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Research Article

A Research Study on the Effect of Inflation on Human Development Index in the Philippines (2000-2023)

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ABSTRACT

Inflation is one of the most important macroeconomic indicators, as persistent changes in the general price level can affect economic conditions and household welfare. This study examines whether inflation affects the Human Development Index (HDI) in the Philippines from 2000 to 2023. A quantitative time-series research design was employed, using secondary data from the Philippine Statistics Authority (PSA) and the United Nations Development Programme (UNDP). The study uses a single-variable time-series framework to examine the temporal relationship between inflation and HDI within the Philippines while accounting for serial dependence in the data. Ordinary Least Squares (OLS) regression was used as the baseline model, followed by diagnostic tests and a Generalized Least Squares (GLS) model with an AR(1) error structure to correct for autocorrelation and improve the reliability of the estimates. The findings indicate that inflation has a negative but statistically insignificant effect on HDI ($p = 0.2515$), explaining only 5.93% of its variation. These findings suggest that inflation alone is insufficient to be considered the primary driver of human development in the Philippines, which is likely influenced by broader economic and structural factors such as access to education, healthcare, and social protection rather than short-term price movements. While maintaining price stability remains economically important, it should be complemented by sustained investments in human capital and social services to support long-term human development. Future research may incorporate additional variables and alternative econometric approaches to capture the multidimensional determinants of human development.

Keywords: *Economic Development, Generalized Least Squares (GLS), Human Development Index (HDI), Inflation, Ordinary Least Squares (OLS) regression, Philippines, Time-series analysis*

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Introduction

Economic stability and human well-being are closely connected in the context of inflation and rising living costs. At the global macroeconomic level, inflation remains a major economic challenge because it can influence income distribution, consumer behavior, and overall quality of life. According to the World Bank (2020), prolonged inflation tends to disproportionately affect low-income households by reducing real income and limiting their access to essential goods and services, a pattern also documented by Nasir et al. (2024) across multiple countries. Similarly, the International Monetary Fund notes that fluctuations in inflation can weaken economic stability and slow improvements in living standards, particularly in developing countries. Persistent price increases or unstable price changes can reduce purchasing power and constrain access to basic services such as healthcare and education, which are essential components for human development.

Consequently, inflation is increasingly recognized not only as an economic concern but also as a development issue. The United Nations Development Programme (UNDP) emphasizes that key human development outcomes, such as health, education, and income, are highly sensitive to macroeconomic conditions. When inflation persists, it can slow down progress in human capital development and lead to uneven development outcomes across countries.

While these global trends provide important insights, the situation in the Philippines presents its own set of challenges. Although inflation in the country has generally remained within the government's target range in recent years, it has exhibited periods of volatility, including a peak of nearly 6% in 2023 (Department of Finance, 2024). Increases in food, transportation, and utility prices continue to reduce real income and limit consumer spending. Data from the Philippine Statistics Authority (PSA) indicate that inflation affects household spending patterns, particularly among lower-income households. At the same time, the Bangko Sentral ng Pilipinas (2019) identifies inflation volatility as a major challenge in maintaining stable purchasing power and overall economic stability.

Despite steady economic growth, the Philippines continues to face challenges in achieving inclusive human development. The country's Human Development Index (HDI) has improved over time, reaching around 0.710 in recent years and placing it in the medium human development category (UNDP, 2023). However, this progress is not evenly distributed. Rising living costs can offset improvements in income, education, and health. Reports from the United Nations Development Programme (2023) suggest that macroeconomic instability, including inflation, can constrain human development by reducing real income and limiting access to essential services. Even though poverty incidence has declined in some periods, inflationary pressures may weaken these gains by affecting household welfare and access to quality education and healthcare.

Existing studies have examined the effects of inflation, economic growth, and development outcomes across countries, including studies in Indonesia (Yolanda, 2017; Ramadhan & Pertiwi, 2025; Runtuwu, 2020) and Southern Africa (Chipunza et al., 2026). However, most of these studies focus on global or cross-country or multivariable analyses that examine differences across countries or account for multiple determinants of human development. While such approaches provide comparative insights, they may not fully capture the temporal relationship between inflation and human development within a single country. In the Philippine context, there is limited research that has examined the inflation-HDI relationship using long-term annual time-series data. Furthermore, time-series observations may exhibit serial dependence, which can affect the reliability of conventional regression estimates when autocorrelation is present. Thus, a single-variable time-series framework with an appropriate autocorrelation correction provides a focused approach for examining the temporal relationship between inflation and HDI in the Philippines.

To address this gap, this study examines the effect of inflation on the Human Development Index in the Philippines from 2000 to 2023. It

specifically analyzes trends in inflation and HDI, evaluates their temporal relationship using a single-variable time-series framework. Through empirical analysis using statistical methods, the study seeks to provide evidence that can inform macroeconomic policy and support strategies for inclusive and sustainable human development in the Philippines.

Literature Review

One of the most significant macroeconomic factors within the economic context is Inflation, since it is the most feared economic variable in a country, including the Government, because of its potential to adversely impact a country's economic infrastructure and the standard of living of its citizens. Inflation is referred to as the sustained increase in the general price level of goods and services over time, a crucial macroeconomic indicator that shows the changes in the purchasing power of money (Tamplin, 2025). High or volatile inflation can diminish real incomes, change consumption patterns, discourage savings, and affect investment decisions that may potentially impair economic security (Mankiw, 2021). Monitoring inflation trends allows policymakers to implement strategies that protect vulnerable populations from the adverse effects of rising prices.

The Human Development Index (HDI) developed by the United Nations Development Programme (UNDP) in 1990, is a composite indicator that measure a country's achievements in three key dimensions: (1) Health, which is reflected through expectancy at birth; (2) Education, which is measured through the mean years of schooling for adults aged 25 and over and the expected years of schooling for children; and (3) Income, which is reflected in gross national income per capita). The HDI is designed to reflect broader aspects of human development and social progress that are not captured by economic indicators alone, such as GDP, or, in even more positive terms, to measure improvements in well-being that are not always apparent from economic growth alone (Klugman et al., 2011). As such, HDI provides a more comprehensive understanding of the population's quality of life and areas in need of intervention.

Inflation and HDI thus serve as integral parts for assessing economic and social development. While inflation accounts for what occurs in the macroeconomic environment, the HDI shows how these economic conditions result in tangible outcomes when it comes to human welfare. Food prices, energy costs, and shifting inflation levels after the pandemic are all contributing factors to the prevailing inflation found across countries, including the Philippines. These inflationary pressures directly affect household purchasing power, making it difficult for them to access basic goods and services, thereby influencing HDI outcomes (Mahmoud, 2025).

