and differences between individuals or regions. This method is highly suitable for this research, which uses 175 observations consisting of 35 districts/cities in Central Java Province during the 2019–2023 period. By using panel data, this study can provide more accurate estimations and address heterogeneity between regions, so the analysis results can be more representative and relevant for economic policy in Central Java Province. This research is expected to provide deeper insights into the influence of economic factors on household consumption and offer policy recommendations that can improve community welfare in Central Java Province.

B. METHOD

The method used in this study is a quantitative approach with panel data regression analysis. This method was chosen because it combines time-series and cross-sectional dimensions, enabling the researcher to capture the dynamics of household consumption variables over time and across regencies/cities in Central Java Province. The data used in this study are secondary quantitative data obtained from the Central Bureau of Statistics (BPS) through the annual publications of Central Java Province and official data available at https://bps.go.id. The dataset consists of 35 regencies/cities from 2019 to 2023, resulting in a total of 175 observations (balanced panel data). The variables used in this study consist of one dependent variable (Y) and four independent variables (X) as shown in Table 1.

Tabel 1. Research Variables

Variabel	Description
Y	Household Consumption
X_1	Gross Regional Domestic Product (GRDP)
X_2	Population Size
X_3	Open Unemployment Rate (OUR)
X_4	Percentage of Poor Population

The general panel data regression model used in this study can be expressed as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \mu_{it}$$
$$i = 1,2, \ldots, N$$
$$i = 1,2, \ldots, T$$

Where,

Y_{it} : Dependent variable of individual unit i and time period t
β_0 : Intercept coefficient
β_k : Regression coefficient of independent variable k
X_{kit} : Independent variable k for individual unit i and time period t
μ_{it} : Residual for individual unit i and time period t
N : Number of cross-sectional units
T : Number of time period units
k : Number of independent variables

This study applies three main panel regression models:

1. Common Effect Model (CEM)

Assumes no differences across entities or time. The model is estimated using Ordinary Least Squares (OLS):

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + u_{it} \quad (1)$$

2. Fixed Effect Model (FEM)

Considers unobserved heterogeneity by allowing a unique intercept for eachentity:

$$Y_{it} = \beta_{0i} + \beta_1 X_{1,it} + \beta_2 X_{2it} + \cdots \beta_k X_{kit} + u_{it} \quad (2)$$

3. Random Effect Model (REM)

Assumes that individual-specific effects are random and uncorrelated with the regressors:

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \beta_2 X_{2it} + \cdots + \beta_n X_{nit} + W_{it}; W_{it} = u_{it} + \quad (3)$$

To determine the most appropriate model, three tests were conducted:

a. Chow Test (to compare CEM and FEM)
b. Hausman Test (to compare FEM and REM)
c. Lagrange Multiplier (LM) Test (to compare CEM and REM)

To ensure the validity of the panel data regression model, several classical assumption tests were performed, including:

a. Normality Test
   Conducted to determine whether the residuals of the model are normally distributed, typically using the Jarque-Bera test.
b. Multicollinearity Test
   Examined using the Variance Inflation Factor (VIF) to ensure that the independent variables are not highly correlated with each other.
c. Heteroscedasticity Test
   Performed using the Breusch-Pagan or White test to verify whether the variance of residuals is constant across observations.

In addition to the classical assumption tests, this study also conducted significance testing of the model and its parameters:

a. Partial Significance Test (t-test): Used to assess the significance of each independent variable in explaining variations in household consumption. A variable is considered significant if its p-value is below the 5% significance level.
b. Simultaneous Significance Test (F-test): Determines whether the independent variables jointly have a significant effect on the dependent variable.
c. Coefficient of Determination (R^2): Measures the proportion of variation in household consumption that can be explained by the independent variables. A higher R^2 indicates better model explanatory power.

The interpretation focuses on the direction and magnitude of the regression coefficients to understand how changes in GRDP, population size, unemployment, and poverty affect household consumption across regencies/cities in Central Java Province over the 2019–2023

period. All estimations, classical assumption tests, and significance testing were performed using EViews 12.

C. RESULTS AND DISCUSSION

1. Descriptive statistics

Descriptive statistics analysis was used to describe the characteristics of the data, as shown in Table 2.

