Research Inventy: International Journal of Engineering and Science
Vol.16, Issue 8 (August 2026), PP 23-30
Issn (e): 2278-4721, Issn (p):2319-6483, www.researchinventy.com

Modeling Inflation in Türkiye Using Beta Regression

Şenol Çelik
Biometry Genetics Unit, Department of Animal Science, Agricultural Faculty, Bingöl University, Bingol, Türkiye
** Corresponding author*

Abstract
This study investigates the determinants of the inflation rate in Türkiye over the period 2000–2025 using beta regression models. Since the annual inflation rate was transformed into a continuous variable bounded between 0 and 1, beta regression was considered an appropriate modeling framework. Five explanatory variables were included in the analysis: gold prices, gasoline prices, exchange rate, external debt, and gross domestic product (GDP). Four alternative beta regression models were estimated and compared using the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), log-likelihood, pseudo R^2, prediction accuracy measures, and likelihood ratio tests. Descriptive statistics and correlation analyses were also performed, while multicollinearity was assessed using the Variance Inflation Factor (VIF).
The results showed that the full beta regression model achieved the best overall model fit, with the lowest AIC (−45.38), the lowest BIC (−36.57), the highest log-likelihood (29.69), and the highest pseudo R^2 (0.740). The model also exhibited satisfactory predictive performance, with an RMSE of 0.101, an MAE of 0.072, and a correlation coefficient of 0.855 between observed and predicted inflation values. Gold prices and GDP were statistically significant in the full model, whereas gasoline prices, the exchange rate, and external debt became significant in reduced models, indicating the influence of multicollinearity on coefficient estimation. VIF analysis confirmed severe multicollinearity in the full specification but demonstrated a substantial reduction after model simplification. Overall, the findings indicate that beta regression provides an effective framework for modeling bounded inflation data and offers valuable insights into the macroeconomic determinants of inflation in Türkiye.
Keywords: *Beta regression, Inflation, Türkiye, Macroeconomic indicators, Model comparison, Multicollinearity.*

Date of Submission: 05-08-2026 Date of Acceptance: 17-08-2026

I. Introduction

Inflation is one of the most important macroeconomic indicators affecting economic stability, purchasing power, investment decisions, and sustainable economic growth (Mankiw, 2021; Blanchard, 2021). Persistent inflation reduces the real value of money, distorts price signals, weakens consumer confidence, and increases uncertainty in financial markets (Mishkin, 2022). Consequently, understanding the determinants of inflation has become one of the primary objectives of macroeconomic research and monetary policy.

In developing economies such as Türkiye, inflation dynamics are influenced by a combination of domestic and external macroeconomic factors (OECD, 2024; IMF, 2024). During the last two decades, Türkiye has experienced substantial fluctuations in inflation associated with exchange rate volatility, energy price shocks, external borrowing, and changes in economic growth. These developments have increased the need for empirical studies investigating the factors driving inflation.

Previous empirical studies have identified exchange rates, energy prices, gold prices, money supply, interest rates, gross domestic product (GDP), and external debt as important determinants of inflation (Stock and Watson, 2020; Gujarati and Porter, 2009; Wooldridge, 2020). Exchange rate depreciation generally increases import prices and production costs, resulting in higher consumer prices. Similarly, increases in gasoline prices affect transportation and production costs, while fluctuations in gold prices often reflect inflation expectations and financial market uncertainty (Mishkin, 2022).

Various econometric methods have been employed to analyze inflation determinants, including ordinary least squares (OLS), autoregressive distributed lag (ARDL), vector autoregression (VAR), vector error correction (VECM), generalized method of moments (GMM), and panel data models (Gujarati & Porter, 2009; Wooldridge, 2020). Although these techniques have produced valuable findings, they generally assume an unbounded dependent variable and may not be appropriate when the response variable is expressed as a continuous proportion restricted to the interval (0,1).