The present-day literature reviews highlight that there are efforts towards the investigation of the impact of inflation on the Human Development Index from various perspectives, as follows:

Significant Inflation-HDI Impact

A study by Yolanda (2017), titled "*Analysis of Factors Affecting Inflation and its Impact on Human Development Index and Poverty in Indonesia*," conducted at the University of Malaya, used a multiple linear regression model with secondary time-series data spanning 1997 to 2016 to analyze the macroeconomic determinants of inflation and its ensuing socioeconomic effects in Indonesia. While this study focused on Indonesia, its methodological framework and findings offer crucial insights for the Philippines, where inflation is similarly driven by strong supply-side factors (particularly food and energy prices). Yolanda found that Bank of Indonesia interest rates, money supply (M2), oil prices, and gold prices significantly increased inflation, with oil prices showing the highest elasticity due to energy import dependence, an economic pattern directly related to the Philippines, which imports most of its petroleum needs. Moreover, the study documented that inflation had a significant positive impact on both HDI and poverty levels during Indonesia's post-1997 Asian Financial Crisis recovery, attributed to "growth-associated inflation," in which rising prices were associated with economic expansion that improved access to education and health services.

A study published by Ramadhan and Pertiwi (2025) titled "*The Influence of the Gini Ratio and Inflation on the Human Development Index (HDI)*" in Indonesia. The methods used in the study are multiple linear regression with secondary data for analysis. Using these statistical methods, the researchers found that HDI is negatively and significantly influenced by inflation, suggesting that rising inflation can lower the quality and progress of human development by eroding people's purchasing power and complicating their access to healthcare and education. Conversely, the Gini Ratio showed no significant impact on HDI, indicating that income inequality has not yet emerged as a major macroeconomic factor influencing HDI. The results showed that both independent variables significantly affected HDI, with the model accounting for 23.9% of the variation in HDI, while the remaining variation was accounted for by other factors. The findings demonstrate that inflation is a key driver of improvements in human development in Indonesia, especially in the household's ability to purchase food and other essentials, as price increases directly restrict access to education and healthcare services, which underpin HDI.

A study titled "*Inflation, Indebtedness and Human Development: Panel Evidence from Southern Africa*" by Chipunza et at. (2025) examined the impact of inflation and external debt on human development in 14 Southern African Development Community (SADC) countries. Using the compiled panel data and a two-step system of Generalized Method of Moments (GMM). Additional robustness checks through the use of pooled Ordinary Least Squares (POLS) and the GMM difference. Using the methodologies used to gather statistical data, the researchers have found that both inflation and external debt have a negative, yet statistically significant, effect on the Human Development Index (HDI), indicating that rising inflation and higher indebtedness hinder human development. The results suggest that high inflation weakens households' purchasing power and limits their access to health and education. At the same time, heavy external debt burdens can divert public spending from social services toward debt servicing, further thwarting the supposed growth and improvements in HDI.

Insignificant Inflation-HDI Impact

A study conducted by Herman (2021) titled "*Impact of Inflation and City Minimum Wages on Human Development Index in Indonesia*" analyzes annual data dating from 2010 to 2020 across 12 districts of Pekanbaru City, Riau Province of Indonesia, through the methods of a panel data regression approach with SPSS version 25. The research openly tested the partial and joint effects of inflation and city minimum wages on HDI, making the conducted study pertinent to the Philippine economic context, where regional wage boards set minimum wage standards and where the 2023 6.0% inflation rate conformed with wage adjustments in the country (Department of Finance, 2024). The study conducted by Herman found that, when isolated, inflation had no statistical significance as a partial effect on HDI ($p > 0.05$). However, city minimum wages demonstrated high significance, indicating a positive impact ($\beta = 0.842$, $p < 0.01$) and explaining 71.3% of HDI variance independently. When both variables were included in the joint model, they explained 98.8% of HDI variance, with the interaction term indicating that higher minimum wages amplified HDI gains even during moderate inflation periods (3–5% annually). Therefore, in simple terms, the results strongly suggest that higher minimum wages are closely linked with improvements in living standards, education, and overall well-being. Furthermore, the findings suggest that inflation is insufficient to work as a sole determinant of growth or decline in human development, showcasing that income-related economic factors are more closely related to HDI than inflation. The Pekanbaru study provides an economic contrast that emphasizes the relevance of the differences between regional economies in shaping inflation-HDI dynamics.

A study titled "*The Effect of Open Unemployment Rate, Inflation Rate, and Investment on Human Development Index (HDI) and Poverty in South Sulawesi Province*" (Nurisana & Sudirman, 2024) analyzed how open unemployment, inflation, and investment consequently shape human development and poverty in South Sulawesi, Indonesia. The research used quantitative methods with secondary time-se-

ries data from 2006 to 2020 and applied multiple regression to examine the relationships among the open unemployment rate (TPT), the inflation rate, investment, HDI, and poverty indicators. The study found that open unemployment, inflation, and investment each have a negative but statistically insignificant effect on HDI, suggesting that the variables used, including inflation, are insufficient to properly determine human development in South Sulawesi during the sample period. Whereas open unemployment and inflation both have a positive and significant effect on poverty, meaning higher joblessness and rising prices tend to increase poverty levels. In contrast, investment has a negative, significant effect on poverty, suggesting that higher investment is associated with lower poverty. Finally, HDI itself has a negative and insignificant effect on poverty, suggesting that improvements in health, education, and income alone, whether inflation is present, do not reduce poverty without complementary structural changes.

A study conducted by Runtunuwu (2020) titled "*Analysis of Macroeconomic Indicators and Its Effect on Human Development Index (HDI)*" examined how inflation, per capita income, and unemployment could affect the Human Development Index (HDI) in Ternate City, Indonesia. Using a quantitative descriptive approach with multiple linear regression, followed by a classical assumption test, and secondary data from 2010 to 2019. The researcher found that inflation has a negative, insignificant effect on HDI, suggesting that rising prices slightly weaken households' purchasing power but do not strongly determine HDI variations in Ternate during the sample period. However, per capita income and unemployment both have negative, significant effects on HDI, indicating that higher unemployment reduces people's ability to access health and education services.

In contrast, income dynamics in this economic context do not contribute positively to human development. The overall model shows that inflation, per capita income, and unemployment collectively significantly affect HDI in Ternate City, with an R-square of 0.836, meaning these three macroeconomic indicators explain 83.6% of the variation in HDI. In contrast, the remaining 16.4% is influenced by other factors such as government policies, infrastructure, and social programs.

