

Kpkukumu, Kabineh; Barrie, Mohamed Samba

Working Paper

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# The Proposed Tollgate Price Hike's Potential Impact on Inflation in Sierra Leone: A Counterfactual Estimation

Kpukumu, Kabineh<sup>1</sup> and Barrie, Mohamed Samba<sup>2</sup>

## Abstract

This research investigates the potential impact of proposed tollgate price adjustments on inflation dynamics in Sierra Leone using a suite of Bayesian Vector Autoregressive (VAR) models with data from 2007M1 to 2024M1. Around 2015-2016, the government of Sierra Leone initiated a crucial road expansion project in partnership with China Railway Seventh Group Co., Ltd. (CRSG), aiming to improve transportation networks by extending the road from Wellington in Freetown to Masiaka in Port Loko District. As per the agreement, three tollgates were to be erected at strategic points along this expanded route: Hastings, Songo, and Masiaka. Despite maintaining stable tollgate prices since their inception in 2017, CSG has indicated recently that they want to revise the tollgate prices to reflect exchange rate depreciation, thus prompting an examination of this proposed move on inflation. Projections from the model simulations indicate that if the proposed toll gate price revisions are enacted in April 2024, transport inflation would surge by 1.55% month-on-month and by 5.3% year-on-year from April to July 2024 cumulatively. In dissecting the transport sector, our analysis revealed a clear pattern: without the tollgate effect, transport inflation showed a gradual upward trajectory. However, upon modeling the potential effects of the proposed tollgate price revisions, a sharp increase in transport inflation is observed. Moreover, food inflation is projected to experience a significant year-on-year rise of 7.15% cumulatively, while headline inflation is expected to increase by 4.62% over the period from April to June 2024. Furthermore, an examination of food inflation patterns revealed an interesting trend: before accounting for the toll gate effect, food inflation showed a declining trend over the observation period. However, upon factoring in the tollgate effect, while food inflation continued to decline, it did so at levels higher than would have been the case without the toll gate effect. These insights hold key policy implications, such as closely monitoring, communicating transparently, and coordinating responses to mitigate inflationary impacts and foster economic stability.

**Keywords:** Tollgate prices, Inflation dynamics, Bayesian VAR framework, Policy implications, Sierra Leone

**JEL Codes:** H54, L91, R42, E31, C11

**Disclaimer:** The views expressed in this research paper are those of the authors and do not necessarily reflect the official policy or position of the Bank of Sierra Leone.

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<sup>1</sup> *Modelling and Forecasting Section, Economic Modelling and Forecasting Division, Research and Statistics Department*

<sup>2</sup> *Macroeconomic Research Section, Policy Analysis Division, Research and Statistics Department*

## **1.1 Background**

The infrastructure development sector plays a pivotal role in fostering economic growth and development within any nation. Acknowledging the crucial role of infrastructure development in driving economic progress, the government of Sierra Leone initiated a substantial road expansion endeavor in partnership with the Chinese firm, China Railway Seventh Group Co., Ltd. (CRSG). The overarching objective of this collaborative effort was to bolster the nation's transportation networks by enlarging the roadway stretching from Wellington in Freetown to Masiaka in the Port Loko District. Within the framework of the agreement inked between the Sierra Leonean government and CRSG, plans were set in motion for the establishment of three toll gates strategically positioned along the extended route. These toll gates were earmarked for placement at designated locales: Hastings, Songo, and Masiaka. This coordinated effort aimed not only to improve connectivity but also to provide a sustainable funding mechanism for ongoing maintenance and infrastructure development.

The inauguration of the toll gates in August 2017 marked a pivotal moment in the project's progress. As per the contractual agreement to fund the road expansion, CRSG and the government devised a streamlined system for toll collection and management. To facilitate this process, vehicles traversing the expanded route were classified into six distinct groups, taking into account their dimensions, weight, and intended use. These categories encompassed a spectrum of vehicles, ranging from compact three-wheelers known as kekes to bulkier counterparts such as heavy trucks and mining vehicles. This categorization framework ensured a structured approach to toll collection, tailored to the varied characteristics of vehicles utilizing the roadway. The toll fee structure was designed to correspond with these vehicle categories, with prices set at NLe 1.00 for Group 1 vehicles, and up to NLe 250.00 for Group 6 vehicles. This pricing scheme remained unchanged from its inception in 2017 until March 2024, providing a stable framework for revenue generation and road maintenance funding.

