Analyzing Inflation Trends in Key Commodities in the Philippines: A Study Based on Bangko Sentral ng Pilipinas Data Using ARIMA Forecasting

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ABSTRACT

Inflation is a sustained growth in general price levels triggered by demand-pull and cost-push factors, diminishes the purchasing power of money, impacts different economic sectors, and significantly affects household budgets and general economic stability. This study aims to analyze and forecast inflation trends in the Philippines and focuses on essential commodities using the Auto-Regressive Integrated Moving Average (ARIMA) model. The study uses historical data from the Bangko Sentral ng Pilipinas (BSP) spanning 2014 to 2023, covering the following 12 key commodities: food and non-alcoholic beverages; alcoholic beverages and tobacco; clothing and footwear; housing, water, electricity, gas, and other fuels; furnishing, household equipment, and routine household maintenance; health; transport; information and communication; recreation, sport, and culture; education services; restaurant and accommodation services; and personal care and miscellaneous goods and services. The ARIMA model forecasts the inflation rates in these commodities and predicts the trend over the next ten years while offering indications for analyzing the inflationary trends and their long-term projection. The results indicate that inflation affects different sectors in varying degrees, such as food and transport, which are experiencing significant fluctuations. Some commodity groups gradually stabilize while others remain uncertain, with food and transportation having the most significant fluctuation and notable inflation rate increase. Other sectors, including housing and utilities, remained uncertain, as inflation rates were expected to remain volatile. Other sectors were described to stabilize progressively, while services and nonessential goods followed the track of more predictable inflationary trends. The findings evidence-based strategies that policymakers may seek to mitigate the adverse impacts of inflation toward long-term economic resilience for Filipino households and businesses.

Keyword: *inflation, inflation rate, inflation trend, Philippines, commodity, ARIMA, forecast*

1. INTRODUCTION

Inflation is defined as the sustained increase in general price levels, erodes the purchasing power of money and affects all facets of an economy. It often stems from demand-pull factors, where demand outpaces supply due to increased consumer spending or government policies, or cost-push factors, such as rising production costs due to increased wages or higher raw material prices [1]. Natural disasters, changes in monetary policy, and interruptions in the global supply chain are additional reasons for inflation that worsen its consequences in weaker countries like the Philippines [2]. The cost of living and household budgets in the Philippines are significantly impacted by inflation, which has a powerful effect on essentials like food and power [3]. This highlights the importance of understanding inflationary forces to preserve economic stability and mitigate socioeconomic inequalities [4].

Inflation rates in the Philippines have fluctuated according to domestic and international economic factors. According to Lo (2024) from the Department of Finance, the inflation rate fell to 3.9% in December 2023 due to recent stabilization efforts [5]. This must be consistent, as shocks in the economy, increased oil prices globally, and supply chain disruptions have previously led to significant price hikes [2]. Such inflationary pressures have been found to retard long-run economic growth and reduce the purchasing power of wages, which makes it highly necessary for

targeted economic reforms [6]. Forecasting models are pivotal tools for understanding inflation trends and predicting their future trajectory. The Auto-Regressive Integrated Moving Average (ARIMA) model has proven effective in analyzing and forecasting time series data consisting of sequences of economic data points recorded over time intervals [7]. The model's ability to identify trends, seasonality, and fluctuations makes it widely used in macroeconomics, financial analysis, and commodity price forecasting [8]. Such flexibility in modeling inflationary trends in developing economies, whose structural changes in supply and demand create unpredictable price fluctuations, makes studies highlight such importance [6]. The reliability of forecasting changes in price levels through such modeling emphasizes its role in informing economic policy.

This study employs the ARIMA model to analyze inflation trends in the Philippines, particularly concerning essential commodities. The model has been extensively validated for its robustness in modeling historical price data and forecasting future movements, as evidenced by its applications in financial markets and national economic planning [9, 10]. Using ARIMA, this study provides policymakers with actionable information to address inflation issues and create economic resilience. The practical application of the ARIMA model in this study is aimed at arming decision-makers with evidence-based strategies to mitigate the effects of inflation on Filipino households and businesses, ensuring a stable and inclusive economic environment.

2. THEORETICAL FRAMEWORK

Cost-push and Demand-pull Inflation Theory

This study utilizes the demand-pull and cost-push inflation framework to analyze inflation trends in the Philippines while focusing on essential commodities such as food and energy. Philippine inflation has been shaped by domestic and global factors, including agricultural productivity, energy supply issues, and fluctuations in global commodity prices [11]. Demand-pull inflation driven by heightened consumer demand or expansionary policies and cost-push inflation caused by rising production costs and external shocks have significantly influenced price levels [1, 12]. These inflationary pressures disproportionately affect low-income households and exacerbate poverty and inequality while straining the broader economy [13].