Synthesis

Contemporary literature regarding the impact of Inflation on the Human Development Index (HDI) presents mixed findings, derived from studies found based on the international economic context, through the means and usage of Regression Models on either time-series or panel data from multiple countries, such as Indonesia, and those from the regions of Southern Africa, to which the Philippine economic context can be related. In Indonesia, Yolanda (2017) found that inflation positively affects HDI during the post-1997 Asian financial crisis economic recovery via "growth-associated inflation" driven by oil prices and the money supply. In contrast, according to the study by Ramadhan and Pertiwi (2025), inflation negatively and significantly affects HDI by weakening households' purchasing power, hindering their ability to access healthcare and education. Similarly, Chipunza et al. (2025), using evidence across all 14 SADC countries, uncovered that Inflation had a negative and significant impact on HDI, as indicated by the GMM model.

However, as per the findings of other studies, it is indicated that inflation does not necessarily have a significant effect on HDI. According to the study conducted by Herman (2021) in Pekanbaru, Indonesia, inflation showed no partial effect ($p > 0.05$), with minimum wages driving the effect (98.8% joint variance). This implies that income-related factors might have a stronger influence on HDI than inflation. Moreover, according to a study by Nurisana and Sudirman (2024) in South Sulawesi, inflation, unemployment, and investment were found to be insignificant for HDI, despite these factors accelerating poverty. Likewise, Runtunuwu's (2020) study in Ternate City, Indonesia, found that inflation is negatively associated with HDI. While income and unemployment had a stronger effect on human development (joint variance of 83.6%). Overall, while there is a clear relationship between inflation and HDI in the cases of some developing countries, it is still important to recognize that the presence of inflation alone is not sufficient for

explaining the differing variations in Human Development. The contrasting statements and findings provide a basis for examining whether a similar case of inflation interacting with varying macroeconomic and socioeconomic factors to determine its effects on human development exists within the Philippine context.

Statement of the Problem

This study aims to determine whether inflation significantly affects human development in the Philippines from 2000 to 2023.

Specifically, this study seeks to answer the following questions:

1. What are the trends in inflation in the Philippines from 2000 to 2023?
2. What are the trends in the Human Development Index in the Philippines from 2000 to 2023?
3. Does Inflation have a significant impact on human development in the Philippines?
4. Does inflation have a significant short-run and long-run impact on human development in the Philippines?

Methodology

Research Design

The study employed a quantitative research design to examine the effect of inflation on the Human Development Index (HDI) in the Philippines from 2000 to 2023. A quantitative approach is appropriate because it allows for objective measurement and statistical analysis of variables using numerical data (Creswell & Creswell, 2018). In particular, the study used simple linear regression to estimate the effect of inflation on HDI and determine whether annual changes in the price level correspond to measurable changes in human development outcomes. This method enables the researchers to quantify the relationship and test whether the effect is statistically significant (Wooldridge, 2019). In addition, it adopted a time-series research design, as it analyzed annual data over 24 years of annual data from 2000 to 2023, which is well-suited for capturing how the effect between inflation and HDI evolves across distinct economic periods in the Philippines, including the 2008 global food crisis and the 2018 rice shortage (Bangko Sentral ng Pilipinas, 2019). This approach allows for a more accurate assessment of how inflation affects human development across different economic conditions (Gujarati & Porter, 2009).

Overall, this research design is appropriate because it provides a systematic and empirical framework for estimating the effect of inflation on HDI, ensuring that the findings are statistically valid, reliable, and grounded in established econometric methods (Stock & Watson, 2020). However, the study is limited to a single independent variable model and does not include other potential determinants of HDI, such as education expenditure, health investment, or income levels. This may introduce omitted-variable bias; therefore, the results should be interpreted with caution.

Source of Data

The study used secondary data from established, publicly accessible databases to ensure the reliability and consistency of the information. Data on inflation, the independent variable, were sourced from the Philippine Statistics Authority (PSA), the official government agency responsible for producing and maintaining the country's macroeconomic statistics. Meanwhile, data for the dependent variable, the Human Development Index (HDI), were collected from the United Nations Development Programme (UNDP). This internationally recognized institution compiles and standardizes human development indicators across countries.

It is important to note that the most recent HDI data available from the UNDP at the time of the study covered only 2023. To ensure consistency and comparability across variables, the inflation data were likewise limited to the same period, 2000 to 2023. The use of these credible sources enhances the study's validity, as both institutions adhere to rigorous data-collection, verification, and reporting standards.

Data Analysis and Statistical Treatment

Ordinary Least Squares (OLS) regression was used to assess the effect of inflation on the Human Development Index (HDI) in the Philippines from 2000 to 2023. The OLS model estimates the linear effect of inflation on HDI, producing the regression coefficient (β), the

coefficient of determination (R^2), and the p-value for significance testing (Gujarati & Porter, 2009). This method was chosen as the baseline because it provides fair and accurate estimates under the classical regression assumptions (Stock & Watson, 2020).

After estimating the OLS model, diagnostic tests were conducted to check whether the regression assumptions were satisfied. Homoskedasticity was tested using the Breusch-Pagan test; a p-value above 0.05 indicates constant error variance (Breusch & Pagan, 1979). Normality of the residuals and linearity were assessed through the Normal Q-Q plot and the Residuals versus Fitted plot, respectively. The Durbin-Watson (DW) test was then applied to detect first-order autocorrelation, which is a common problem in time-series data. A DW value near 2.0 indicates no serial correlation, while values near 0 indicate strong positive autocorrelation (Wooldridge, 2019).

In cases where autocorrelation was present, correction methods were applied and compared, including the Cochrane-Orcutt procedure, the Prais-Winsten transformation, and the Generalized Least Squares model with an AR(1) error structure [GLS-AR(1)] (Cochrane & Orcutt, 1949; Prais & Winsten, 1954). The GLS-AR(1) approach was selected as the final model after it successfully passed the Box-Ljung portmanteau test ($p > 0.05$), indicating that statistically significant residual autocorrelation was no longer detected (Box & Jenkins, 1976). This careful statistical procedure ensures that a valid quantitative estimate of the relationship is obtained in the final model. The baseline regression model is specified as:

$$HDI_t = \beta_0 + \beta_1(Inflation_t) + \varepsilon_t$$

Where HDI_t is the Human Development Index in year t, β_0 is the intercept, β_1 is the regression coefficient for inflation, $Inflation_t$ is the annual inflation rate, and ε_t is the error term.

The coefficient β_1 indicates the average change in HDI for every one-percentage-point increase in inflation. Statistical significance was evaluated at the 0.05 level: a p-value below 0.05 to rejection of the null hypothesis that inflation does not affect HDI, while a p-value above 0.05 indicates insufficient evidence to reject the null hypothesis (Field, 2018). The R^2 value was also examined to determine how much of the variation in HDI is explained by inflation alone; a low R^2 suggests that other structural factors, such as government spending on health and education, are more important drivers of human development (Ranis et al., 2000).