Despite the stability of tollgate prices over the past few years, recent developments have sparked discussions regarding their upward revision. The current government has indicated that the contract signed with CRSG by the previous administration includes provisions for adjusting tollgate prices to account for exchange rate depreciation.

The proposed increment in tollgate prices, if implemented, could have far-reaching implications, particularly in terms of its potential impact on inflation. The increase in transportation costs associated with higher toll fees may lead to elevated prices of goods and services, thereby affecting the overall consumer price index. Understanding the potential repercussions of such a policy shift is crucial for policymakers, economists, and stakeholders involved in Sierra Leone's economic development. Therefore, this research aims to explore the impact of the proposed increment in tollgate prices on inflation through counterfactual estimation techniques.

The primary objective of this research is to assess the impact of the proposed increment in tollgate prices on inflation in Sierra Leone. To achieve this overarching goal, the study will pursue the following specific objectives: To analyze the current tollgate pricing structure and its implications for transportation costs. Secondly, to examine the relationship between tollgate prices, headline inflation, and the components of the Consumer Price Index. Finally, conduct counterfactual estimation exercises to simulate the potential impact of the proposed tollgate price increment on future inflation in the near term.

**Methodology:**

To estimate the impact of the proposed tollgate prices on inflation, we employed a statistical model based on the Bayesian Vector Autoregressive (VAR) framework. Additionally, we utilized the Bayesian Time-varying Vector Autoregressive approach to capture potential time-varying dynamics. The Bayesian VAR extends the traditional VAR model by integrating Bayesian inference techniques. In this framework, each variable's current value is modeled as a linear combination of its own lagged values and those of other variables in the system. Coefficients in the model represent contemporaneous relationships among the variables. Within the Bayesian VAR framework, prior distributions are specified for coefficients and other parameters. These priors are then updated with observed data using Bayes' theorem to derive posterior distributions, representing updated uncertainty about the parameters given the data. This approach enables estimation of the posterior distribution of coefficients, offering a range of plausible values for variable relationships. By incorporating prior knowledge or beliefs about parameters, the Bayesian VAR allows for uncertainty quantification.

We specified a Bayesian VAR model with a lag length of 12. Denoted as 'p', this lag length indicates the number of lagged observations included in the model. The general form of the Bayesian VAR model is as follows:

$$Y_t = \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \dots + \Phi_p Y_{t-p} + \varepsilon_t$$

Where:

$Y_t$  is a vector of endogenous variables at time  $t$

$\Phi_1, \Phi_2, \dots, \Phi_p$  are coefficient matrices

$\varepsilon_t$  is a vector of error terms at time  $t$

To conduct Bayesian VAR estimation, we needed to specify prior distributions for the coefficients and the error covariance matrix. To adjust for this we employed a Wishart prior, which is commonly used in Bayesian VAR estimation. For the Prior Distribution for Coefficients ( $\Phi$ ): we assumed a normal-inverse Wishart prior distribution for the coefficients, which is standard for Bayesian VAR estimation. For the Prior Distribution for Error Covariance Matrix ( $\Sigma$ ): we assumed an inverted Wishart prior distribution for the