The study uses the Auto-Regressive Integrated Moving Average (ARIMA) model to understand and address these trends better. This model effectively forecasts economic indicators by analyzing historical inflation data. The study can help understand the reasons behind price inflation and assess the potential impact of applying the model. These results focus on informing policies and planning strategies to reduce the effects of inflation on Filipino households and lead to economic resilience and stability. The importance of these findings in informing economic policy cannot be overstated, empowering policymakers with the knowledge they need to make informed decisions [7, 9].

3. MATERIALS AND METHODS

3.1 Materials

The study uses a comprehensive dataset from the Bangko Sentral ng Pilipinas (BSP) that covers 2014 to 2023 and will be our source for the trend analysis. This dataset includes historical inflation rates and price indices for 12 key commodities in the Philippines: food and non-alcoholic beverages; alcoholic beverages and tobacco; clothing and footwear; housing, water, electricity, gas, and other fuels; furnishing, household equipment, and routine household maintenance; health; transport; information and communication; recreation, sport, and culture; education services; restaurant and accommodation services; and personal and miscellaneous goods and services.

3.2 Methods

A time series analysis is utilized for a systematic approach to understanding the progression of processes and underlying dynamics over time while facilitating accurate forecasting of future parameter values based on chronologically organized data. The ARIMA model effectively captures and represents data patterns, even in cases where the series is not strictly stationary, but demonstrates homogeneity and statistical equilibrium as a comprehensive time series framework [14]. It is a relatively intuitive and explainable approach widely recognized for its flexibility and reliability, making it one of economics and finance's most extensively used models [15], [16]. Accordingly, the ARIMA model was used to forecast the current inflation rate of the 12 key commodities and the predicted trend for the next ten years. The ARIMA (p, d, q) model is expressed mathematically as:

$$Xt = \Phi 1Xt - 1 + \ldots + \Phi pXt - p + at - \Theta 1at - 1 - \ldots - \Theta qat - q \qquad \text{(Equation -1)}$$

where Xt represents the current value in the series, Φ terms correspond to the coefficients of the autoregressive component, which denotes the error term, and Θ terms are the coefficients of the moving average component.

The study used a systematic architectural design with three main steps: model identification, parameter estimation, and predictive analysis. Time series data was prepared and examined with autocorrelation and partial autocorrelation to identify suitable ARIMA models. GRETL software was used for visualization and forecasting, providing information and insights on inflation rate trends.

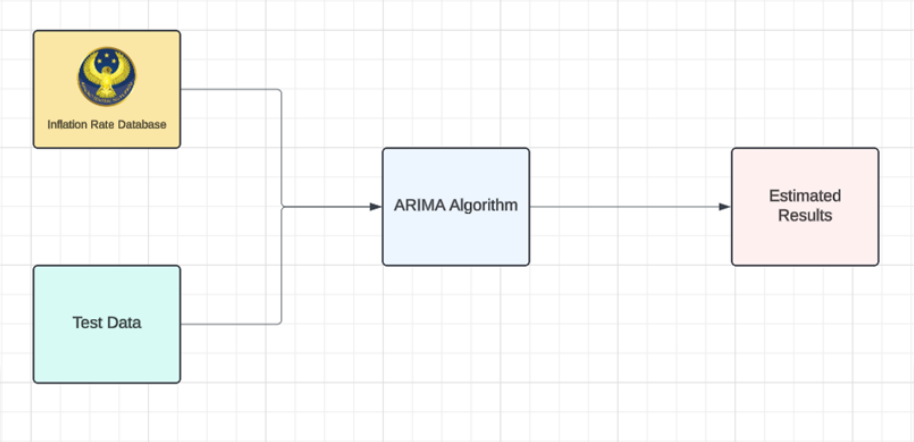

Fig -1: Architectural Design of the Study

4. RESULTS AND DISCUSSION

Table -1: Raw data of Inflation Trends in Key Commodities.

Commodity Group	Year									
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Food and Non-Alcoholic Beverages	5.8	1.9	1.6	3.1	6.8	1.6	2.9	4.2	5.9	7.9
Alcoholic Beverages and Tobacco	6.1	3.0	4.7	6.9	20.0	12.0	15.4	9.7	7.9	10.7
Clothing and Footwear	3.4	2.5	2.1	2.4	2.4	2.6	2.3	1.8	2.6	4.8
Housing, Water, Electricity, Gas, and Other Fuels	2.6	-1.2	0.4	2.7	4.0	2.5	0.7	2.5	6.4	4.9
Furnishing, Household Equipment, and Routine Household Maintenance	2.8	1.9	1.8	2.2	3.1	2.9	3.2	2.1	3.2	5.6
Health	2.3	2.0	2.2	2.6	3.3	4.0	3.9	3.8	2.6	3.9
Transport	0.6	-5.4	-1.3	5.0	6.5	1.1	1.5	9.3	12.9	1.6
Information and Communication	0.2	0.0	0.3	0.3	0.3	0.4	0.5	0.6	0.6	0.7
Recreation, Sport, and Culture	5.6	1.2	1.4	1.7	3.3	3.5	1.0	0.3	2.3	4.7
Education Services	4.4	3.8	3.0	2.5	-0.8	3.9	2.0	0.9	1.8	3.6