Table 2. Descriptive Statistics of Research Variables

Variabel	Mean	Minimum	Maksimum
Y	1,107,952	739,467	2,394,280
X_1	42,202,484	8,713,159	2,490,000,000
X_2	1,043,143	121,526	2,043,077
X_3	5,376,457	1,760,000	9,970,000
X_4	10,91%	3,98%	17,83%

2. Panel Regression Model Estimation

This study employed three panel data regression models: Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) to analyze the effect of GRDP, population, unemployment, and poverty on household consumption. The estimation results of each model are presented below.

a. Commont Effect Model (CEM)

The CEM assumes that there are no differences across entities or over time. It is estimated using the Ordinary Least Squares (OLS) method and serves as the base model for panel regression.

Table 3. Estimation Results of Commont Effect Model (CEM)

Variabel	Coefficient	$t-stat$	$p-value$
C	1,348***	18,954	0,0000
X_1	0,003***	6,358	0,0000
X_2	-0,357***	-7,522	0,0000
X_3	3,579***	4,431	0,0000
X_4	-1,917***	-3,355	0,0010

Note :

*) significant at a = 10%

**) significant at a = 5%

***) significant at a = 1%

Table 3 shows that the estimation results of the CEM produce the regression model equation.

$$\hat{Y}_{it} = 1{,}348 + 0{,}003_{1it} - -0{,}357_{2it} + 3{,}579_{3it} - 1{,}917_{4it}$$

Where,
$\hat{Y}_{it}$ =Estimated Household Consumption in region i and time t (dependent variable).
$X_{1,it}$ = (GRDP) has a positive effect on household consumption.
$X_{2,it}$ = Open Unemployment Rate – has a negative effect.
$X_{3,it}$ = Population Size – has a positive effect.
$X_{4,it}$ = Poverty Rate – has a negative effect
1,348 = Constant/intercept, when all independent variables are zero.

Coefficient Interpretation:
Every 1-unit increase in GRDP (X_1) increases household consumption by 0.003 units.
Every 1-unit increase in unemployment rate (X_2) reduces consumption by 0.357 units.
Every 1-unit increase in population (X_3) increases consumption by 3.579 units.
Every 1-unit increase in poverty rate (X_4) reduces consumption by 1.917 units.

The CEM estimation results indicate that all independent variables significantly affect household consumption at the 1% significance level. GRDP and population size have a positive impact, while the open unemployment rate and poverty have a negative effect. These findings highlight the importance of economic growth, unemployment control, and poverty reduction in promoting household consumption in Central Java.

b. Fixed Effect Model (FEM)
FEM considers unobserved heterogeneity by assigning a unique intercept to each cross-sectional unit (district). This model accounts for time-invariant characteristics within entities.

Table 4. Estimation Results of Fixed Effect Model (FEM)

Variabel	Coefficient	$t-stat$	$p-value$
C	2,329	0,796	0,4271
X_1	0,008*	4,920	0,0000
X_2	0,870*	4,144	0,0001
X_3	-3,946	-0,041	0,9668
X_4	-3,453	-1,622	0,1070

Note :
*) significant at a = 10%
**) significant at a = 5%
***) significant at a = 1%

Table 4 shows that the estimation results of the FEM produce the regression model equation.

$$\hat{Y}_{it} = 2{,}329 + 0{,}008_{1it} + 0{,}870_{2it} - \text{-}3{,}946_{3it} - 3{,}453_{4it}$$

The FEM estimation results show that only GRDP and population size significantly affect household consumption at the 1% level, both with a positive influence. In contrast, government spending and poverty are statistically insignificant, indicating that economic and demographic factors play a more dominant role in influencing household consumption in Central Java.

c. Random Effect Model (REM)

The REM assumes that individual-specific effects are random and uncorrelated with the regressors. Estimation is conducted using the Generalized Least Squares (GLS) method.

Table 5. Estimation Results of Random Effect Model (REM)

Variabel	Coefficient	$t-stat$	$p-value$
C	1,406***	13,382	0,0000
X_1	0,004***	4,988	0,0000
X_2	-0,235***	-3027	0,0028
X_3	8,468	1,129	0,2604
X_4	-2,604***	-2,815	0,0054

Note :

*) significant at a = 10%

**) significant at a = 5%

***) significant at a = 1%

Table 5 it shows that the REM estimation results yield the regression model equation.

$$\widehat{Y}_{it} = 1{,}406 + 0{,}004_{1it} - \text{-}0{,}235_{2it} + 8{,}468_{3it} - 2{,}604_{4it}$$

The REM results show that GRDP, population size, and poverty significantly affect household consumption at the 1% level. GRDP has a positive impact, while population and poverty have negative effects. Government spending is not statistically significant. These findings highlight the importance of macroeconomic and social factors in shaping household consumption in Central Java.