The Ordinary Least Squares (OLS) regression is a statistical method used to estimate the relationship between a dependent variable and one or more independent variables by minimizing the sum of squared differences between observed and predicted values (Montgomery et al., 2012). To conduct the OLS regression, the following code was executed in R:

```
> View(Thesis_Dataset)
> group7<-lm(Thesis_Dataset$HDI~Thesis_Dataset$Inflation)
> summary(group7)

Call:
lm(formula = Thesis_Dataset$HDI ~ Thesis_Dataset$Inflation)

Residuals:
      Min        1Q    Median        3Q
-0.036979 -0.017126  0.001454  0.014135
      Max
 0.050836

Coefficients:
                            Estimate Std. Error
(Intercept)                 0.688827   0.012384
Thesis_Dataset$Inflation -0.003277   0.002783
                           t value Pr(>|t|)
(Intercept)                 55.621   <2e-16 ***
Thesis_Dataset$Inflation  -1.178    0.252
---
Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.02464 on 22 degrees of freedom
Multiple R-squared:  0.0593,    Adjusted R-squared:  0.01654
F-statistic: 1.387 on 1 and 22 DF,  p-value: 0.2515
```

Figure 1. OLS Regression

Figure 1 presents the process and the results of the OLS regression analysis examining the effect of inflation on the Human Development Index (HDI) in the Philippines from 2000 to 2023. The regression model was specified as $HDI_t = \beta_0 + \beta_1(Inflation_t) + \varepsilon_t$, inflation is the independent variable. The estimated intercept (β_0) is 0.688827, while the regression coefficient (β_1) is −0.003277, indicating that for every one-percentage-point increase in inflation, HDI decreases by approximately 0.003277 units. However, the p-value of 0.2515 exceeds the 0.05 significance level, suggesting that this relationship is not statistically significant. Furthermore, the Multiple R^2 of 0.0593 indicates that inflation accounts for only 5.93% of the variation in HDI, implying that other structural factors play a far greater role in influencing human development outcomes.

The Durbin-Watson test is a diagnostic statistic used to detect autocorrelation in the residuals of a regression model, with values ranging from 0 to 4; a value near 2 indicates no autocorrelation (Durbin & Watson, 1951). The Breusch-Pagan test, on the other hand, assesses whether the variance of the residuals is constant across all levels of the independent variable, a property known as homoscedasticity (Breusch & Pagan, 1979). To perform both tests, the following code was used:

```
> dwtest(group7)

        Durbin-Watson test

data:  group7
DW = 0.18518, p-value = 1.127e-11
alternative hypothesis: true autocorrelation is greater than 0

> bptest(group7)

        studentized Breusch-Pagan test

data:  group7
BP = 1.9752, df = 1, p-value = 0.1599
```

Figure 2. Durbin-Watson Test and Breusch-Pagan Test

Figure 2 displays the coding and the results of these two diagnostic tests used to assess the validity of the OLS regression model. The Durbin-Watson test yielded a DW statistic of 0.18518 and a p-value of 1.127e-11, which is far below the 0.05 threshold, indicating significant positive autocorrelation in the error terms. This violates one of the key assumptions of OLS regression and suggests that the model needs to be corrected (Durbin & Watson, 1951). On the other hand, the Breusch-Pagan test returned a p-value of 0.1599, which is greater than 0.05, confirming that the residuals exhibit constant variance and that heteroscedasticity is not a concern in this model (Breusch & Pagan, 1979). While heteroscedasticity is undesirable, autocorrelation necessitates the application of corrective procedures to ensure the reliability of regression estimates.

The Q-Q (Quantile-Quantile) plot is a graphical diagnostic tool used to assess whether a dataset follows a specified theoretical distribution, most commonly the normal distribution, by plotting sample quantiles against theoretical quantiles (Wilk & Gnanadesikan, 1968). A perfectly normal distribution would result in all points falling exactly along the diagonal reference line. Furthermore, the Residuals-versus-Fitted plot is a diagnostic graph used to detect violations of the linearity and homoscedasticity assumptions in a regression model, where an ideal plot would display residuals randomly scattered around the horizontal zero line with no systematic pattern (Cook & Weisberg, 1982). To generate these plots, the following code was executed as part of the plot diagnostics:

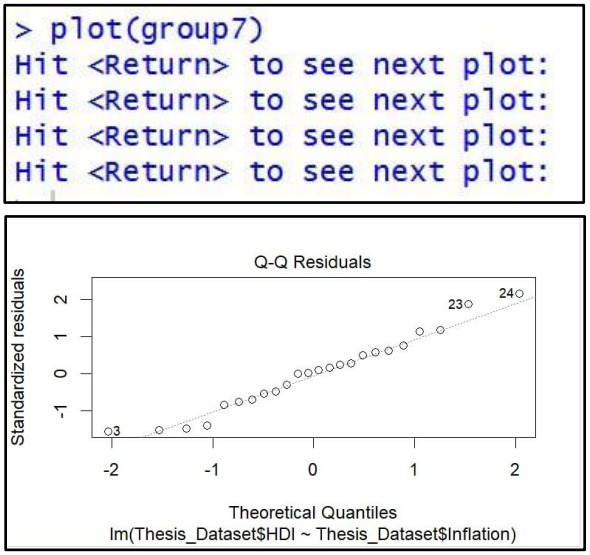

Figure 3. Q-Q plot

Figure 3 shows the Q-Q plot of the standardized residuals from the OLS regression model. As shown in the figure, most data points follow the diagonal reference line reasonably well across the middle range; however, there are noticeable deviations in the upper tail, particularly at observations 23 and 24, corresponding to the years 2022 and 2023, which deviate from the expected normal pattern. These deviations suggest that, although the residuals are approximately normally distributed, they deviate from normality at the extremes (Field, 2018). This finding indicates that the normality assumption is largely satisfied but not fully met, a common occurrence in real-world time series data.

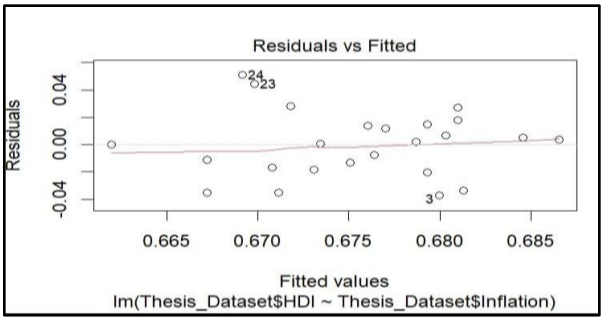

Figure 4. Residuals-versus-Fitted plot

Figure 4 presents the Residuals-versus-Fitted plot, which evaluates the assumptions of linearity and homoscedasticity in the regression model. The plot shows a relatively random distribution of residuals around the zero line, which provides some support for the model's linearity assumption (Cook & Weisberg, 1982). However, slight clustering and non-random patterns are also visible, consistent with the autocorrelation identified by the Durbin-Watson test. Overall, this plot reinforces the earlier diagnostic finding that, while the model meets some basic assumptions, the issue of autocorrelation persists and must be addressed through additional corrective measures.