Beta regression, originally proposed by Ferrari and Cribari-Neto (2004), provides a flexible framework for modeling continuous variables bounded between zero and one. Unlike ordinary linear regression, beta regression accounts for heteroscedasticity and asymmetric distributions commonly observed in proportion data

(Ferrari and Cribari-Neto, 2004). Owing to these advantages, beta regression has been widely applied in agriculture, medicine, ecology, finance, and economics (Cribari-Neto andZeileis, 2010).

Despite these advantages, studies applying beta regression to inflation modeling remain limited, particularly for Türkiye. Most previous studies have relied on conventional linear regression or time-series techniques without considering the bounded nature of transformed inflation rates. Moreover, few studies have systematically compared alternative beta regression models using model selection criteria, likelihood ratio tests, and multicollinearity diagnostics.

Although ordinary linear regression is widely used in empirical inflation studies, beta regression provides a statistically appropriate alternative when the dependent variable is expressed as a bounded proportion. Furthermore, evaluating competing beta regression models using information criteria and diagnostic measures enables researchers to identify a specification that balances predictive performance with parameter interpretability.

Therefore, the objective of this study is to investigate the determinants of annual inflation in Türkiye during the period 2000–2025 using beta regression analysis. Four alternative beta regression models are estimated and compared using the Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), log-likelihood, pseudo-R^2, likelihood ratio tests, and multicollinearity diagnostics. The findings are expected to contribute to the empirical literature on inflation modeling while demonstrating the applicability of beta regression to bounded macroeconomic variables.

II. Material and Methods

Data Sources

Annual data covering the period 2000–2025 were compiled from official national and international databases. The dependent variable was the annual inflation rate (INF), expressed as a proportion bounded between 0 and 1. The explanatory variables consisted of gold prices (GOLD), gasoline prices (GASOLINE), exchange rate (EXCHANGE), external debt (EXTDEBT), and gross domestic product (GDP) (Table 1).

The annual inflation rate, exchange rate, gold prices, and external debt data were primarily obtained from the Electronic Data Delivery System (EVDS) of the Central Bank of the Republic of Türkiye (CBRT). Annual GDP data were obtained from the Turkish Statistical Institute (TurkStat) and cross-checked with international statistics published by the World Bank and Worldometers. Historical gasoline prices were obtained from archived fuel price records published by Aytemiz Petroleum.

All monetary variables were converted to annual averages where necessary. The inflation rate was transformed into the (0,1) interval before model estimation to satisfy the assumptions of the beta regression model.

Table 1. Data sources

Variable	Description	Unit	Source
INF	Annual inflation (CPI)	Ratio (0–1)	Turkish Statistical Institute (TurkStat), CBRT EVDS
GOLD	Gold price	TRY/gram	CBRT EVDS
GASOLINE	Gasoline price	TRY/liter	Aytemiz historical fuel prices
EXCHANGE	USD/TRY exchange rate	Annual average	CBRT EVDS
EXTDEBT	Gross external debt	Million USD	CBRT EVDS
GDP	Gross Domestic Product	Current USD	TurkStat / World Bank

Beta regression model

Ferrari and Cribari-Neto (2004) established the class of beta regression models, which are helpful for modeling continuous variables y that take on values in the open standard unit interval (0, 1). Additionally, $(y \cdot (n - 1) + 0.5)/n$, where n is the sample size, is a practical transformation if y also assumes the extremes 0 and 1 (Smithson and Verkuilen 2006).

The alternate parameterization of the beta density in terms of the variate mean and a precision parameter forms the foundation of the beta regression model. The beta density is typically written as

$$f(y; p, q) = \frac{\Gamma(p+q)}{\Gamma(p)\Gamma(q)} y^{p-1}(1-y)^{q-1}, 0 < y < 1,$$

where p, q > 0 and $\Gamma(\cdot)$ is the gamma function (VasconcellosandCribari-Neto, 2005).

The beta distribution is parameterized in terms of its mean and a precision (or dispersion) parameter in beta regression models. Generalized linear models and simple beta regression models are comparable (Paolino, 2001; KieschnickandMcCullough, 2003).