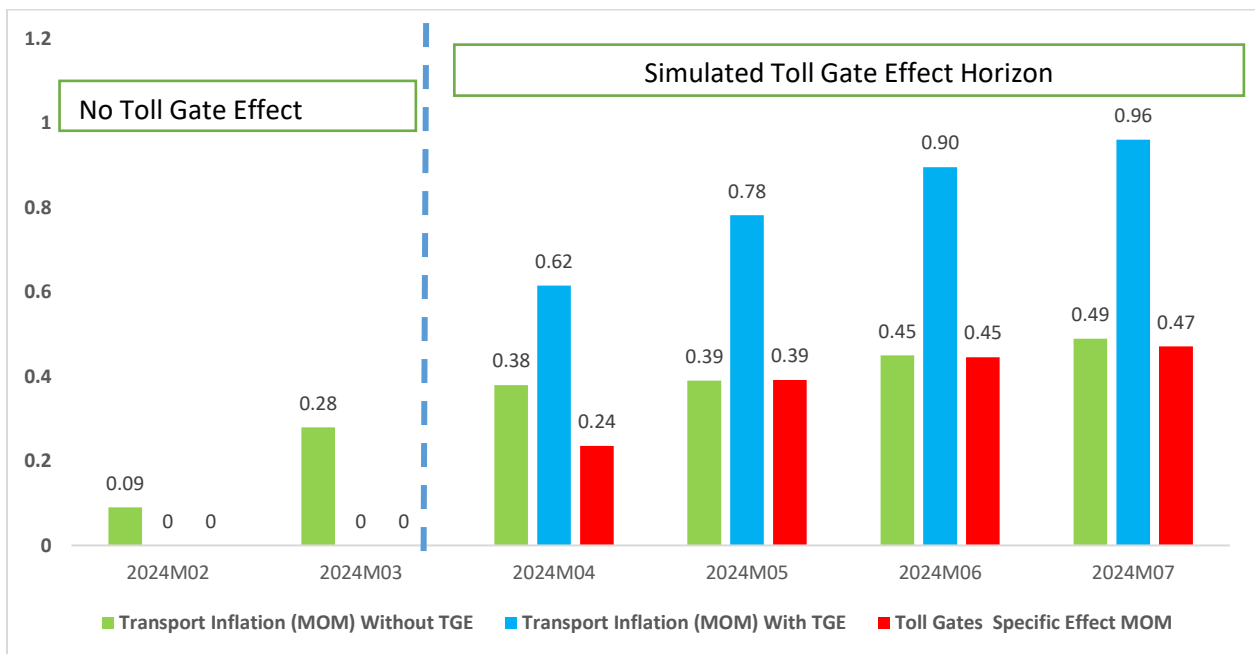
error covariance matrix. For the Lag Length Selection: We determine the appropriate lag length ( $p$ ) using the Akaike Information Criterion (AIC) since we aimed to forecast the effect of the Proposed Toll Gates Prices.

To accurately estimate the impact of the proposed increment in tollgate prices on inflation in Sierra Leone, we employed a Bayesian Vector Autoregressive (VAR) modeling approach. We used monthly data spanning from January 2007 to January 2024 in our analysis. This timeframe was chosen to ensure an adequate sample size that covers various economic conditions and captures potential long-term trends and seasonal patterns.

One critical aspect of our methodology was the inclusion of 12 lags in the VAR model. This decision was made to account for the potential lagged effects of tollgate price changes on inflation and to capture any delayed responses within the economic system. By incorporating multiple lags, we aimed to ensure that the model adequately captures the dynamics of the relationship between tollgate prices and inflation over time. Furthermore, it was imperative to ensure that the models passed the stability condition, a necessary prerequisite for employing Bayesian VAR models for forecasting and policy simulations. The stability condition ensures that the estimated parameters of the model produce reliable and consistent forecasts over time. To satisfy this condition, we conducted rigorous diagnostic tests and sensitivity analyses to identify and address any potential issues such as multicollinearity, autocorrelation, or model misspecification.

