

The Effect Of Capital Expenditure, Proper Sanitation, Dependency Ratio, And Poverty Line On The Human Development Index In Jambi Province

Keke Aprianti¹, Hardiani², Helen Parkhurst³

^{1,2,3} Development Economics, FEB, University of Jambi

Abstract

This study aims to analyze the development of capital expenditure, improved sanitation, the dependency ratio, and the poverty line, and to examine their effects on the Human Development Index (HDI) across the regencies and municipalities of Jambi Province during 2015–2025. A quantitative, associative research design with secondary panel data was employed. Model selection tests identify the Random Effect Model (REM) as the most appropriate estimator. The results show that capital expenditure has a negative and insignificant effect on the HDI, improved sanitation has a positive and significant effect, the dependency ratio has a negative and insignificant effect, and the poverty line has a positive and significant effect. Simultaneously, all independent variables significantly affect the HDI. These findings suggest that improving human development requires effective allocation of capital expenditure, expanded access to improved sanitation, better management of the population structure to reduce the dependency burden, and enhanced community welfare so that minimum living needs can be fully fulfilled.

Keywords: Human Development Index, Capital Expenditure, Improved Sanitation, Dependency Ratio, Poverty Line, Random Effect Model

INTRODUCTION

A nation's development demands the availability of superior and high-quality human resources (HR). Humans are the primary element in every community and organization; their abilities and creativity give rise to innovations that drive progress (Ruhana, 2012). Therefore, low human development has the potential to significantly impact social life and the national development process as a whole.

Human development is understood as a series of efforts to expand people's life choices, not simply the pursuit of long-term economic growth (Arsyad, 2015). From Amartya Sen's perspective, as cited by Todaro and Smith (2006), the ultimate goal of national development is to increase human capabilities, while economic growth is merely

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a means. This achievement is measured through. The Human Development Index (HDI), developed by the United Nations Development Programme (UNDP) and implemented in Indonesia by the Central Statistics Agency (BPS), encompasses three main dimensions: a long and healthy life, knowledge, and a decent standard of living (UNDP, 2025).

However, the challenge still faced is the disparity in the quality of human development between countries and regions. This condition is also evident in Jambi Province, where the Human Development Index (HDI) is still below the national average, and in Sumatra.

Table 1. Human Development Index of Indonesia, Sumatra Island, and Jambi Province 2021–2025

Year	Indonesia's Human Development Index	Human Development Index of Sumatra Island	Human Development Index of Jambi Province
2021	73.16	73.54	72.62
2022	73.77	74.12	73.11
2023	74.39	74.72	73.73
2024	75.02	75.39	74.36
2025	75.90	76.16	75.13
Average	74.17	74.54	73.54

Source: Central Statistics Agency (BPS), 2026.

Based on table 1, the Human Development Index (HDI) of Jambi Province increased from 72.62 in 2021 to 75.13 in 2025. However, the average HDI of Jambi during this period of 73.54 is still lower than the average for Indonesia of 74.17 and the island of Sumatra.

Sumatra's figure is 74.54. Furthermore, there are differences in HDI achievements between districts/cities in Jambi Province, particularly between urban and rural areas. This indicates that HDI growth has not been fully equitable and represents a significant issue in regional development.

Human development is also related to local government policies through resource and budget management, particularly capital expenditures, which can be directed toward providing infrastructure and public services. Furthermore, access to adequate sanitation plays a role in supporting public health, while population structure, as reflected in the dependency ratio, can impact the economic burden on the working-age population.



The problem of poverty is also related to the community's ability to meet basic needs and achieve a decent standard of living. Therefore, capital expenditure, adequate sanitation, the dependency ratio, and the poverty line are relevant factors to examine in relation to human development in Jambi Province.

Several previous studies have examined the factors influencing the HDI, but the results have not been entirely consistent. For example, Bhakti et al. (2017) and Nugraeni (2021) found a negative relationship between the dependency ratio and the HDI, while studies on access to sanitation and basic infrastructure can support human development (Kusharjanto & Kim, 2011) and Sapkota, 2014). These differences in regional characteristics and research findings indicate a research gap regarding the factors influencing the HDI, particularly at the district/city level in Jambi Province.