Beta density:

$$f(y; \mu, \phi) = \frac{\Gamma(\phi)}{\Gamma(\mu\phi)\Gamma((1-\mu)\phi)} y^{\mu\phi-1}(1-y)^{(1-\mu)\phi-1}, 0 < y < 1$$

where $0 < \mu < 1$ and $\mu > 0$. Note that

$$E(y) = \mu$$

and

$$var(y) = \frac{\mu(1-\mu)}{1+\phi}$$

Hence, ϕ can be regarded as a precision parameter. This is not the usual parameterization of the beta law, but is convenient for modeling purposes (Ferrari and Cribari–Neto, 2004).

III. Results

Descriptive statistics for the variables used are given in Table 2.

Table 2. Descriptive Statistics

Variables	N	Minimum	Maximum	Mean	Std. Error	Skewness	Kurtosis
INF	26	0,06	0,69	0,216	0,039	1,418	0,863
gold	26	38,87	31205,98	3190,74	1374,14	3,202	10,776
gasoline	26	0,59	52,73	9,40	2,66	2,386	4,865
exchange	26	0,58	44,79	7,41	2,20	2,417	5,315
ExtDebt	26	113592	520482	329466	24106	-0,539	-1,012
GDP	26	201253493382	1597301000000	760315673001	63582244934	0,368	0,884

Table 2 presents the descriptive statistics of the variables used in the analysis. The average inflation rate (INF) during the study period was 0.216 (21.6%), ranging from 0.062 to 0.685. Inflation exhibited moderate positive skewness (1.418), indicating that relatively high inflation values occurred less frequently than low inflation values. Gold prices, gasoline prices, and the exchange rate showed substantial positive skewness and leptokurtic distributions, suggesting the presence of extreme values. External debt and GDP displayed relatively symmetric distributions, although logarithmic transformation was considered to improve scale comparability and model estimation.

The correlation coefficients between the variables are given in Table 3.

Table 3. Correlation Matrix

Variables		INF	gold	gasoline	exchange	ExtDebt	GDP
INF	r	1	0,400*	0,491*	0,496**	-0,072	0,056
	p		0,043	0,011	0,010	0,727	0,786
gold	r	0,400*	1	0,965**	0,975**	0,496**	0,751**
	p	0,043		0,000	0,000	0,010	0,000
gasoline	r	0,491*	0,965**	1	0,996**	0,557**	0,795**
	p	0,011	0,000		0,000	0,003	0,000
exchange	r	0,496**	0,975**	0,996**	1	0,543**	0,776**
	p	0,010	0,000	0,000		0,004	0,000
ExtDebt	r	-0,072	0,496**	0,557**	0,543**	1	0,912**
	p	0,727	0,010	0,003	0,004		0,000
GDP	r	0,056	0,751**	0,795**	0,776**	0,912**	1
	p	0,786	0,000	0,000	0,000	0,000	

Table 3 indicates that inflation is positively and significantly correlated with gold prices (r = 0.400), gasoline prices (r = 0.491), and the exchange rate (r = 0.496). In contrast, external debt and GDP are not significantly associated with inflation during the study period. The correlation matrix also reveals extremely high correlations among gold prices, gasoline prices, and the exchange rate (r = 0.965–0.996), indicating potential multicollinearity. Therefore, multicollinearity diagnostics using the variance inflation factor (VIF) are required before estimating the regression model.

The results of the multiple linear regression model are presented in Table 4.

Table 4. Multiple Linear Regression

Variables	B	Std. Error	t	p	Tolerance	VIF
(Constant)	0,424	0,085	5,011	0,000		
gold	-3,692E-05	0,000	-1,885	0,074	0,032	31,520
gasoline	0,025	0,026	0,950	0,354	0,005	207,763
exchange	0,018	0,035	0,501	0,622	0,004	265,108
ExtDebt	7,791E-07	0,000	0,949	0,354	0,059	17,063
GDP	-9,335E-13	0,000	-2,150	0,044	0,030	33,180