## Results and Analysis

**Figure1: Estimated Toll Gates Effect on Transport Inflation on a Month-on-Month Basis**



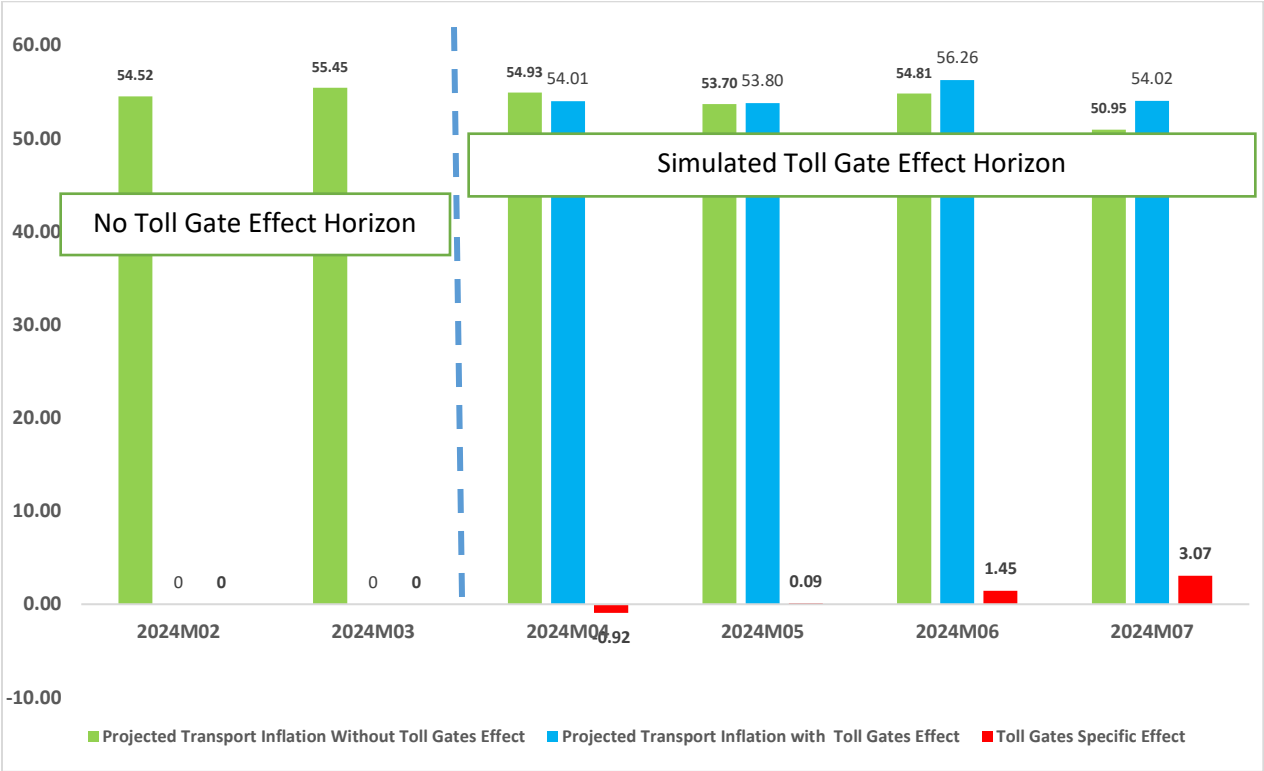
*Source: Authors' Computation from Model Results*

Figure 1 above reveals notable trends in transport inflation before and after the introduction of new proposed Tollgate Prices (TGE) in Sierra Leone. Before the Tollgate Effect (TGE) simulation, transport inflation exhibited a gradual increase, starting at 0.09 in February 2024 and peaking at 0.49 by July 2024. However, upon modeling the potential effects of the proposed upward revision of Tollgate Prices, a significant spike in transport inflation becomes evident, with values nearly doubling in certain months.

The projected Tollgate-specific effect accentuates the direct impact of TGE implementation on inflation. For instance, in April 2024, the specific effect registers at 0.24, indicating that 0.24% of the total transport inflation that month can be attributed directly to the Toll Gate Price increment. This effect magnifies over subsequent months, reaching 0.47 by July 2024.

The data suggests that the proposed increment in Tollgate Prices has a significant impact on inflation in Sierra Leone, particularly on transport-related inflation. The impact seems to intensify over time, indicating that the effects of the Tollgate Price increment might accumulate and exacerbate inflationary pressures.