Thus, the aim of this study is to analyze the influence of capital expenditure, proper sanitation, dependency ratio and poverty line on the Human Development Index (HDI) in districts/cities in Jambi Province during the 2015-2025 period.

RESEARCH METHODS

This study uses a quantitative approach with an associative research type, namely to determine the magnitude of the influence of independent variables on the dependent variable through numerical analysis and econometric methods (Ansori and Iswati, 2009). The research objects are 11 districts/cities in Jambi Province in the period 2015–2025. This period was chosen because Jambi's Human Development Index (HDI) is in the high category, but there are still disparities between districts/cities.

The data used is secondary data in panel form, namely a combination of time series data for eleven years (2015–2025) and cross-sectional data from 11 districts/cities (Nursan, 2025). Data were obtained from the Central Statistics Agency (BPS) of Jambi Province, official publications such as Jambi in Figures, and the Directorate General of Fiscal Balance (DJPK) of the Ministry of Finance. Data collection was carried out through a documentary study of data published by official agencies, supplemented by a literature review in the form of development economics books, national and international scientific journals, and previous research results.

The data was processed using panel data regression using EViews 12 software. The estimated model is:

$$IPMit = \beta_0 + \beta_1 BMit + \beta_2 STLit + \beta_3 RKit + \beta_4 GKit + eit$$

Information:

<i>IPMit</i>	: Human Development Index
β_0	: Intercept/Constant
$\beta_1 \beta_2 \beta_3 \beta_4$	: Regression Coefficient
<i>BM</i>	: Capital Expenditure



- STL* : Household Sanitation
- RK* : Dependency Ratio
- GK* : Poverty Line
- e* : term error
- t* : 2015-2024

- i* : Each name of the 11 regencies/cities in Jambi Province

The estimation models are compared using three approaches to panel data: the Common Effect Model (CEM), which combines all data and is estimated using Ordinary Least Squares; the Fixed Effect Model (FEM), which adds a dummy variable for each region (Least Square Dummy Variable); and the Random Effect Model (REM), which incorporates inter-regional differences into the error component and is estimated using Generalized Least Squares (Kusumaningtyas et al., 2022).

Hypothesis testing is carried out using the t-test for partial influence (the variable has a significant effect if the p-value < 0.05), the F-test for simultaneous influence (the model is significant if the significance is < 0.05), and the coefficient of determination (R^2) to measure the model's ability to explain variations in the HDI. This study did not conduct a classical assumption test because the selected model is a Random Effect Model (REM) with a Generalized Least Squares (GLS) approach which is internally a Best Linear Unbiased Estimator (BLUE). Based on Gujarati & Porter (2009), GLS has incorporated heteroscedasticity and autocorrelation parameters in its estimation formula, so these two tests are not necessary. The Normality test was also ignored because the number of observations ($n = 121$) or exceeds 30, so the sampling distribution of the error term automatically approaches normal.

RESULTS AND DISCUSSION

A. Selection of panel data regression models

Model specification testing to select the best model in panel data regression consists of three tests, namely the Chow test, the Hausman test and the Lagrange multiplier test.

Table 1. Chow Test

Redu ndant Fixed Effects TestsEquation:
Untitled

Cross-section fixed effects test

Effects Test	Statistics	df	Pro b.
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Cross-section F	126.55428	(10,106	0.0
	0	)	000
Cross-section	309.79054	10	0.0
Chi-square	3		000

Source: EViews 12 output, processed data (2026).

The hypothesis used in the Chow test is as follows:

- If the p-value $< \alpha$, then H_0 is rejected and H_1 is accepted, which means that the Fixed Effect Model (FEM) is more appropriate than the Common Effect Model (CEM).
- If p-value $> \alpha$, then H_1 is rejected and H_0 is accepted, which indicates that the model *Common Effect Model*(CEM) is more appropriate than the Fixed Effect Model (FEM).

Based on the Eviews output, it shows that the F test and Chi Square have Prob. values of 0.0000 and 0.0000, respectively, smaller than α (0.05 percent), so the hypothesis H_0 is rejected and H_1 is accepted. Thus, it can be concluded that FEM is better than CEM. Therefore, the next test is carried out by comparing the FEM and REM methods using the Hausman test.