Restaurants and Accommodation Services	1.3	1.3	1.5	1.6	4.3	3.5	2.1	3.5	4.1	7.4
Personal Care and Miscellaneous Goods and Services	2.2	1.6	2.1	2.0	2.3	2.4	2.4	2.3	3.0	5.4
Annual Average	3.1	1.1	1.7	2.8	4.6	3.4	3.2	3.4	4.4	5.1

The raw data show that the "Alcoholic Beverages and Tobacco" category had the highest inflation rates, peaking at 20.0% in 2018, followed by the "Transport" category, which had a considerable inflation rate of 12.9% in 2022. In contrast, "Education Services" and "Financial Services" had consistently lower and more steady inflation rates. This gap indicates the imbalanced inflationary effect on different product groups, especially necessities such as transportation and high-tax items such as tobacco, which is why dealing with inflation in those sectors would be essential to contain its influence on the economy and family budgets.

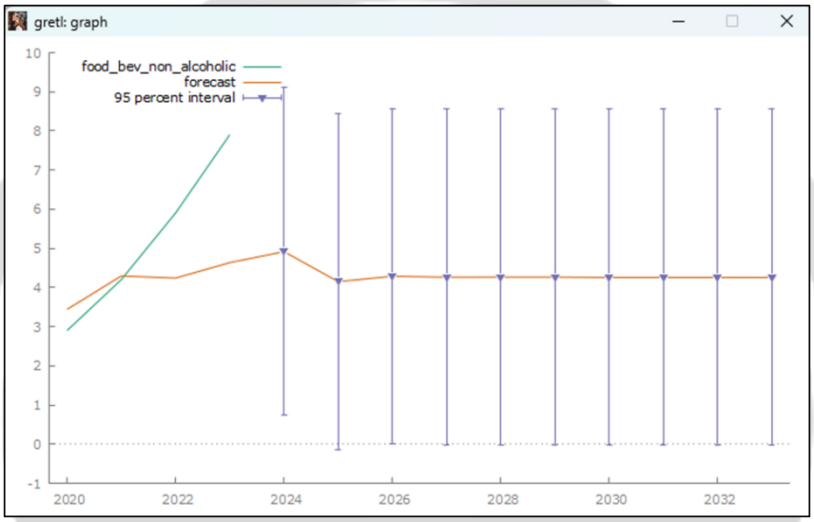

Chart -2: Forecasted Food and Non-Alcoholic Beverages Commodity Group Inflation Rate (2024-2033)

Chart 2 shows a ten-year prediction of food and non-alcoholic beverages inflation rates from 2024 to 2033 using ARIMA modeling. The historical data shows a significant upward trend from 2020 to 2023, peaking at around 8% by 2023, while the forecast predicts a gradual incline in the inflation rate from 2020 and peaking in 2024. After the peak, the graph indicates a short decline in 2025 and is expected to stabilize at approximately 4.5% in the subsequent years. The 95% prediction interval is quite wide in 2024, suggesting high uncertainty in the forecast for that year. The interval remains wide but consistent from 2025 to 2033, indicating ongoing uncertainty in the long-term forecast.

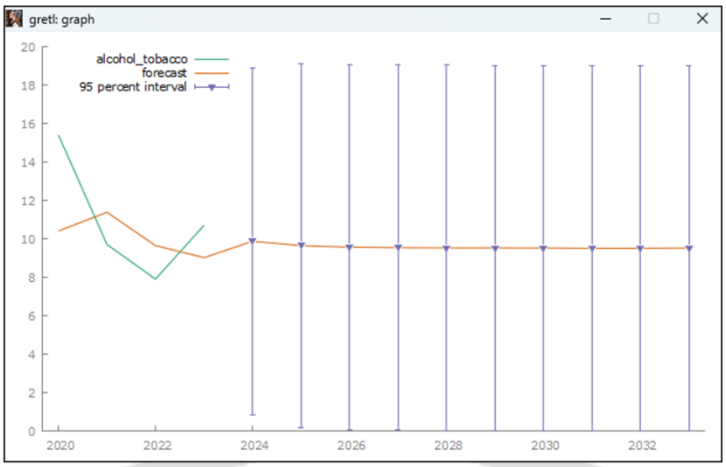

Chart -3: Forecasted Alcoholic Beverages and Tobacco Commodity Group Inflation Rate (2024-2033)