The Cochrane-Orcutt procedure is an iterative method for correcting first order autocorrelation in regression models by transforming the variables using an estimated autocorrelation parameter, thereby producing more efficient and unbiased estimates (Cochrane & Orcutt, 1949). To apply this procedure, the following code was executed in R:

```
> library(orcutt)
> result1<-cochrane.orcutt(group7)

Warning message:
In cochrane.orcutt(group7) : Did not converge


> dwtest(result1)

        Durbin-Watson test

data:  result1
DW = 2.1311, p-value = 0.6481
alternative hypothesis: true autocorrelation is greater than 0
```

Figure 5. Cochrane-Orcutt and DW Test

Figure 5 shows the application of the Cochrane-Orcutt procedure as a corrective measure to address the autocorrelation detected in the original OLS model. However, as indicated by the warning message in the output, "Did not converge," the procedure failed to converge fully, suggesting that the autocorrelation structure in the data is more complex than the method can resolve (Cochrane & Orcutt, 1949). Despite this, the subsequent Durbin-Watson test on the corrected model yielded a DW statistic of 2.1311 with a p-value of 0.6481, which is well above the 0.05 level, indicating that autocorrelation is no longer statistically significant after the transformation. While this is an improvement, the convergence warning raises concerns about the robustness of this correction, prompting the use of alternative methods.

The Prais-Winsten transformation is a generalized least squares method used to correct for first-order autocorrelation in regression models. Unlike the Cochrane-Orcutt procedure, the Prais-Winsten method retains the first observation by transforming it using the estimated autocorrelation parameter, making it a more efficient correction method (Prais & Winsten, 1954). To apply this procedure, the following code was executed in R:

```
rary(prais)
ult2<-prais::prais_winsten(group7,data = Thesis_Dataset,index = c("Year"
tion 0: rho = 0
tion 1: rho = 0.9476
tion 2: rho = 0.9507
tion 3: rho = 0.9507
tion 4: rho = 0.9507
est(result2)

   Durbin-Watson test

  result2
0.18518, p-value = 1.127e-11
native hypothesis: true autocorrelation is greater than 0
```

Figure 6. Prais-Winsten and DW Test

Figure 6 presents the application of the Prais-Winsten transformation as a second corrective measure after the Cochrane-Orcutt procedure failed to converge. As shown in the output, the estimation process converged after 4 iterations, stabilizing at $\rho = 0.9507$. Despite achieving convergence, the subsequent Durbin-Watson test on the corrected residuals returned a DW statistic of 0.18518 with a p-value of 1.127×10^{-11}, which is identical to the result obtained from the original OLS model. This indicates that the Prais-Winsten transformation failed to eliminate the autocorrelation present in the residuals. The persistence of autocorrelation even after convergence highlights the limitations of OLS-derived correction methods when the autocorrelation coefficient approaches a unit root, as in this study ($\rho = 0.9507$). Consequently, a more robust correction method was necessary, prompting the application of the Generalized Least Squares model with an AR(1) error structure.

Generalized Least Squares (GLS) is a regression technique that extends OLS by allowing for

non-constant variance and correlated errors, making it particularly suitable for time series data that exhibit autocorrelation (Greene, 2012). The Autoregressive (AR) model is a time series framework that models the temporal dependency structure of residuals by regressing the current error term on its own previous values (Box & Jenkins, 1976). To fit the GLS-AR model, the following code was used in R:

```
> library(nlme)
> result3<-gls(HDI~Inflation,data = Thesis_Dataset,correlation = corARMA(p=1,q=0))
> result4<-resid(result3,type = "normalized")
> result5<-fitted(result3)
> plot(result5,result4,xlab = "Fit",ylab = "res")
> abline(h=0,col="red")
```

Figure 7. GLS-AR(1)

Figure 7 illustrates the application of the GLS model with AR(1) errors as a more robust alternative to address the autocorrelation issue identified in the original OLS model. Unlike OLS, which assumes independently and identically distributed errors, GLS accounts for correlated errors by explicitly modeling the serial dependence in the error term (Greene, 2012). By incorporating an AR(1) component into the error term, the model accounts for the temporal dependencies present in the residuals, thereby improving the reliability of statistical inference under the specified error structure (Box & Jenkins, 1976). This approach is particularly appropriate for time series data in which residuals exhibit persistent autocorrelation patterns that simpler correction methods, such as the Cochrane-Orcutt method, fail to resolve adequately. The AR(1) structure was selected over more complex specifications based on the ACF plot, which showed that autocorrelation was primarily at lag 1, making higher-order models unnecessary.

The Autocorrelation Function (ACF) plot is a statistical visualization tool that measures and displays the degree of correlation between a time series and its lagged values at various time intervals and is commonly used to identify the order of autocorrelation in regression residuals (Box & Jenkins, 1976). Bars extending beyond the significance bounds in an ACF plot indicate statistically significant autocorrelation at the corresponding lag. To generate the ACF plot, the following code was executed:

```
> acf(result4)
```

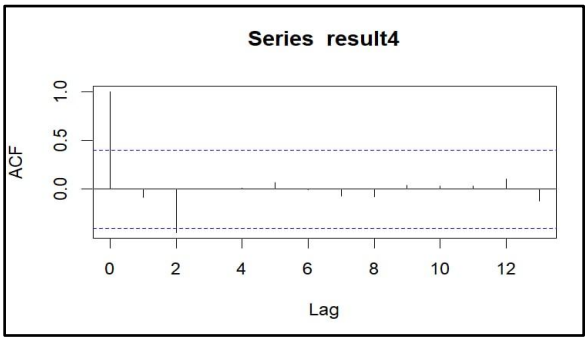

Figure 8. ACF Plot

Figure 8 displays the ACF plot of the residuals from the fitted model, providing a visual representation of the degree of autocorrelation present at various time lags. As shown in the figure, the bar at lag 1 approaches the significance boundary, indicating first-order autocorrelation in the residuals. The remaining lags fall within the significance bounds, indicating that the autocorrelation is primarily concentrated at lag 1. This result further justifies

the decision to apply the GLS-AR(1) correction, as the ACF plot provides empirical evidence of the temporal dependency structure that must be accounted for in the model (Box & Jenkins, 1976).