**Figure 2: Estimated Toll Gates Effect on Transport Inflation on a Year-on-Year Basis**



*Source: Authors' Computation from Model Results*

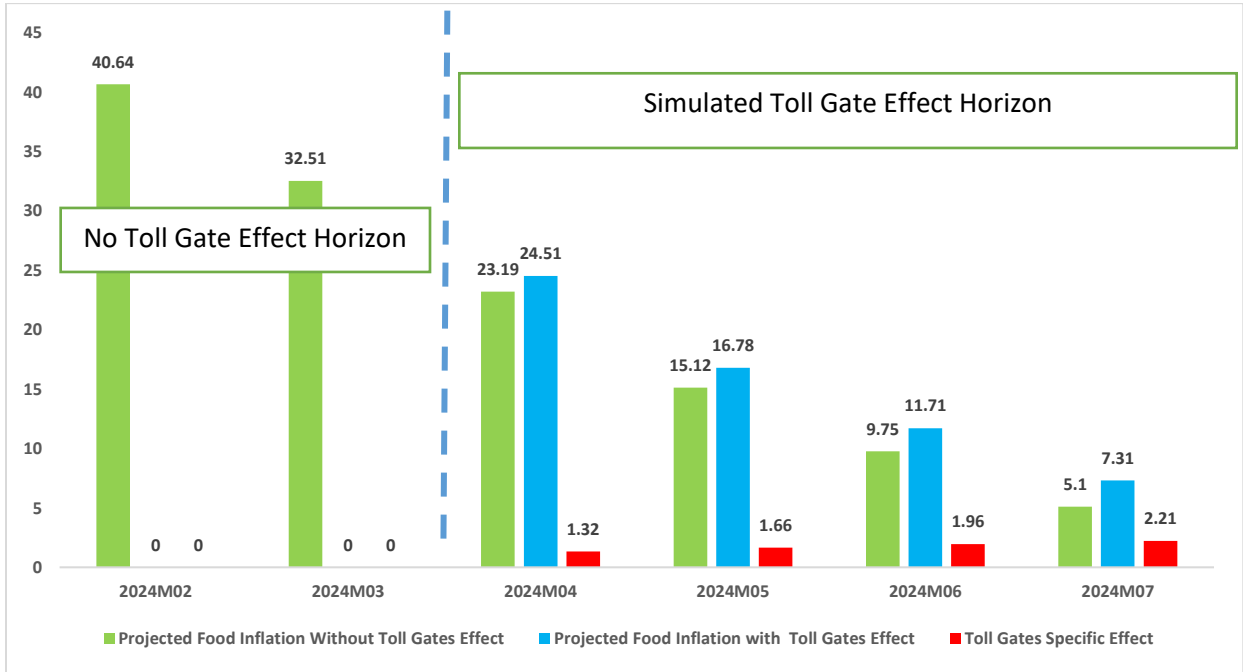
Figure 2 presents year-on-year projections of transport inflation with and without the Tollgates effect, along with the Tollgates specific effect. Initially, before considering the Tollgates effect, the projected transport

inflation exhibits variability across the months, starting at 54.52 in February 2024 and slightly fluctuating until reaching 50.95 in July 2024.

Upon incorporating the Tollgates effect, alterations in the projected transport inflation values become apparent. While in some months, such as April and May 2024, the inflation experiences a slight decrease compared to projections without the Tollgates effect, in others, notably June and July 2024, there is an observed increase in inflation when considering the Tollgates effect.

The Tollgate-specific effect is crucial in elucidating the direct impact of Tollgates on transport inflation. For instance, in April 2024, the Tollgates specific effect is negative (-0.92), signifying that the Toll Gates implementation is linked with a reduction in projected transport inflation by 0.92 percentage points. Conversely, in June and July 2024, the Toll Gates specific effect assumes positive values, indicating that the Toll Gates implementation contributes to an augmentation in projected transport inflation by 1.45 and 3.07 percentage points, respectively.

**Figure 3: Estimated Toll Gates Effect on Year-on-Year Food Inflation**



*Source: Authors’ Computation from Model Results*

Figure 3 above provides insights into the year-on-year projections of food inflation with and without the Tollgate effect, alongside the Tollgate-specific effect.