Chart 3 shows a ten-year prediction of alcoholic beverages and tobacco inflation rates from 2024 to 2033 using ARIMA modeling. The historical data from 2020 to 2023 indicates a rather downward trend, with the bottom at approximately 8% in 2022 and an increase in 2023 at about 11%. The forecast shows fluctuations in the inflation rate from 2020 to 2024, peaking in 2021, a gradual decline in 2023, and stabilization starting from 2024 at about 10%. The steady inflation rate trend suggests that price fluctuations are not expected for this commodity group soon. The 95% prediction interval is significantly wide across the forecasted years and indicates uncertainty in the forecast predictions.

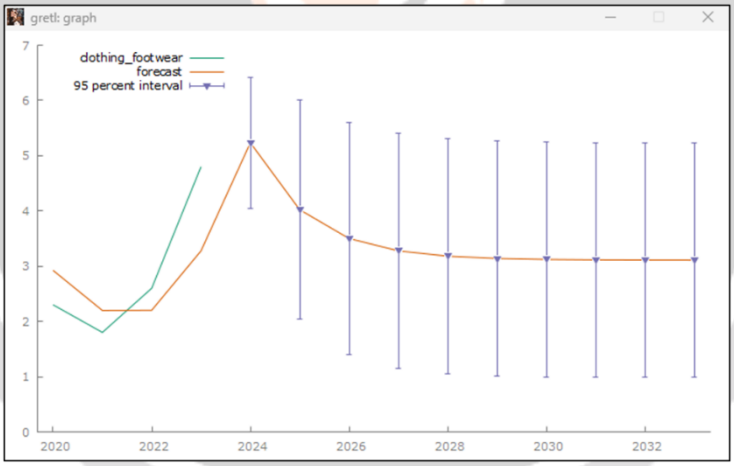

Chart -4: Forecasted Clothing and Footwear Commodity Group Inflation Rate (2024-2033)

Chart 4 shows a ten-year clothing and footwear inflation rate prediction from 2024 to 2033 using ARIMA modeling. From 2020 to 2023, the graph showed a gradual incline in the inflation rate, peaking at approximately 5.0% in 2023 for the historical data. The forecast predicted the same gradual inclination but slightly higher than the historical data, peaking at around 5% in 2024. After 2024, a decline and stabilization occur at approximately a 3% inflation rate. The 95% prediction interval widens significantly around the peak and indicates greater uncertainty during this volatile period, indicating higher uncertainty in the subsequent years.

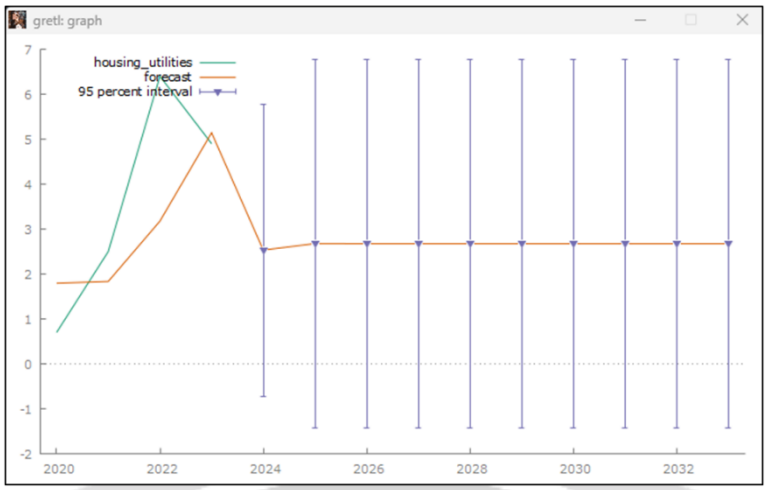

Chart -5: Forecasted Housing, Water, Electricity, Gas, and Other Fuels Commodity Group Inflation Rate (2024-2033)

Chart 5 uses ARIMA modeling to show a ten-year prediction of the inflation rate of housing, water, electricity, gas, and other fuels from 2024 to 2033. From 2020 to 2023, the historical data shows a high incline in the inflation rate, peaking at approximately 6.5% in 2023, while the forecast predicted a steady line in the inflation rate starting from 2024 to 2033 at around 3.5%. The 95% prediction interval expands after 2024, reflecting uncertainty during the transitional phase, but remains consistent as the trend stabilizes in the later years, indicating that while inflation for housing and utilities is expected to peak and stabilize, uncertainty remains high during the adjustment period.