The Box-Ljung test is a statistical hypothesis test used to determine whether any group of autocorrelations in a time series model is significantly different from zero, making it a useful tool for evaluating the adequacy of a fitted model's residuals (Ljung & Box, 1978). The Normal Q-Q plot, on the other hand, is a graphical method used to assess the normality of residuals after model fitting, serving as a post-estimation diagnostic to verify that the corrected model satisfies the distributional assumptions required for valid statistical inference (Wilk & Gnanadesikan, 1968). To conduct both diagnostics, the following code was executed:

```
> Box.test(result4,type = "Ljung-Box")

        Box-Ljung test

data:  result4
X-squared = 0.19177, df = 1, p-value =
0.6614

> qqnorm(result4)
> qqline(result4,col="black")
```

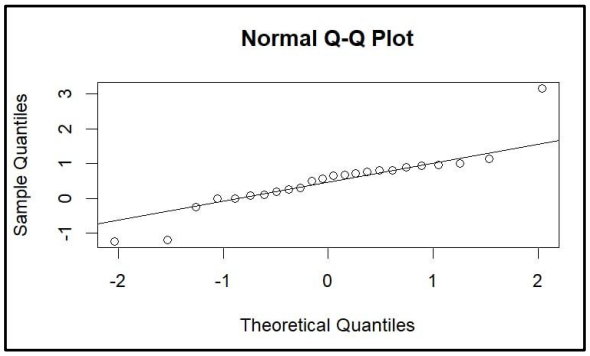

Figure 9. Box-Ljung Test and Normal Q-Q Plot

Figure 9 presents the process and results of both the Box-Ljung test and the Normal Q-Q plot, which together serve as complementary diagnostic tools for evaluating the adequacy of the GLS-AR(1) model. The Box-Ljung test yielded an X-squared value of 0.19177 with df = 1 and a p-value of 0.6614, which is substantially greater than the 0.05 significance level. This result means that the null hypothesis that the residuals are independently distributed cannot be rejected, formally confirming that residual autocorrelation is no longer a statistically significant concern after the GLS-AR(1) correction (Ljung & Box, 1978). Complementing this statistical finding, the Normal Q-Q plot shows that the data points follow the reference line reasonably well across the central portion of the distribution, with only minor deviations observed at the lower and upper tails. These slight departures from normality at the extremes are relatively minor and are not uncommon in time series data of this length (Field, 2018). Together, both diagnostics provide statistical and visual evidence that the GLS-AR(1) model has successfully addressed the autocorrelation issue and that the corrected model's residuals are approximately normally distributed, supporting reliable statistical inference from the final model.

Because the GLS-AR(1) model is static, the estimated inflation coefficient should be interpreted as a contemporaneous association between inflation and HDI rather than as a structural long-run elasticity. The AR(1) correction addresses serial correlation in the error term and improves the reliability of the estimated standard errors and statistical interference; it does not by itself establish a long-run causal or structural relationship between inflation and human development.

Result

Table 1. Ordinary Least Squares (OLS) Regression

Intercept (β0)	Estimate (β1)	Std. Error	Multiple R^2	Adjusted R^2	P-value
0.688827	−0.003277	0.002783	0.0593	0.01654	0.2515

Table 1 presents the results of the basic regression analysis of inflation and the Human Development Index (HDI) in the Philippines from 2000 to 2023. The inflation coefficient is −0.003277, indicating that a 1% increase in inflation is associated with a very small decrease in HDI. However, the p-value of 0.2515 is greater than 0.05, indicating that the relationship is not statistically significant and that inflation does not have a reliable effect on HDI. The Multiple R^2 of 0.0593 suggests that inflation explains only 5.93% of the variation in HDI, while the remaining 94% is not explained by inflation in this model and may reflect other factors such as education, healthcare, and government support. This finding supports the argument of Ranis et al. (2000) that human development is driven more by structural and social factors than by economic indicators alone. Similarly, the UNDP (2020) emphasizes that HDI is a multidimensional measure shaped by long-term investments in health, education, and living standards rather than short-term macroeconomic changes.

The negative but statistically insignificant coefficient represents a contemporaneous association rather than evidence of a short-run causal or long-run structural effect. As HDI changes gradually, short-term price shocks, such as the 2018 rice crisis, may be buffered by social protection and human-capital programs such as the 4Ps, Universal Health Care Act (Republic Act No. 11223, 2019) and the Universal Access to Quality Tertiary Education Act (Republic Act No. 10931, 2017), limiting their immediate impact on HDI.

Table 2. Diagnostic Test Results of the OLS Regression Model (group7)

Diagnostic Test	Statistic	p-value	Decision
Durbin-Watson Test	DW = 0.18518	1.127e-11	Reject H_0
Breusch-Pagan Test	BP = 1.9752	0.1599	Accept H_0
Q-Q Plot (Normality)			Normal
Residuals vs Fitted (Linearity)			Linear

Table 2 checks if the basic assumptions of regression are met. The Durbin-Watson test gave a value of 0.18518 (p = 1.127×10−11), which is very far from the ideal value of 2. This indicates strong autocorrelation; in simple terms, the data from one year are too closely connected to the next, which is a problem for regression (Gujarati & Porter, 2009). The Breusch-Pagan test (p = 0.1599 > 0.05) provides insufficient evidence of heteroscedasticity, satisfying the equal-variance assumption (Wooldridge, 2013). The Q-Q and residual plots also show that the data are roughly normal and linear. Overall, the model passes most checks but fails the autocorrelation test, which needs to be fixed before we can trust the results.

Table 3. Comparison of Autocorrelation Correction Methods Applied to the OLS Regression Model

Method	ρ (rho)	DW Statistic	p-value	Status
OLS — Original	—	0.18518	1.127e-11	Failed
Cochrane-Orcutt	0.9476	2.1311	0.6481	Failed (non-convergence)
Prais-Winsten	0.9507	0.18518	1.127e-11	Failed
GLS — AR(1)	0.9507	X^2=0.19177	0.6614	Passed

Table 3 presents the results of three successive autocorrelation correction procedures applied to address the severe serial correlation detected in the OLS residuals. The Cochrane-Orcutt (CO) procedure was the first method attempted. While it produced a Durbin-Watson statistic of DW = 2.1311 (p = 0.6481), which technically passes the autocorrelation test, the R output issued a "Did not converge" warning, indicating that the iterative estimation process failed to stabilize. This non-convergence is associated with the very high estimated autocorrelation coefficient (ρ ≈ = 0.9476), indicating strong serial dependence in the annual observations (Cochrane & Orcutt, 1949; Beach & MacKinnon, 1978). Because convergence is a prerequisite for valid CO estimates, this result is deemed unreliable. The Prais-Winsten (PW) method was then applied, converging after four iterations at ρ = 0.9507. However, the resulting Durbin-Watson test on the Prais-Winsten residuals returned DW = 0.18518 (p = 1.127×10−11), identical to the original OLS result, indicating that the Prais-Winsten transformation failed to eliminate autocorrelation despite convergence. This failure highlights the limitations of OLS-based correction methods under near-unit-root autocorrelation. Finally, Generalized Least Squares (GLS) with an AR(1) correlation structure was applied via the nlme package. The Box-Ljung test on the GLS-normalized residuals (result4) yielded X^2 = 0.19177 (df = 1, p = 0.6614), providing insufficient evidence of remaining autocorrelation. Since p = 0.6614 > 0.05, the null hypothesis of no autocorrelation cannot be rejected. The GLS-AR (1) model is thus the only method that adequately corrects the serial correlation, and all subsequent assumption validation and inference are based on this model.