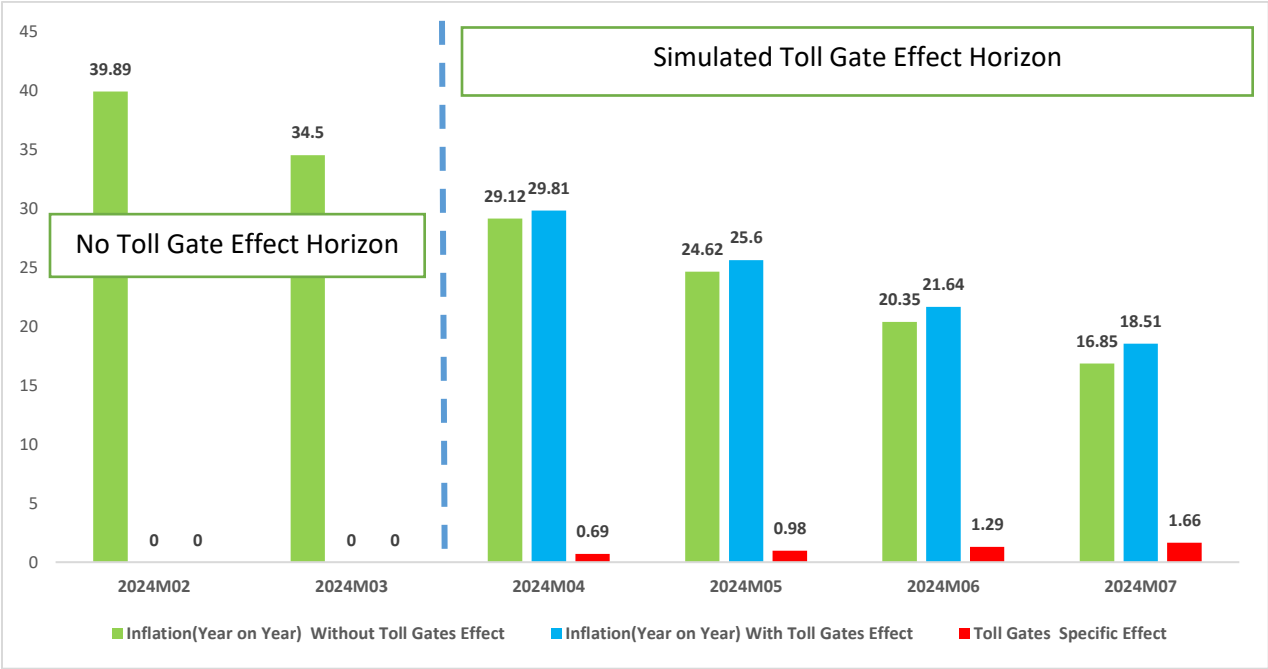
Before considering the Tollgate effect, the projected food inflation demonstrates a decreasing trend over the months. It begins at 40.64 in February 2024 and steadily declines to 5.10 by July 2024.

When factoring in the Tollgate effect, the projected food inflation values generally increase compared to projections without the Tollgate effect. In April 2024, for instance, the inflation with the Tollgate effect slightly surpasses that without Tollgates, with values of 24.51 and 23.19, respectively. This trend persists with higher values in May, June, and July 2024.

The Tollgate-specific effect indicates the direct impact of Tollgates on food inflation, calculated as the difference between projected food inflation with and without Tollgates effect. In April 2024, this effect is positive (1.32), meaning that Tollgates implementation contributes to a 1.32 percentage point increase in projected food inflation. This effect intensifies in subsequent months, with Tollgates contributing to increases of 1.66, 1.96, and 2.21 percentage points in May, June, and July 2024, respectively.

Overall, the data suggests that the implementation of the revised Tollgate prices has a notable impact on projected food inflation, leading to higher inflationary pressures within the food sector. The Tollgates specific effect consistently shows a positive contribution to food inflation, indicating that Tollgate price implementation exacerbates inflation within the food market.

**Figure 4: Estimated Toll Gates Effect on Year-on-Year Inflation**



*Source: Authors’ Computation from Model Results*

Figure 4 presents year-on-year figures for headline inflation with and without the Tollgates effect, along with the Tollgates specific effect.

Before considering the Tollgates effect, the headline inflation (year-on-year) demonstrates a downward trend over the months. It starts at 39.89 in February 2024 and gradually decreases to 16.85 by July 2024.



Upon factoring in the Tollgate effect, the headline inflation (year-on-year) values generally increase compared to scenarios without Tollgates. In April 2024, for example, the inflation with Tollgates effect slightly exceeds that without Tollgates, with values of 29.81 and 29.12, respectively. This trend continues with higher values in May, June, and July 2024.

The Tollgate-specific effect indicates the direct impact of Tollgates on headline inflation, calculated as the difference between headline inflation with and without the Tollgates effect. In April 2024, the Tollgates-specific effect is positive (0.69), meaning that the Tollgates implementation contributes to an increase in headline inflation by 0.69 percentage points. This effect intensifies in subsequent months, with Tollgates contributing to increases of 0.98, 1.29, and 1.66 percentage points in May, June, and July 2024, respectively. Overall, the data suggests that the implementation of the revised Tollgates prices has a notable impact on headline inflation, leading to higher inflationary pressures within the economy. The Tollgates-specific effect consistently shows a positive contribution to headline inflation, indicating that Tollgates implementation exacerbates inflation within the economy. This indicates that Tollgates are associated with an increase in headline inflation, which may have implications for monetary policy and overall economic stability.