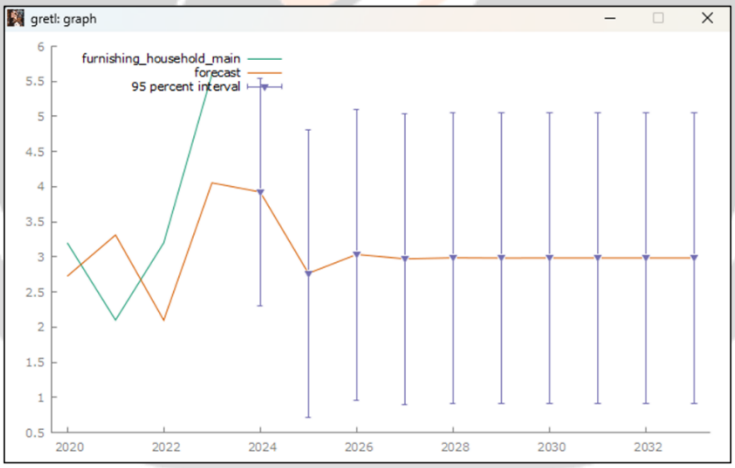

Chart -6: Forecasted Furnishing, Household Equipment, and Routine Household Maintenance Commodity Group Inflation Rate (2024-2033)

Chart 6 shows a ten-year forecast of the inflation rate of furnishing, household equipment, and routine household maintenance from 2024 to 2033 using ARIMA modeling. The historical data from 2020 to 2024 show fluctuations in the inflation rate and peaks at around 5.5% in 2023. The forecast predicts relatively stable inflation rates from 2024 to 2033, indicating that no major inflation trend changes for this commodity group are expected. The 95% prediction interval is narrow in 2024 but widened significantly into the future, indicating uncertainty in predicting the inflation rate in the long term.

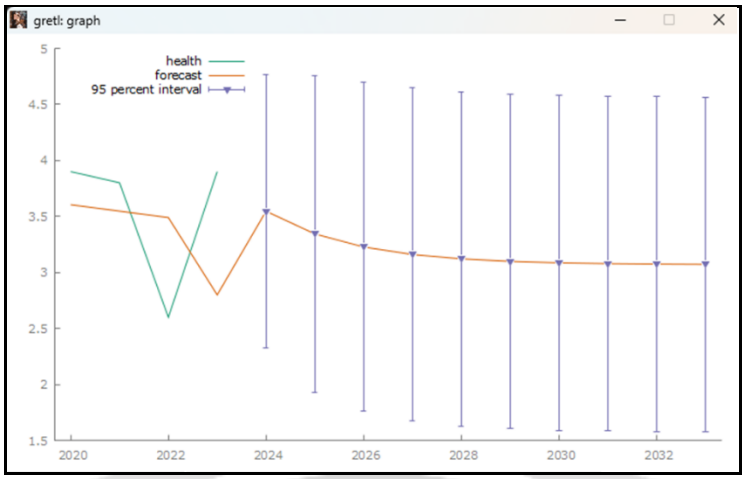

Chart -7: Forecasted Health Commodity Group Inflation Rate (2024-2033)

Chart 7 illustrates a ten-year forecast of the inflation rate for the health commodity group from 2024 to 2033 using ARIMA modeling. The historical data from 2020 to 2023 show fluctuations, beginning at around 4.2% in 2020, followed by a decrease to 3.6% in 2021. The inflation rate then drops significantly to 2.3% in 2023 before rising to approximately 3.8% in 2024. The forecast predicts a gradual decline from 3.8% in 2024 to around 3.5% by 2026 and maintains stability at this level until 2033. The interval is narrow at the beginning of the forecast period but widens significantly in continuing years, indicating increasing uncertainty in long-term forecasts.

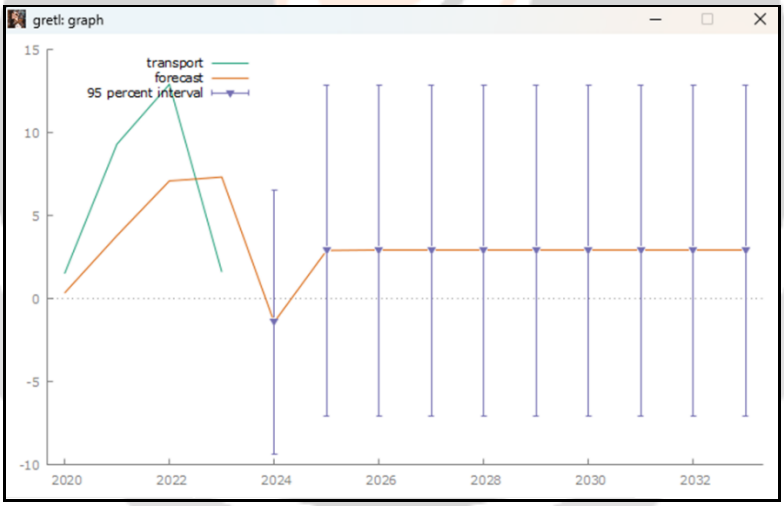

Chart -8: Forecasting Transport Commodity Group Inflation Rate (2024-2033)