The coefficient estimates revealed severe multicollinearity among the explanatory variables. Variance Inflation Factor (VIF) values ranged from 17.06 to 265.11, substantially exceeding the commonly accepted threshold of 10. Likewise, tolerance values were well below 0.10. These findings indicate that the regression coefficients are unstable and should be interpreted with caution. Consequently, alternative modeling strategies or variable selection procedures are recommended before estimating the final model (Table 4). The multiple linear regression model was statistically significant ($F = 8.921$, $p < 0.001$), explaining approximately 69.0% of the variation in the inflation rate ($R^2 = 0.690$). After adjusting for the number of predictors, the explanatory power remained substantial (Adjusted $R^2 = 0.613$). The Durbin–Watson statistic was 1.393, suggesting a possible presence of positive serial correlation in the residuals, which should be further investigated using residual diagnostic tests.

The results of the beta regression model are shown in Table 5.

Table 5. Beta Regression Results for Model 1 (Full Model)

Variable	Estimate (β)	Std. Error	z-value	p
Intercept	-0.1420	0.3368	-0.422	0.673
Gold	-0.0001666	0.0000802	-2.078	0.0377
Gasoline	0.0892	0.1072	0.832	0.4054
Exchange rate	0.1423	0.1485	0.959	0.3377
External debt	0.0000060	0.0000040	1.507	0.1318
GDP	-6.111×10^{-12}	2.057×10^{-12}	-2.971	0.0030
Precision parameter (φ)	19.190	5.323	3.605	0.0003

Significance levels: $p < 0.05$ (), $p < 0.01$ (), $p < 0.001$ (). $p>0.05$ = Not Significant.

Table 5 presents the estimation results of the full beta regression model for the annual inflation rate in Türkiye. The model was estimated using the maximum likelihood method with a logit link function.

The estimated model demonstrated a good overall fit, yielding a pseudoR^2 of 0.740 and a log-likelihood value of 29.688. These results indicate that the selected macroeconomic variables jointly explained approximately 74.0% of the variation in the bounded inflation rate.

Among the explanatory variables, gold prices were found to have a statistically significant negative association with inflation ($\beta = -0.000167$, $p = 0.0377$). Similarly, gross domestic product (GDP) exhibited a statistically significant negative coefficient ($\beta = -6.111 \times 10^{-12}$, $p = 0.0030$). In contrast, gasoline prices, the exchange rate, and external debt did not have statistically significant effects on inflation at the 5% significance level.

The estimated precision parameter ($\varphi = 19.19$, $p< 0.001$) was highly significant, indicating that the beta distribution adequately captured the variability of the response variable and that the fitted model possessed satisfactory precision.

In beta regression, the dependent variable is defined as

$$Y \sim Beta(\mu, \phi)$$

The mean must be $0 < \mu < 1$.Since the model uses a logit link function, the linear component (η) is equal to the logit transform of the expected value:

$$\text{logit}(\mu_i) = \ln\left(\frac{\mu_i}{1-\mu_i}\right) = \beta_0 + \beta_1 \cdot \text{gold}_i + \beta_2 \cdot \text{gasoline}_i + \beta_3 \cdot \text{exchange}_i + \beta_4 \cdot \text{ExtDebt}_i + \beta_5 \cdot \text{GDP}_i$$

When the coefficient values are substituted:

$$\ln\left(\frac{\mu_i}{1-\mu_i}\right) = -0.1420 - 0.0001666 \cdot \text{gold}_i + 0.08917 \cdot \text{gasoline}_i + 0.1423 \cdot \text{exchange}_i + 0.000005985 \cdot \text{ExtDebt}_i - 0.000000000006111 \cdot \text{GDP}_i$$

To obtain the directly estimated value of the inflation rate($\mu_i = E(\text{INF}_i)$) (0,1)the inverse of the logit function (sigmoid/logistic transformation) is used:

$$\hat{\mu}_i = \frac{1}{1+e^{-\eta_i}} = \frac{e^{\eta_i}}{1+e^{\eta_i}}$$

The linear equation here is(η_i):

$$\eta_i = -0.1420 - 1.666 \times 10^{-4} \cdot \mathrm{gold}_i + 8.917 \times 10^{-2} \cdot \mathrm{gasoline}_i + 1.423 \times 10^{-1} \cdot \mathrm{exchange}_i + 5.985 \times 10^{-6} \cdot \mathrm{ExtDebt}_i - 6.111 \times 10^{-12} \cdot \mathrm{GDP}_i$$