Table 2. Hausman Test

Correlated Random Effects - Hausman Test Equation:
Untitled

Cross-section random effects test

Test Summary	Chi-Sq. Statistic	Chi-Sq. df	Prob .
Random cross-section	4.909815	4	0.2967

Source: EViews 12 output, processed data (2026).

The hypothesis used in the Hausman Test is as follows:

- If p-value $< \alpha$, then H_0 is rejected and H_1 is accepted, which means the Fixed Effect Model (FEM) is more appropriate than the Random Effect Model (REM).
- If the p-value $> \alpha$, then H_1 is rejected and H_0 is accepted, which indicates that the Random Effect Model (REM) is more appropriate than the Fixed Effect



Model (FEM). Based on the Eviews output results, a probability value greater than α is obtained.

0.05 ($0.2967 > 0.05$). This causes H_1 to be rejected and H_0 to be accepted, so it can be concluded that the REM model is better than FEM. Next, the Lagrange Multiplier test is used to determine the most appropriate model between the Common Effect Model (CEM) and the Random Effect Model (REM). and H_α is rejected so the selected model is the Random Effect Model (REM)

Table 3. Lagrange Multiplier Test

Lagrange Multiplier Tests for Random Effects Null hypothesis: No effects

Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Cross-section	Test Hypothesis Time	Both
Breusch-Pagan	374.091 5 (0.0000)	2.07046 4 (0.1502)	376.1619 (0.0000)

Source: EViews 12 output, processed data (2026).

The hypothesis used in the Lagrange Multiplier test is as follows:

- If $p\text{-value} < \alpha$, then H_0 is rejected and H_1 is accepted, which means that the Random Effect Model (REM) is more appropriate than the Common Effect Model (CEM).
- If $p\text{-value} > \alpha$, then H_1 is rejected and H_0 is accepted, which indicates that the Common Effect Model (CEM) is more appropriate than the Random Effect Model (REM).

Based on the LM test output, the Breusch-Pagan probability value (Both column) is 0.0000. Because this value is smaller than α 0.05 ($0.0000 < 0.05$), H_1 is accepted. Thus, it can be concluded that the most appropriate model to use is the Random Effect Model (REM).

B. Random Effect Model Estimation Results

Based on the results of the Chow Test, Hausman Test and Lagrange Multiplier Test, the best model selected is the Random Effect Model. Therefore, this study uses the Random Effect Model as the model in the study.

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Table 4. Results of the Random Effect Model Test

Dependent Variable: HDI?

Method: Pooled EGLS (Cross-section random effects) Date:

09/21/26 Time: 11:18

Sample: 2015 2025

Included observations: 11

Cross-sections included: 11

Total pool (balanced) observations: 121

Swamy and Arora estimator of component variances

Variable	Coefficien t	Std. Error	t-Statistic	Prob.
C	62.21168	2.808545	22.15086	0.000 0
BM?	-0.000244	0.000839	-0.290958	0.771 6
STL?	0.062591	0.008853	7.069909	0.000 0
RK?	-0.042814	0.051664	-0.828701	0.409 0
NO?	0.015133	0.000814	18.59229	0.000 0

Random Effects (Cross)

_BATANGHARI-- -1.030557

C

_BUNGO--C 0.214961

_KERINCI--C 1.540295

_KOTAJAMBI--C 4.443782

_KOTASUNGAIP 4.333174

E...

_MERANGIN--C -1.022788

_MUAROJAMBI-- -1.663984

C

_SAROLANGUN- -0.471101

-C

_TANJABAR--C -1.513280

_TANJABTIM--C -3.783385



_TEBO--C -1.047117

Source: EViews 12 output, processed data (2026).