Chart 8 shows a ten-year forecast of the inflation rate for the transport commodity group from 2024 to 2033 using ARIMA modeling. The historical data from 2020 to 2023 reveal significant fluctuations, starting at approximately 2% in 2020, peaking at 12% in 2022, and declining to 5% in 2023. The forecast predicts a further drop in the inflation rate of about -2% in 2024, followed by a recovery of 3% in 2025 and stabilizing starting in that period. The 95% prediction interval is narrow in 2024, widens the next year, and is consistent throughout the forecast horizon, suggesting uncertainty in long-term projections.

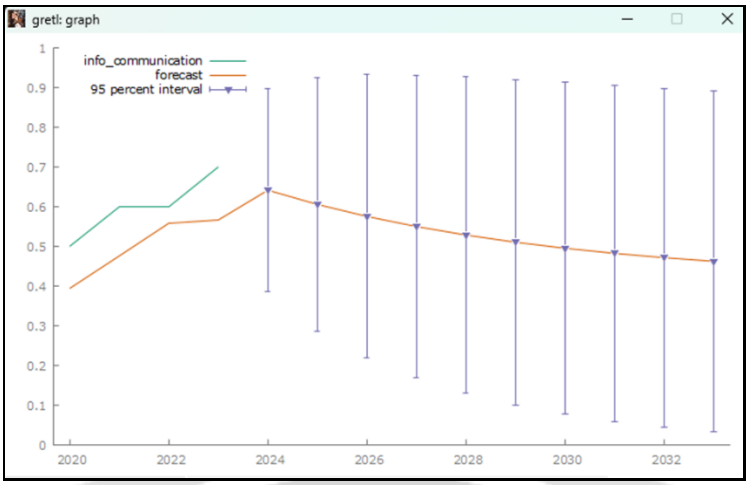

Chart -9: Forecasted Information and Communication Commodity Group Inflation Rate (2024-2033)

Chart 9 presents a ten-year forecast of the information and communications inflation rate from 2024 to 2033 using ARIMA modeling. The historical data from 2020 to 2023 show steady growth, peaking at around 0.7% in 2023. The forecast then predicts a gradual decline starting in 2024. The 95% prediction interval is notably narrow in the early forecast period and gradually widened in the later years, reflecting increased uncertainty in the predicted stabilization trend for this commodity group.

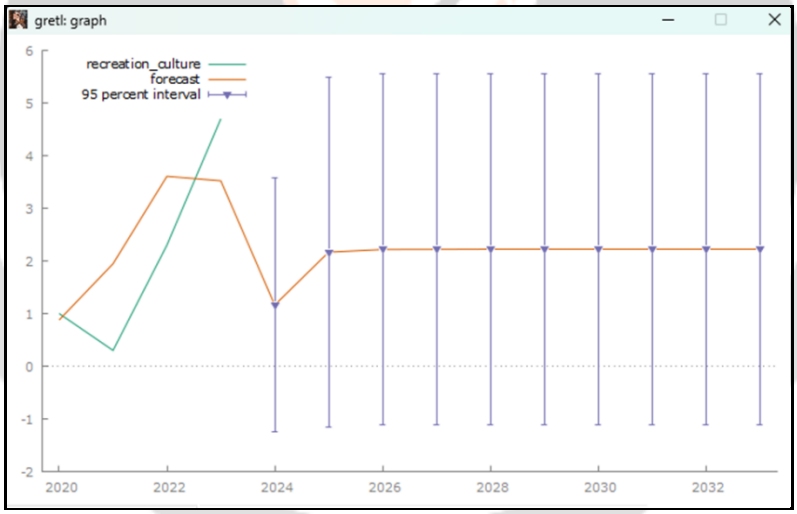

Chart -10: Forecasted Recreation, Sport, and Culture Commodity Group Inflation Rate (2024-2033)

Chart 10 shows a ten-year forecast of the inflation rate for the recreation, sport, and culture commodity group from 2024 to 2033 using ARIMA modeling. The historical data from 2020-2023 shows a sudden drop in the inflation rate in 2021, followed by a sharp peak in 2023 at approximately 5%. The forecast predicts a fluctuation in the inflation rate starting from around 1% in 2020, a peak of approximately 3.5% in 2022, then a sharp decline in 2024, returning to around 1%. After the period, a steady inflation rate of around 2% remains for the rest of the forecast period starting in 2025. The 95% prediction interval is narrow in 2024 and widens the next year, which becomes constant in the subsequent years, implying consistent uncertainty to the forecast prediction.