Overall, the full beta regression model provided a satisfactory statistical fit to the data. Nevertheless, subsequent multicollinearity diagnostics revealed substantial correlations among several explanatory variables. Therefore, although the full model achieved the best overall goodness-of-fit according to the information criteria, the estimated coefficients should be interpreted with caution. This issue motivated the estimation and comparison of alternative reduced beta regression models presented in the following section.

A comparison of all beta regression models used is shown in Table 6.

Table 6. Comparison of Alternative Beta Regression Models

Model	Model 1	Model 2	Model 3	Model 4
LogLik	29,69	27,9	25,2	23,24
AIC	-45,38	-43,8	-40,41	-38,48
BIC	-36,57	-36,25	-34,12	-33,44
Pseudo R^2	0,74	0,695	0,654	0,59
Max VIF	264,68	153,88	17,85	2,51
LR Test (χ^2)	–	3,58	5,39	3,93
p-value	–	0,058	0,02	0,047
Decision	Best fit	Competitive	Reduced model	Lowest multicollinearity

Note: LogLik = Log-likelihood; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; Pseudo R^2 = McFadden's pseudo coefficient of determination; VIF = Variance Inflation Factor; LR = Likelihood Ratio test. Lower AIC and BIC values indicate better model fit, whereas lower VIF values indicate lower multicollinearity. Model 1: Gold + Gasoline + Exchange + ExtDebt + GDP, Model 2: Gasoline + Exchange + ExtDebt + GDP, Model 3: Exchange + ExtDebt + GDP, Model 4: Exchange + GDP.

Table 6 compares the four beta regression models estimated for the inflation rate using several model selection and diagnostic criteria. The comparison included the log-likelihood, Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), pseudo R^2, variance inflation factor (VIF), and likelihood ratio (LR) tests.

Among the competing models, Model 1 achieved the best overall statistical performance, yielding the highest log-likelihood (29.69), the lowest AIC (−45.38), the lowest BIC (−36.57), and the highest pseudo R^2 (0.740). These results indicate that the full specification provided the best fit to the observed inflation data.

However, multicollinearity diagnostics revealed substantial collinearity among the explanatory variables included in Model 1 (maximum VIF = 264.68). Although the predictive performance decreased gradually as variables were removed from the model, multicollinearity was also substantially reduced. In particular, Model 4 exhibited the lowest VIF value (2.51), indicating that multicollinearity was no longer a serious concern.

Likelihood ratio tests further showed that removing gasoline prices (Model 2 versus Model 3; $\chi^2 = 5.39$, $p = 0.020$) and external debt (Model 3 versus Model 4; $\chi^2 = 3.93$, $p = 0.047$) significantly reduced model fit. In contrast, removing gold prices (Model 1 versus Model 2) resulted in only a marginally significant reduction in model performance ($\chi^2 = 3.58$, $p = 0.058$).

The mathematical expressions for the other models (Model 2, Model 3, and Model 4) are summarized below.

Logit form of Model 2 (model without the gold trim):

$$\ln\left(\frac{\mu_i}{1-\mu_i}\right) = 0.07813 + 0.2279 \cdot \mathrm{gasoline}_i - 0.1036 \cdot \mathrm{exchange}_i + 1.060 \times 10^{-5} \cdot \mathrm{ExtDebt}_i - 8.397 \times 10^{-12} \cdot \mathrm{GDP}_i$$

Expected value form($\hat{\mathrm{INF}}_i$):

$$\hat{\mu}_i = \frac{e^{\eta_i}}{1+e^{\eta_i}}$$

$$\eta_i = 0.07813 + 0.2279 \cdot \mathrm{gasoline}_i - 0.1036 \cdot \mathrm{exchange}_i + 1.060 \times 10^{-5} \cdot \mathrm{ExtDebt}_i - 8.397 \times 10^{-12} \cdot \mathrm{GDP}_i$$