Table 4. Summary of Regression Assumption Tests After GLS-AR (1) Correction (result3)

Assumption	Test Used	Test Statistic	p-value	Result
Linearity	Residuals vs Fitted Plot			Passed
Normality of Residuals	Normal Q-Q Plot			Passed
Homoskedasticity	Breusch-Pagan	BP = 1.9752, df = 1	0.1599	Passed
No Autocorrelation	Box-Ljung	X^2 = 0.19177, df = 1	0.6614	Passed

Table 4 confirms that after applying the GLS correction, the regression model meets the diagnostic criteria assessed in the study. The data show a linear pattern; the errors are normally distributed; the variance is constant (Breusch-Pagan p = 0); and autocorrelation is indicated (Box-Ljung p = 0.6614), supporting the reliability of statistical inference under the specified model (Greene, 2012).

Even with a clean model, however, inflation still shows no significant effect on HDI (t = −1.178, p = 0.2515). This confirms that inflation alone is not a key driver of human development in the Philippines, consistent with the broader view that human development is shaped by multiple social, institutional, and economic factors (Paliova et al., 2019).

Discussion

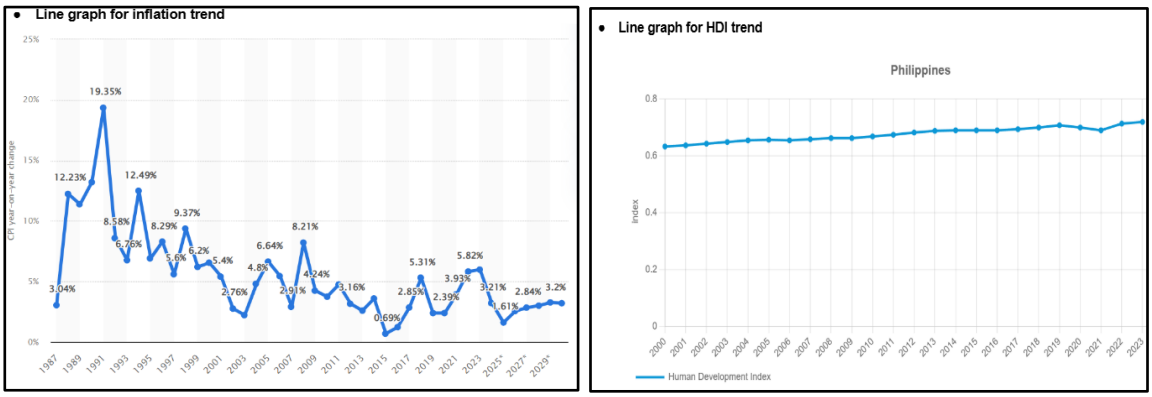

Figure 10. Trends in Inflation in the Philippines (2000–2023)
Source: Statista and Asian Development Bank

The results indicate that inflation in the Philippines was highly unstable from 2000 to 2023, with significant peaks during the 2008 global food and energy crisis and the 2018 rice shortage (BSP, 2019). In contrast, the Human Development Index (HDI) showed a steady upward trend, increasing from 0.624 in 2000 to 0.699 in 2022 (UNDP, 2023). These differing trends suggest that although inflation shifted significantly, human development remained stable and continued to improve over time.

The regression results support this observation. The OLS model produced an R^2 value of 0.0593, indicating that inflation explains less than 6% of the variation in HDI. This low explanatory value suggests that inflation and HDI largely move separately. Yolanda (2017) similarly found that Indonesia's HDI continued to increase despite inflation related surges, attributing this resilience to macroeconomic policies and government spending. Likewise, Nusrullah et al. (2023) argued that the relationship between inflation and human development is indirect and thus influenced by public expenditure, implying that sustained investment in social services can mitigate the negative effects of inflation. These findings are consistent with the Philippine context, where long-term investments in health, education, and social protection programs and services appear to improve HDI rather than favorable inflationary environment (World Bank, 2020).

Further analysis using the GLS-AR(1) model showed that inflation does not have a statistically significant effect on HDI, as denoted by the coefficient of −0.003277 and a p-value of 0.2515. Since the p-value exceeds the 0.05 significance level, the null hypothesis is therefore accepted. Moreover, the R^2 value of 5.93% suggests that approximately 94% of the variation in HDI is explained by other socioeconomic factors, such as healthcare access, educational attainment, and assistance programs. This finding corresponds with Runtunuwu (2020), who also found inflation to have a negative but statistically insignificant effect, while other variables had stronger effects on HDI. Although Ramadhan and Pertiwi (2025) reported a statistically significant negative relationship, a large portion of HDI variation remained unexplained, reinforcing the idea that human development is a multidimensional phenomenon that a single macroeconomic indicator cannot fully explain.

In terms of magnitude, the coefficient indicates that a one-percentage-point increase in inflation leads to a decrease of only 0.003 in HDI, which is practically negligible. Additionally, the high autocorrelation ($\rho = 0.9507$) suggests that HDI is strongly influenced by its past values, indicating a persistent, self-reinforcing trend. This implies that human development in the Philippines is shaped more by long-term structural conditions than by short-term price fluctuations. Ozkan and Gurbuz (2024) found that inflation significantly affects HDI only when it exceeds a certain threshold, particularly above 10%. Since inflation in the Philip-

pines remained within manageable levels during most of the study period, its impact on HDI appears minimal. Similarly, Musa et al. (2024) emphasized that inflation becomes more harmful when institutional responses are weak, suggesting that government interventions in the Philippines may have helped cushion its potential adverse effects.

In the short run, inflation can negatively affect human development by reducing purchasing power and increasing the cost of essential goods and services, as noted by Ferreira and Ravallion (2008). This was evident during the 2018 food price crisis, when poverty levels temporarily increased (PSA, 2019). However, despite these short-term effects, the regression results indicate that inflation does not have a statistically significant impact on HDI, suggesting that social protection programs and government interventions may have mitigated these pressures.