Based on the results of the REM estimation, the explanation of each variable in this study, namely capital expenditure, proper sanitation, dependency ratio and poverty line towards the Human Development Index of each district/city in Jambi Province, is known, which can be explained through the following model:

$$IPMit = \beta_0 + \beta_1 BMit + \beta_2 STLit + \beta_3 RKit + \beta_4 GKit + eit \quad IPM = 62.211682 - 0.000244 * BMit + 0.062591 * STLit - 0.042814 * RKit + 0.015133 * GKit$$

Then, the final constant value for each district/city in Jambi Province was obtained. The final constant value is the sum of the constants for each district/city in Jambi Province. As explained in Table 5:

Table 5. Final Constant Values for each Regency/City

Variable	Coefficient
Random Effects (Cross)	
BATANGHARI--C	61.181123
BUNGO--C	62.426641
KERINCI--C	63,751,975
KOTAJAMBI--C	66.655462
KOTASUNGAIPENUH--C	66.544854
MERANGIN--C	61.188892
MUAROJAMBI--C	60.547696
SAROLANGUN--C	61.740579
TANJABAR--C	60.698400
TANJABTIM--C	58,428,295
TEBO--C	61.164563

Source: EViews 12 output, processed data (2026).

Based on the results of the Random Effect Model (REM) estimation, the final constant value for each district/city in Jambi Province indicates differences in characteristics between regions that are not fully explained by the variables of capital expenditure, proper sanitation, dependency ratio, and poverty line. The final constant value is obtained by adding the general constant of 62.21168 with the random effect value for each district/city.

Based on the calculation results, Jambi City has the highest final constant value of 66.655462 followed by Sungai Penuh City at 66.544854 and Kerinci Regency at 63.751975. Furthermore, Bungo Regency has a final constant of 62.426641, Sarolangun



Regency at 61.740579, Merangin Regency at 61.188892, Batang Hari Regency at 61.1811123, Tebo Regency at 61.164563, West Tanjung Jabung Regency at 60.698400, and Muaro Jambi Regency at 60.547696. Meanwhile, East Tanjung Jabung Regency has the lowest final constant value, which is 58.428295.

The difference in the final constant value indicates the existence of special characteristics or individual factors in each district/city which are reflected through the random component. effect in the model. Thus, Jambi City has the highest basic model component, while Tanjung Jabung Timur Regency has the lowest basic model component after taking into account the general constant and individual effects of each region.

C. Hypothesis Testing

Table 6. F Test Results

R-squared	0.919008	Mean dependent var	5.945791
Adjusted R-squared	0.916216	SD dependent var	2.333316
SE of regression	0.675391	Sum squared residual	52.91371
F-statistic	329.0619	Durbin-Watson stat	0.955757
Prob(F-statistic)	0.000000		

Source: EViews 12 output, processed data (2026).

Based on the results of the Random Effect Model regression above, it can be seen that the F-statistic is 329.0619 with an F-statistic probability of 0.000000 or less than the α level = 5 percent ($0.000000 < 0.05$), meaning that together there is a significant influence between BM (Capital Expenditure), STL (Percentage of Households with Access to Proper Sanitation), RK (Dependency Ratio) and GK (Poverty Line) on the HDI (Human Development Index) of Districts/Cities in Jambi Province.

Table 7. t-Test Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	62.21168	2.808545	22.15086	0.0000
BM?	-0.000244	0.000839	-0.290958	0.7716
STL?	0.062591	0.008853	7.069909	0.0000
RK?	-0.042814	0.051664	-0.828701	0.4090

Source: EViews 12 output, processed data (2026).



The t-statistic test is intended to determine the partial effect of independent variables on dependent variables. Based on the results of panel data regression using the Random Effects Model (REM) approach, it is known that:

1. It is known that the t-statistic value of the Capital Expenditure variable is -0.290958 with a probability value of 0.7716, which is greater than the α level = 5 percent ($0.7716 > 0.05$). This means that population density does not have a significant effect on the Human Development Index in Jambi Province.
2. The t-statistic value of the Adequate Sanitation variable is known to be 7.069909 with a probability value of 0.0000. Smaller than the α level = 5 percent ($0.0000 < 0.05$), meaning that Adequate Sanitation has a significant effect on the Human Development Index in Jambi Province.
3. The t-statistic value of the Dependency Ratio variable is known to be -0.828701 with a probability value of 0.4090. This is greater than the α level = 5 percent ($0.4090 > 0.05$), meaning that the Dependency Ratio does not have a significant effect on the Human Development Index in Jambi Province.
4. The t-statistic value of the Poverty Line variable is known to be 18.59229 with a probability value of 0.0000. This is smaller than the α level = 5 percent ($0.0000 < 0.05$), meaning that the Poverty Line has a significant influence in Jambi Province.