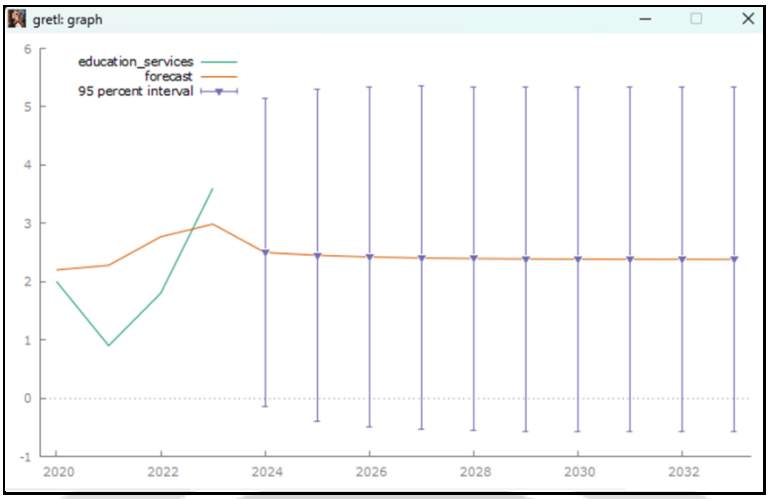

Chart -11: Forecasted Education Services Commodity Group Inflation Rate (2024-2033)

Chart 11 illustrates a ten-year inflation rate forecast for the education services commodity group from 2024 to 2033 using ARIMA modeling. The historical data starts at approximately 2% in 2020, then a decline to around 1% occurs in 2021, followed by a steady increase reaching a peak of approximately 3.5% by 2023. The forecast predicts an incline in the inflation rate from 2020 to 2023, then a slight decline in 2024 before stabilizing at around 2.5% for the remainder of the forecast period. The 95% prediction interval is relatively wide, indicating higher uncertainty that remains consistent as the forecast progresses, suggesting continued uncertainty in the long-term projections in this commodity group despite the stabilization trend.

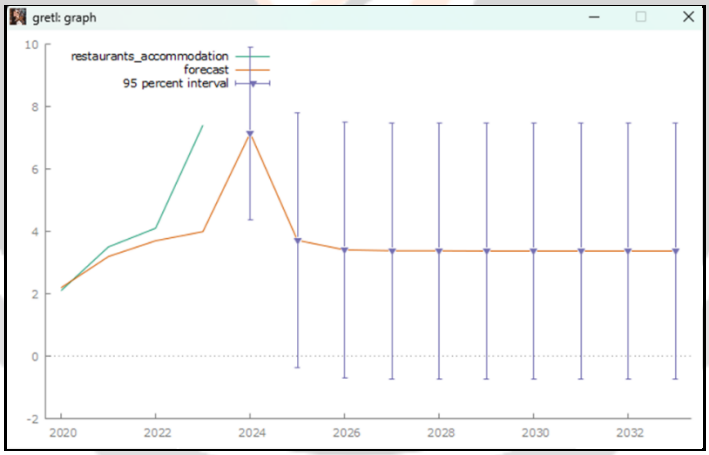

Chart -12: Forecasted Restaurants and Accommodation Services Commodity Group Inflation Rate (2024-2033)

Chart 12 shows the ten-year forecast for the inflation rate of restaurants and accommodation services commodity groups from 2024 to 2033 using ARIMA modeling. The historical data show a steady incline, reaching approximately 4% by 2022 and a peak of approximately 8% in 2023. The forecast predicts a decline in 2024, dropping sharply to around 3.5%, maintained throughout the forecast period. The 95% prediction interval is wide in the early forecast period, indicating considerable uncertainty that remains consistent in the later years despite stabilizing the predicted trend for this commodity group.

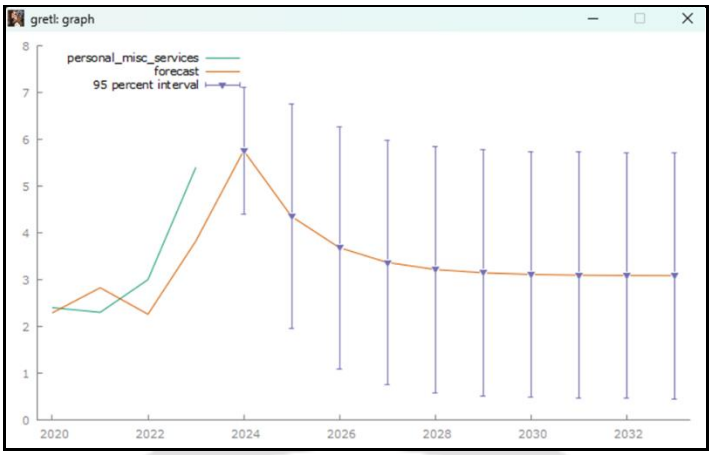

Chart -13: Forecasted Personal Care and Miscellaneous Goods and Services Commodity Group Inflation Rate (2024-2033)