In the long run, the high persistence of HDI ($\rho = 0.9507$) indicates that it follows a stable trajectory driven by structural factors rather than macroeconomic volatility. Herman (2021) emphasized that sustained wage policies and broader economic conditions, rather than inflation alone, are key drivers of human development. Similarly, Suprapto et al. (2022) found that HDI is more responsive to income and consumption factors than to price levels. Overall, these findings suggest that while maintaining low and stable inflation is important, it is not sufficient to drive improvements in human development. Instead, sustained investments in education, healthcare, and social protection remain the primary determinants of long-term HDI growth in the Philippines.

Conclusion

This study found that inflation is not a sufficient determinant of the Human Development Index (HDI) in the Philippines from 2000 to 2023. The estimated coefficient of -0.003277 is relatively small, and the p-value of 0.2515 exceeds the 0.05 level of significance. This indicates that inflation does not have a statistically significant effect on HDI. Furthermore, inflation explains only 5.93% of the variation in HDI, suggesting that approximately 94% of the factors affecting human development are connected to variables other than inflation. These findings suggest that maintaining low inflation alone is not enough to improve the living standards of the Philippines. Instead, sustained investments in education, healthcare, and social protection programs play a more important role in enhancing human development, and policymakers are advised to prioritize them. The UNDP (2023) agrees with such sentiments and underlines that the main drivers of HDI improvements are long-term investments in health, education, and income. Similarly, Ranis et al. (2000) emphasize that human development outcomes are further guided by structural and institutional factors, rather than by a sole macroeconomic indicator, such as inflation.

The findings are supported by Human Capital Theory, developed by Theodore Schultz (1961), which states that a nation develops through investments in its people, particularly in education, health, and skills development. While rising inflation may make it more difficult for individuals to afford education, healthcare, and food, which are key components of human capital, the theory emphasizes that mediating inflation alone does not automatically lead to improved living standards. What matters more is whether individuals have access to essential services that enable personal development. The low R^2 value of 5.93% supports the idea, indicating that most of the variation in HDI is driven by structural factors such as the quality of education, the accessibility of healthcare, and government support systems rather than inflation itself. The result aligns with Bhatta (2013), who concluded that, compared to macroeconomic stability, public investment in social services has a stronger and more enduring effect on human development.

The results are also consistent with the Capability Approach proposed by Amartya Sen (1999), which supports the measurement of HDI. This approach emphasizes that development should be assessed based on individuals' capabilities and their freedom to live the lives they value, rather than solely focusing on economic indicators such as inflation or income. Although rising prices can reduce households' ability to afford education and healthcare, thereby limiting their capacity to purchase, the

continuous improvement in the Philippines' HDI despite periods of high inflation suggests the effectiveness of government interventions. In addition, more institutionalized programs, such as the Pantawid Pamilyang Pilipino Program (4Ps), are known to provide conditional cash transfers to vulnerable families. Moreover, other broad, institutionalized programs have been very influential. According to Republic Act No. 11223 (2019), or the Universal Health Care Act, which opens access to basic health care services to all Filipinos, as published by the Official Gazette of the Republic of the Philippines. Similarly, Republic Act No. 10931 (2017), or the Universal Access to Quality Tertiary Education Act, ensures free tuition in state universities and colleges, also sourced from the Official Gazette. Furthermore, the K to 12 Basic Education Reform has supported basic education and skills development. Such policies are perceived to be more sustainable and reliable in enhancing long-term capabilities, as they solidified the rights to education and healthcare rather than relying on meager support. This underscores the fact that price stability is not as crucial if institutions and inclusive social policies guarantee access to basic services, thereby facilitating human development.

Moreover, the Structuralist Theory of Inflation, formulated by Raúl Prebisch (1950), provides further explanation for the insufficient relationship between inflation and HDI. According to the theory, inflation in developing countries is mainly driven by structural issues such as inefficient supply chains, low agricultural productivity, and persistent inequality. These underlying factors simultaneously influence both inflation and human development outcomes. As a result, a direct and significant relationship between inflation and HDI is not necessarily to be expected. To improve HDI, it requires addressing these structural challenges through reforms in agriculture, enhancements in public service delivery, and strengthened social programs, rather than focusing solely to control inflation. The theory corresponds with Mahmoud (2025), who clarifies that the impact of inflation on living standards is usually indirect and moderated by structural conditions.

Overall, the study emphasizes that while managing inflation remains important, it is not enough on its own to drive human development in the Philippines. Sustainable improvements in living standards require long-term and strategic investments in crucial services that shape how people live, learn, and maintain their health.

Recommendations

The study provides grounded knowledge and insights for various stakeholders involved in formulating and implementing policies for economic planning and human development in the Philippines. Firstly, are the *policymakers*, which are the government agencies such as economic planners and fiscal authorities like the *Bangko Sentral ng Pilipinas (BSP), Department of Finance (DOF), and the Department of Budget and Management (DBM)*, that could benefit from the findings of this study by basing decisions on inflation is insufficient to improve human development outcomes. Hence, policymakers and involved agencies should prioritize sustained investments in education, healthcare, and social welfare programs, since socioeconomic factors have a more significant impact on improving the Human Development Index (HDI). Strengthening human development and sustainability-focused programs can help soften the effects of inflation and promote more inclusive growth for their constituents.

Secondly, *future researchers and academic institutions*, particularly in the field of economics can benefit from this study by using it as a basis for more comprehensive economic analyses. As the study explains, inflation accounts for only a small portion of HDI variation; future studies are encouraged to include additional variables, such as poverty rate, government expenditure, unemployment, and income inequality, to better capture the determinants of human development. Moreover, applying advanced econometric models and broader datasets may provide a much deeper understanding of the short- and long-run dynamics of Inflation and HDI. Lastly, *development organizations and local government units (LGUs)* may also use these findings to design community-level planning and projects that directly improve standard of living, rather than solely depending on macroeconomic indicators.

Compliance with Ethical Standards

This study complied with ethical standards in the conduct and reporting of this research. As the study relied exclusively on secondary data obtained from publicly available sources, specifically the Philippine Statistics Authority (PSA) and the United Nations Development Programme (UNDP), no human participants were involved. On the other hand, informed consent, the right to withdraw, confidentiality of respondents, and Data Privacy Act requirements regarding personal data were not applicable. The researchers ensured that all data were properly cited, accurately represented, and used solely for academic and research purposes. No conflict of interest existed throughout the conduct of the study. Plagiarism was strictly avoided through proper acknowledgment of all sources, and the interpretation of findings was carried out objectively to minimize bias. The researchers recognize that the study is limited to a single independent variable model and does not account for other potential determinants of the Human Development Index (HDI), such as education expenditure, health investment, and income levels, which may result in omitted-variable bias. Therefore, the findings should be interpreted with caution. Artificial intelligence (AI) tools were used solely to improve sentence structure, grammar, and language clarity. All analyses, interpretations, conclusions, and final decisions remained the responsibility of the researchers.

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