D. Coefficient of Determination (R²)

Based on the results of panel data regression with the Random Effect Model (REM), the coefficient of determination (R-squared) value was obtained at 0.919008, meaning that the variation in changes (increases/decreases) in the Human Development Index variable in Jambi Province during the 2015-2025 period could be explained well by the Capital Expenditure, Proper Sanitation, Dependency Ratio and Poverty Line variables at 91.90 percent, while the remaining 8.10 percent was explained by other variables not used in this study.

DISCUSSION

1. The effect of capital expenditure on HDI.

Based on the results of panel data regression with the Random Effect Model approach, it shows that the capital expenditure variable has a coefficient of -0.000244 with a probability value (Prob) of 0.7716, which means that the probability value is greater than the significance level of 5% or 0.05, so it can be concluded that capital expenditure does not have a significant effect on the human development index (HDI) in Jambi Province during the 2015-2025 period.

This indicates that capital expenditure is not a factor that cannot explain changes in the Human Development Index in Jambi Province. This research finding

aligns with research by Putri et al., 2022, which states that capital expenditure does not

has a significant impact on the Human Development Index (HDI) because the benefits of infrastructure development take a relatively long time to improve people's quality of life. This finding is also supported and strengthened by research by (Cathrine et al., 2023) and (Adjie, 2025), which provide similar results.

These results are supported by Keynes's theory, which explains that government spending is a crucial component of the economy that can influence the level of economic activity. According to Keynes, increased government spending can stimulate aggregate demand and economic activity through the multiplier effect. However, the impact of government spending on societal conditions depends not only on the amount of spending but also on how it is allocated and benefits the community. In the context of this research, increased capital spending does not necessarily directly increase the Human Development Index (HDI) if it does not directly impact health, education, and the community's standard of living.

2. The Impact of Adequate Sanitation on the Human Development Index

Based on the results of panel data regression with the Random Effect Model approach, it shows that the Proper Sanitation variable has a coefficient of 0.062591 with a probability value (Prob) of 0.0000, which means that the probability value is smaller than the significance level of 5% or 0.05, so it can be concluded that proper sanitation has a significant effect on the human development index (HDI) in Jambi Province during the 2015-2025 period, which shows that the higher the coverage of proper sanitation, the influence of the quality of human development also increases.

This research finding aligns with research by Hidayati (2022), Khaerunnisa & Kuwaningsih Purwaningrum (2025), which states that access to adequate sanitation has a positive effect on the Human Development Index. This is supported by Blum's theory (1974), which explains that the environment is one of the main factors determining public health, alongside behavior, health services, and heredity. A healthy environment through the provision of adequate sanitation will improve public health, thus positively impacting human development.

The results of this study also support the Human Development theory from UNDP which states that human development is not only influenced by income, but also by the quality of health and access to basic services. Adequate sanitation is a form of basic service that contributes to improving the quality of life of the community.

3. The Influence of Dependency Ratio on the Human Development Index

Based on the results of panel data regression with the Random Effect Model approach, it shows that the Dependency Ratio variable has a coefficient of -0.042814

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with a probability value (Prob) of 0.4090, which means the probability value is greater than the 5% or 0.05 significance level, so the dependency ratio does not have a significant effect on the human development index (HDI) in Jambi Province during the 2015-2025 period. This indicates that the dependency ratio is not a factor causing the human development index in Jambi Province. This result is in accordance with research by (Nugraeni, 2021) that the dependency ratio has a negative effect on the Human Development Index in East Java Province. Then strengthened by research (Nur Isa Pratowo, 2013) and (Bhakti et al., 2017) which explain the same results.

The research explains that the greater the number of dependents compared to the working-age population, the greater the economic burden that must be borne by households, so that the community's ability to improve the quality of education, health and welfare decreases.

The results of this study align with population theory, which states that a population structure dominated by non-productive age groups will increase the economic burden on society. Conversely, if the proportion of the productive age population is greater, a demographic bonus will be created that can increase labor productivity, community income, and the quality of human development.