Precision (ϕ): 16.603

Logit form of Model 3 (model without gold and gasoline versions):

$$\ln\left(\frac{\mu_i}{1-\mu_i}\right) = -0.08620 + 0.1387 \cdot \text{exchange}_i + 6.867 \times 10^{-6} \cdot \text{ExtDebt}_i - 6.045 \times 10^{-12} \cdot \text{GDP}_i$$

Expected value form ($\hat{\text{INF}}_i$):

$$\eta_i = -0.08620 + 0.1387 \cdot \text{exchange}_i + 6.867 \times 10^{-6} \cdot \text{ExtDebt}_i - 6.045 \times 10^{-12} \cdot \text{GDP}_i$$

Precision (ϕ): 13.181

Logit form of Model 4 (lean model including only exchange and GDP):

$$\ln\left(\frac{\mu_i}{1-\mu_i}\right) = -0.07759 + 0.1011 \cdot \text{exchange}_i - 2.657 \times 10^{-12} \cdot \text{GDP}_i$$

Expected value form ($\hat{\text{INF}}_i$):

$$\eta_i = -0.07759 + 0.1011 \cdot \text{exchange}_i - 2.657 \times 10^{-12} \cdot \text{GDP}_i$$

Precision (ϕ): 11.027

Overall, the findings indicate a trade-off between model fit and coefficient stability. While Model 1 provided the highest explanatory power, Model 4 offered the most stable parameter estimates because of its substantially lower multicollinearity. Model 3 represented a reasonable compromise between explanatory performance and model interpretability.

The obtained beta regression models were subjected to multicollinearity testing and are presented in Table 7.

Table 7. Multicollinearity Diagnostics for Alternative Beta Regression Models

Model	Variable	VIF	Tolerance	Interpretation
Model 1	Gold	31.50	0.0317	Severe multicollinearity
	Gasoline	207.40	0.0048	Severe multicollinearity
	Exchange rate	264.68	0.0038	Severe multicollinearity
	External debt	17.06	0.0586	High multicollinearity
	GDP	33.16	0.0302	Severe multicollinearity
Model 2	Gasoline	153.88	0.0065	Severe multicollinearity
	Exchange rate	131.02	0.0076	Severe multicollinearity
	External debt	11.90	0.0841	High multicollinearity
	GDP	23.38	0.0428	Severe multicollinearity
Model 3	Exchange rate	4.25	0.2356	Acceptable
	External debt	10.07	0.0993	Borderline high
	GDP	17.85	0.0560	High multicollinearity
Model 4	Exchange rate	2.51	0.3977	Acceptable
	GDP	2.51	0.3977	Acceptable

Note: VIF = Variance Inflation Factor. Tolerance = 1/VIF. VIF values greater than 10 and tolerance values below 0.10 generally indicate serious multicollinearity.

Table 7 summarizes the multicollinearity diagnostics for the explanatory variables included in the four beta regression models. Variance Inflation Factor (VIF) and tolerance values were calculated using equivalent linear regression models because these diagnostics are not directly available for beta regression.

The results revealed severe multicollinearity in the full specification (Model 1). The VIF values ranged from 17.06 to 264.68, while the corresponding tolerance values ranged from 0.0038 to 0.0586. In particular, the exchange rate (VIF = 264.68), gasoline prices (VIF = 207.40), and GDP (VIF = 33.16) exhibited extremely high collinearity.

Although multicollinearity remained substantial in Model 2, a noticeable improvement was observed after removing the gold price variable. Further model simplification in Model 3 reduced the VIF of the exchange rate to 4.25, indicating an acceptable level for that variable. Nevertheless, GDP (VIF = 17.85) and external debt (VIF = 10.07) still showed evidence of considerable multicollinearity.