3. Best Model Selection

After estimating the panel data regression using the three approaches, the next step is to determine the best model that fits the characteristics of the data. Model selection is carried out using the Chow test to compare the Common Effect Model (CEM) with the Fixed Effect Model (FEM), and the Hausman test to choose between the Fixed Effect Model (FEM) and the Random Effect Model (REM).

a. Chow Test

The Chow test is conducted to determine whether the Fixed Effect Model (FEM) is more appropriate than the Common Effect Model (CEM), with the results obtained:

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	12.936475	(34,136)	0.0000
Cross-section Chi-square	252.555662	34	0.0000

Figure 1. Chow Test result output using eviews 12

Based on the Chow test results, the F-statistic (12.94) and Chi-square statistic (252.56) both show p-values of 0.0000, indicating that the Fixed Effect Model (FEM) is significantly better than the Common Effect Model (CEM). Therefore, FEM is the preferred model for this study.

b. Hausman Test

The Hausman test is conducted to determine the more appropriate model between the Random Effect Model (REM) and the Fixed Effect Model (FEM), with the results obtained.

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	59.420847	4	0.0000

Figure 2. Output of Hausman test results using eviews 12

Based on the results of the Hausman test, the Chi-Square statistic is 59.42 with a p-value of 0.0000. Since the p-value is less than 0.05, the null hypothesis that the Random Effect Model is appropriate is rejected. Therefore, the Fixed Effect Model is more suitable for this study, as it better accounts for individual heterogeneity across districts/cities in Central Java Province.

4. Classical Assumption Test

The classical assumption test is conducted to ensure that the regression model meets the necessary underlying assumptions, so that the estimation results can be interpreted validly. The tests conducted include the normality test, multicollinearity test, and heteroscedasticity test.

a. Normality Test

The normality test is used to determine whether the residuals in a regression equation follow a normal distribution. Testing for normal distribution can be done using the Jarque-Bera (J-B) test, with the results obtained.

$$JB = \frac{n}{6}\left[S^2 + \frac{(K-3)^2}{4}\right]$$
$$= \frac{175}{6}\left[(0{,}192846)^2 + \frac{(3{,}268576-3)^2}{4}\right]$$
$$= 29{,}1667\left[0{,}037186 + \frac{0{,}072113}{4}\right]$$
$$= 29{,}1667[0{,}037186 + 0{,}018028]$$
$$= 29{,}1667[0{,}037186\ x\ 0{,}055214 = 1{,}638]$$

The results of the analysis using the E-views software are shown in the image below.

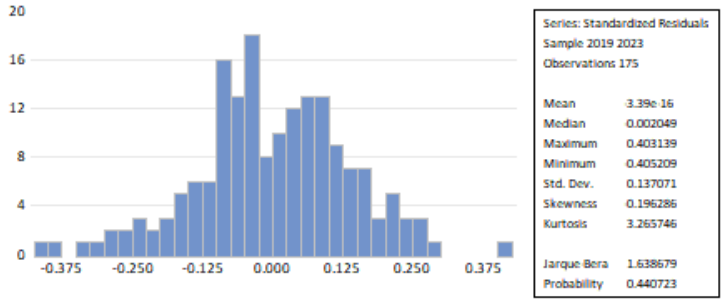

Figure 3. Histogram of normality test results

Based on Figure 3, the JB value is $JB = 1{,}638 < X^2_{(0{,}05;4)} = 9.4877$, and the $p - value = 0{,}4407 > a = 0{,}05$, so H_0 fails to be rejected. This means that the residuals are normally distributed.

b. Multicollinearity Test

The multicollinearity test aims to determine the presence of a linear relationship between independent variables in a regression model. Multicollinearity can be identified by examining the Variance Inflation Factor (VIF) values. The results of the multicollinearity test are presented in Table 6.

Table 6. Multicollinearity test results

Variabel	Nilai VIF
X_1	1.964
X_2	2.105
X_3	1.108
X_4	1.688

Based on Table 6, the VIF values are all less than 10, indicating that there is no correlation among the independent variables.

c. Heteroscedasticity Test

The heteroscedasticity test is conducted to determine whether the variance of the residuals in the regression model is constant. This test is performed using the Glejser test to detect symptoms of heteroscedasticity in the model, with the results obtained.