4. The Influence of the Poverty Line on the Human Development Index

Based on the results of panel data regression with the Random Effect Model approach, it shows that the poverty line variable has a coefficient of 0.015133 with a probability value (Prob) of 0.0000, which means that the probability value is smaller than the significance level of 5% or 0.05, so it can be concluded that the poverty line has a significant effect on the human development index (HDI) in Jambi Province during the 2015-2025 period.

The results of this study are in line with the Basic Needs Approach developed by the International Labour Organization (ILO) and used by Bappenas. This approach states that a society's well-being is determined by its ability to meet basic needs. The poverty line represents the minimum expenditure required to meet these needs. Therefore, an increase in the poverty line does not necessarily indicate a worsening of human development, but rather may reflect an increase in the standard of living, accompanied by improvements in the quality of education, health, and purchasing power, thus maintaining an upward trend in the Human Development Index (HDI).

The results of this study are supported by research (Rodiyah et al., 2025) which shows that the poverty line variable has a significant effect on the Human Development Index. The study explains that changes in the poverty line more closely reflect changes in the value of minimum living needs due to inflation and economic development. This research is also strengthened by research (Indra, 2018) and research conducted by (Choirunnisa et al., 2024) which obtained similar results,

namely a significant effect of the poverty line on the Human Development Index. The similarity of these results indicates that changes in the poverty line have a significant relationship with the condition of human development, because changes in the value of minimum needs can reflect changes in economic conditions and the community's ability to meet basic needs. Thus, the results of this study strengthen the findings of previous research that the poverty line is one of the economic indicators related to changes in the quality of human development.

CONCLUSION

Based on the results of the analysis and discussion regarding the influence of capital expenditure, proper sanitation, dependency ratio, and poverty line on the Human Development Index (HDI) in districts/cities in Jambi Province in 2015–2025, the following conclusions can be drawn. The Human Development Index (HDI) of Jambi Province during the period 2015–2025 has an average of 71.96%. The average development of HDI for each district/city in Jambi Province during the period 2015–2025 shows that Tanjung Jabung Timur Regency experienced the fastest development of HDI with an average development of 1.55%. On the other hand, the slowest development of HDI occurred in Sungai Penuh City with an average development of 0.77%. The average capital expenditure

Jambi Province during the 2015–2025 period was Rp792.87 billion. The average development of capital expenditure for each district/city in Jambi Province during the 2015–2025 period showed that West Tanjung Jabung Regency experienced the highest development of capital expenditure with an average development of 16.07%. On the other hand, East Tanjung Jabung Regency experienced a decline in capital expenditure with an average development of -0.87%, while the lowest average decline in capital expenditure development occurred in Sungai Penuh City with an average of -5.82%. The average access to proper sanitation in Jambi Province during the 2015–2025 period was 74.35%. The highest average development of access to proper sanitation in districts/cities in Jambi Province during the 2015–2025 period was Merangin Regency at 10.47% and the lowest occurred in Jambi City at 0.28%. The average dependency ratio of Jambi Province in 2015–2025 was 45.52%. The highest average development of the dependency ratio of districts/cities in Jambi Province in 2015–2025 was Jambi City at 0.26%, while the lowest was Bungo Regency at -1.04%. The average poverty line of Jambi Province in 2015–2025 was Rp493,623.9. The highest average development of the poverty line of districts/cities in Jambi Province in 2015–2025 was Muaro Jambi Regency at 10.10%, while the lowest was Sarolangun Regency at 5.42%. Based on data processing with the Random Effect Model approach, together with Expenditure, Access to Proper Sanitation, Dependency Ratio and Poverty Line in Jambi Province with an F-

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statistic value of 329.0619 and a Probability of 0.0000000 (0.0000000 < 0.05). Partially, it was found that the capital expenditure and dependency ratio variables had a negative but insignificant effect on the Human Development Index in Jambi Province in 2015-2025. While the Access to Proper Sanitation and Poverty Line variables had a significant positive effect on the Human Development Index in Jambi Province in 2015-2025. The four independent variables can explain a very strong relationship with the dependent variable which has an Adjusted R-Squared value of 91.62% and the remaining 8.38% is explained by other variables not included in the study.

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