Model 4 produced the most favorable diagnostic results. Both explanatory variables had identical VIF values of 2.51 and tolerance values of 0.398, well within commonly accepted thresholds. These findings indicate that multicollinearity was effectively eliminated in the final reduced model.

Overall, the diagnostics demonstrate that simplifying the model substantially improved coefficient stability, although this improvement was accompanied by a moderate reduction in explanatory power. Consequently, the full model offered the best statistical fit, whereas the reduced model provided the most reliable parameter estimates from a multicollinearity perspective.

The graph showing both observed and predicted values is presented in Figure 1.

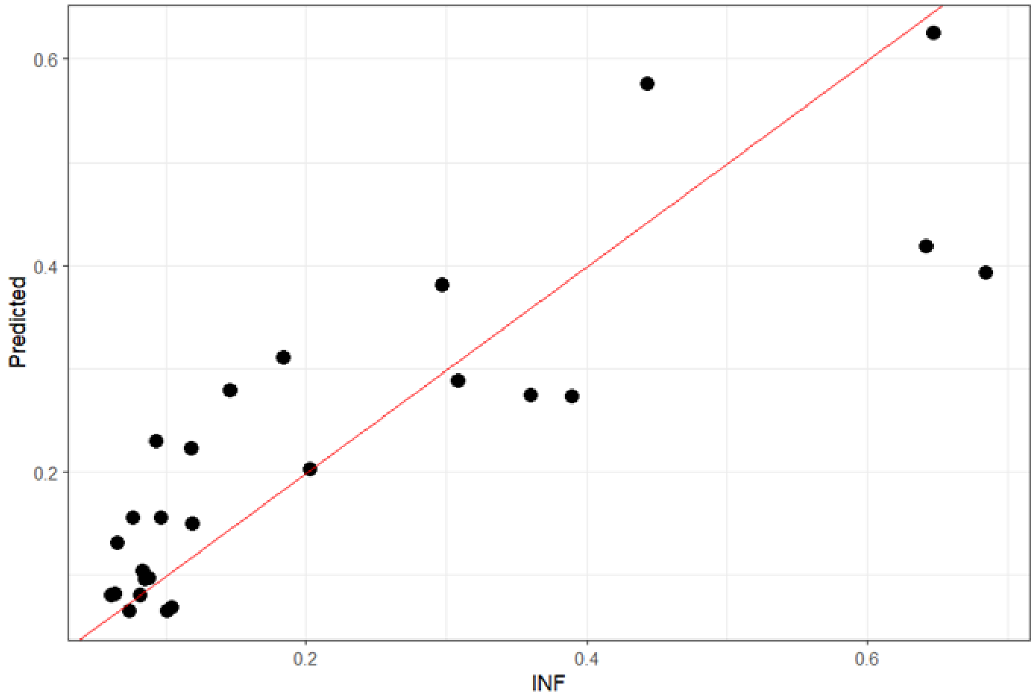

Figure 1. Observed versus Predicted Inflation Values

Figure 1 illustrates the relationship between the observed and predicted inflation values obtained from the full beta regression model. The red 45° reference line represents perfect agreement between the observed and predicted values. Most observations are located reasonably close to the reference line, indicating that the model captures the overall pattern of inflation during the study period. Although several observations deviate from the line, particularly at higher inflation levels, the overall distribution suggests satisfactory predictive performance. This finding is consistent with the relatively high pseudo R^2 (0.740), the correlation coefficient between observed and predicted values ($r = 0.855$), and the low prediction errors (RMSE = 0.101; MAE = 0.072). Although a few observations corresponding to high inflation levels were underestimated, the overall agreement between observed and predicted values indicates that the beta regression model provides a reliable representation of the inflation dynamics over the study period.

IV. Conclusion

This study examined the determinants of the inflation rate in Türkiye during the 2000–2025 period using beta regression models. Because the dependent variable was expressed as a proportion bounded between zero and one, beta regression constituted a statistically appropriate alternative to conventional linear regression. Four competing models were estimated and evaluated using multiple model selection criteria, including AIC, BIC, log-likelihood, pseudo R^2, prediction error measures, and likelihood ratio tests.