Chart 13 shows the forecast for the inflation rate of personal care and miscellaneous goods and services commodity groups from 2024 to 2033 using ARIMA modeling. The historical data starts at around 2.5% and fluctuates slightly in the early period. By 2022, a noticeable incline begins, leading to a sharp peak at approximately 5.5% in 2023. The forecast predicts a gradual decline in the inflation rate at around 5% starting in 2024 and stabilizing at approximately 3.5% from 2025 onwards. The 95% prediction interval is narrow in the early years but widens in the succeeding years, suggesting increasing uncertainty despite the stabilization trend in this commodity group.

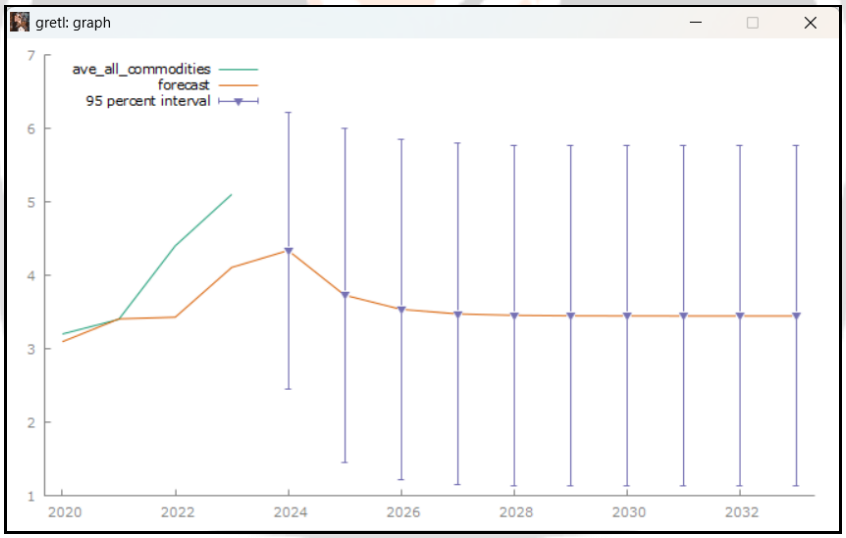

Chart -14: Forecasted Average Annual Inflation Rate for All Commodities (2024–2033)

Chart 14 shows the annual average inflation rate forecast for all commodities from 2024 to 2033 using ARIMA modeling. The historical data begins at around 3% and steadily increases, reaching approximately 5% in 2023. The forecast predicts an initial gradual decline in the inflation rate, dropping to about 3.5% in 2025 and further stabilizing the forecast horizon. The 95% prediction interval is relatively narrow in the early years. However, it significantly widens in the later years, which indicates higher confidence in the short-term predictions other than the increased uncertainty despite stabilization in the projected forecast.

5. CONCLUSIONS AND RECOMMENDATIONS

This study employed the ARIMA model to analyze and forecast inflation trends in the Philippines, focusing on 12 essential commodity groups using historical data from the Bangko Sentral ng Pilipinas. The results revealed instability in the inflation trend across different sectors. "Food and Non-alcoholic Beverages" and "Transport" show significant fluctuations and inclinations in the trends while indicating weakness in price volatility. On the other hand, "Alcoholic Beverages and Tobacco" showed signs of stabilization despite their consistently high inflation rates, and other essential commodity groups, such as housing and utilities, presented varying results with projected stabilization but consistent uncertainty.

Based on these findings, policymakers should concentrate on commodity groups that experience significant price increases by prioritizing programs and implementations to minimize their impact. Investing and establishing strategic help for basic food items to efficiently improve the supply chain and providing temporary, targeted subsidies for vulnerable households are possible actions the government can take. Implementation of strong monitoring and early warning systems in tracking inflationary trends should also be focused on to enable and prepare immediate policy responses.

For long-term economic resilience, the Philippines requires a multifaceted approach, which refers to the diversification of the economy such that dependency on imported goods is reduced, domestic production is encouraged for improved self-sufficiency, and alternative energy sources help reduce external shocks. In this regard, maintaining fiscal and monetary discipline is required to control inflationary pressures while providing stability to the economy. At the same time, financial literacy programs educate the consumer on the proper usage of financial tools to make the most informed choice possible in times of inflation. Doing so will help policymakers diminish some of the negative effects inflation has on Filipino families and businesses toward sustainable, all-inclusive economic growth.

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