### **Conclusion and Policy Implications**

Our research examined the significant impact of proposed tollgate price adjustments on inflation dynamics in Sierra Leone. Employing a Bayesian Vector Autoregressive (VAR) model, we analyzed the complex relationships between tollgate prices and inflation metrics, providing crucial insights for policymakers and stakeholders.

Our investigation reveals a significant correlation between tollgate price adjustments and inflationary pressures, notably prominent in the transport and food sectors. Specifically, tollgate price revisions exhibit a direct link with inflation metrics. Simulations conducted suggest that if the proposed tollgate price revisions are implemented in April 2024, transport inflation would surge by 1.55% month-on-month and by 5.3% year-on-year from April to July. Additionally, food inflation would witness a substantial rise of 7.15% year-on-year, while headline inflation would experience a 4.62% increase over the same period.

In dissecting the transport sector, our analysis unveils a clear pattern: before the implementation of revised tollgate prices, transport inflation showed a gradual upward trajectory. However, upon modeling the potential effects of the proposed tollgate price revisions, a sharp increase in transport inflation became evident. This underscores a direct correlation between tollgate price adjustments and inflationary pressures within the transport sector, with the tollgate-specific effect serving as a crucial indicator of this relationship. Similarly, our examination of food inflation patterns elucidates a noteworthy trend. Before factoring in the tollgate effect, food inflation exhibited a declining trend over the observation period. Yet, upon considering

the tollgate effect, food inflation experienced an upward shift, signifying the significant impact of tollgate price revisions on food prices. The Tollgates specific effect further quantifies this impact, emphasizing the direct contribution of tollgate price adjustments to food inflation.

Furthermore, our analysis extends to headline inflation, where we observe a consistent increase in inflationary pressures following the incorporation of tollgate effects. The tollgate-specific effect reveals a direct positive relationship between tollgate price adjustments and headline inflation, highlighting the broader economic implications of tollgate policy changes.

***Inflation Policy Response:*** Given the significant impact of tollgate price adjustments on inflation dynamics, monetary policymakers must closely monitor these changes and incorporate them into their inflation-targeting frameworks. Adjustments in tollgate prices should be factored into the assessment of inflationary pressures, guiding The Bank of Sierra Leone's policy response.

***Interest Rate Decisions:*** The Bank of Sierra Leone may need to consider adjusting interest rates in response to changes in tollgate prices and their resultant effects on inflation. If tollgate price increments lead to sustained upward pressure on inflation, the central bank may need to implement tighter monetary policies, such as raising interest rates, to counteract inflationary tendencies.

***Monitoring Transmission Channels:*** Monetary policymakers should closely monitor the transmission channels through which tollgate price adjustments impact inflation. This includes assessing the pass-through effects of tollgate price changes on various sectors of the economy, such as transportation, food, and overall consumer prices, to better understand the dynamics of inflationary pressures.

***Forward Guidance:*** The Bank of Sierra Leone should provide clear and transparent forward guidance regarding its policy stance in light of tollgate price adjustments. Communicating the central bank's assessment of the impact of tollgate prices on inflation and outlining potential policy responses can help anchor inflation expectations and guide market participants.

***Communicating Policy Trade-Offs:*** The Bank should communicate the potential trade-offs associated with monetary policy decisions in response to tollgate price adjustments. Policy actions aimed at stabilizing inflation may have implications for other macroeconomic variables, such as economic growth and employment. Clear communication about these trade-offs can enhance public understanding and support for monetary policy decisions.

***Policy Flexibility and Agility:*** Given the uncertainty surrounding the magnitude and timing of tollgate price adjustments and their inflationary impact, The Bank of Sierra Leone should maintain policy flexibility and agility. This may involve adopting a data-dependent approach to policy-making and being prepared to adjust policy measures as new information emerges regarding tollgate price dynamics and their inflationary consequences.