Among the estimated models, the full beta regression model provided the best overall goodness-of-fit, achieving the highest explanatory power and the most favorable information criteria. Nevertheless, diagnostic analyses revealed substantial multicollinearity among several macroeconomic variables, particularly gold prices, gasoline prices, and the exchange rate. As variables were removed from the model, explanatory power decreased moderately, whereas coefficient stability and interpretability improved considerably. In particular, the simplified models highlighted the important roles of the exchange rate, external debt, and GDP in explaining inflation dynamics.

These findings demonstrate that model selection should not rely solely on goodness-of-fit measures. Diagnostic statistics, especially multicollinearity indicators, should also be considered to ensure reliable parameter estimation and meaningful economic interpretation. The comparison of alternative beta regression models provided a more comprehensive understanding of the relationships between inflation and macroeconomic variables than reliance on a single model.

From a policy perspective, the results suggest that inflation in Türkiye is associated with a combination of domestic and external macroeconomic factors. Maintaining macroeconomic stability therefore requires coordinated policies addressing exchange rate dynamics, economic growth, external financing conditions, and commodity price developments.

The study contributes to the empirical literature by demonstrating the applicability of beta regression to bounded macroeconomic data and by providing a systematic comparison of alternative model specifications. Future research may extend this framework by incorporating additional monetary variables, such as money supply and policy interest rates, together with higher-frequency data and dynamic beta regression models to capture the evolving nature of inflation.

References

[1]. Aytemiz Petroleum. (2025). Historical fuel price archive. https://www.aytemiz.com.tr/akaryakit-fiyatlari/arsiv-fiyat-listesi
[2]. Blanchard, O. (2021). Macroeconomics (8th ed.). Pearson.
[3]. Central Bank of the Republic of Türkiye (CBRT). (2025). Electronic Data Delivery System (EVDS). https://evds2.tcmb.gov.tr/
[4]. Cribari-Neto, F., &Zeileis, A. (2010). Beta regression in R. Journal of Statistical Software, 34(2), 1–24.
[5]. Ferrari, S. L. P., & Cribari-Neto, F. (2004). Beta regression for modelling rates and proportions. Journal of Applied Statistics, 31(7), 799–815.
[6]. Gujarati, D. N., & Porter, D. C. (2009). Basic Econometrics (5th ed.). McGraw-Hill.International Monetary Fund (IMF). (2024). World Economic Outlook. IMF.
[7]. Kieschnick, R., McCullough, B.D. (2003). Regression analysis of variates observed on (0,1): percentages, proportions and fractions. Statistical Modelling, 3, 193–213.
[8]. Mankiw, N. G. (2021). Principles of Economics (9th ed.). Cengage.
[9]. Mishkin, F. S. (2022). The Economics of Money, Banking, and Financial Markets (13th ed.). Pearson.
[10]. OECD. (2024). OECD Economic Outlook 2024. OECD Publishing.
[11]. Paolino, P. (2001). Maximum likelihood estimation of models with beta-distributed dependent variables. Political Analysis, 9, 325–346.
[12]. Smithson, M., Verkuilen, J. (2006). A Better Lemon Squeezer? Maximum-Likelihood Regression with Beta-Distributed Dependent Variables. Psychological Methods, 11(1), 54–71.
[13]. Stock, J. H., & Watson, M. W. (2020). Introduction to Econometrics (4th ed.). Pearson.
[14]. Turkish Statistical Institute (TurkStat). (2025). Statistical Data Portal. https://data.tuik.gov.tr/
[15]. Vasconcellos KLP, Cribari-Neto F (2005). “Improved Maximum LikelihoodEstimation in a New Class of Beta RegressionModels.” BrazilianJournal of ProbabilityandStatistics, 19(1), 13–31.
[16]. Wooldridge, J. M. (2020). Introductory Econometrics: A Modern Approach (7th ed.). Cengage.
[17]. World Bank. (2025). World Development Indicators. https://data.worldbank.org/