Table 7. Heteroscedasticity Results

Variabel	$\hat{\beta}_r$	SE$(\hat{\beta}_r)$	$t-hitung$	$p-value$
C	33812,88	201234,4	0,168027	0,8668
X_1	0,001791	0,001144	1,564853	0,1199
X_2	0,108724	0,144501	0,752146	0,4533
X_3	-1450,960	6540,615	-0,223068	0,8238
X_4	-11787,86	14644,25	-0,804948	0,4223

Based on Table 7, the value of |t-statistic| is less than 2.0395 or the p-value is greater than 0.05 for each variable, so H_0fails to be rejected. This indicates that the residual variance is homoscedastic.

5. Parameter Significance Test

The significance test of parameters in panel data regression is used to identify the relationship between the independent and dependent variables. This test consists of the simultaneous test (F-test) and the partial test (T-test).

a. Simultaneous Test (F Test)

The simultaneous test is conducted to examine whether the estimated regression model shows that the independent variables jointly have a significant effect on the dependent variable, with the results obtained.

$$F_{statistics} = \frac{\frac{SSR}{(n+k-1)}}{\frac{SSE}{(nt-n-k)}} = \frac{\frac{1{,}219x10^{13}}{38}}{\frac{1{,}53x10^{12}}{136}} = \frac{3{,}208x10^{11}}{1{,}125x10^{10}} = 28{,}55354$$

Based on the calculation results, the $F_{hitung} = 28{,}55354 > F_{tabel} = 2{,}438$, or the $p-value = 0{,}000 < a = 0{,}05$. Therefore, H_0 is rejected, indicating that all independent variables jointly have a significant effect on the dependent variable.

b. Partial Test (T-Test)

The T-test aims to assess the significance of the influence of each independent variable individually on the dependent variable, assuming that other variables remain constant, with the results obtained.

Table 9. T -test Results

Variabel	$t-statistics$	$p-value$	Conclusion
X_1	4,9200	0,0000	Significant
X_2	4,1448	0,0001	Significant
X_3	-0,0417	0,9668	Not Significant
X_4	-1,6227	0,1070	Not Significant

Based on Table 9, the variables X_3 and X_4 have $|t_{statistics}| < 1{,}977$ or $p - value > 0{,}05$, so H_0 fails to be rejected. This indicates that variables X_3 and X_4 do not have an effect on the dependent variable. On the other hand, variables X_1 and X_2 have $|t_{statistics}| > 1{,}977$ atau $p - value < 0{,}05$, so H_0 is rejected. This suggests that variables X_1 and X_2 have a significant effect on the dependent variable.

6. Coefficient of Determination

The coefficient of determination is used to measure how well the regression model explains the dependent variable. The results of the test show that the panel data regression model with the Fixed Effects Model (FEM) approach has a coefficient of determination (R^2) of 88.86% and an adjusted R^2 of 85.75%. This means that the independent variables in the model are able to explain 88.86% of the variation in the dependent variable, while the remaining 11.14% is explained by other independent variables outside the model.

7. Model Interpretation

Based on the model selection tests, the Fixed Effect Model (FEM) was chosen as the best model to explain the variation in household consumption across districts in Central Java. This model assigns a unique intercep (a_i) for each district. For example, the regression equation for Cilacap Regency is as follows:

$$\widehat{Y}_{it} = 2{,}329 + 0{,}008_{1it} + 0{,}870_{2it} - -3{,}946_{3it} - 3{,}45$$

The coefficients for GRDP (X_1) , and population (X_2) have a **positive effect** on household consumption, meaning that a one-unit increase in these variables is estimated to increase consumption by 0.008 and 0.870 units, respectively. Meanwhile, unemployment (X_3) and poverty (X_4) show **negative effects**, although they are statistically insignificant. This indicates that regional characteristics influence household consumption behavior, and the FEM approach effectively captures this heterogeneity.

D. CONCLUSIONS AND SUGGESTIONS

The best model to explain variations in household consumption in Central Java is the Fixed Effect Model (FEM) with an R^2 value of **88.86%**, indicating that most of the variation is well explained**.** GRDP and population have a significant positive effect on consumption, while unemployment **a**nd poverty are not statistically significant. Based on these results, it is recommended that local governments formulate economic policies tailored to regional characteristics, focusing on enhancing productive sectors, reducing unemployment, and improving household purchasing power. Regions with high consumption potential should also be optimized through investment and infrastructure development to support sustainable economic growth.

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