

The Impact Of The Pay-As-You-Throw System On Consumers' Environmental Behavior: An Empirical Study Of South Korea's Experience And The Potential For Its Implementation In Algeria

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Received: 04/04/2026

Accepted: 23/04/2026

Published: 05/06/2026

Abstract :

This study aims to analyze the impact of the Pay-As-You-Throw system on consumers' environmental behavior through an econometric examination of South Korea's experience during the period 1990–2022, while assessing the potential implementation of this system in Algeria.

Using a Vector Autoregressive (VAR) model, the study investigates the dynamic relationship between household waste generation and several socio-economic variables, including GDP per capita, and a dummy variable representing environmental pricing policy. The findings indicate that the (PAYT) system significantly reduces unsegregated waste and fosters pro-environmental behavior, particularly in the long run, though its short-term effects remain limited. The successful adoption of (PAYT) in Algeria depends on improving waste management infrastructure, enhancing public awareness, and ensuring social fairness in waste pricing.

The study recommends adopting market-based environmental policies such as (PAYT) to promote environmental and economic sustainability in waste management.

Keywords: Algeria, Environmental Behavior, Pay-As-You-Throw (PAYT), VAR Model, Waste Management Policy.

JEL Classification : Q53, Q52, Q01

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Introduction :

Waste management has become one of the most pressing environmental and economic challenges facing contemporary societies, particularly in the context of rising consumption patterns and rapid urbanization. In response to these pressures, the Pay-As-You-Throw (PAYT) system has emerged as a policy instrument rooted in the “polluter pays” principle, designed to incentivize households to reduce waste generation and adopt more responsible environmental behaviors. Empirical evidence from international experiences, especially in South Korea and several European countries, suggests that this approach is effective in increasing recycling rates while significantly reducing unsorted waste. Against this backdrop, the present study

examines the Korean experience as a reference framework and investigates the potential applicability of this system in Algeria, in line with its broader commitment to achieving the Sustainable Development Goals. The central research question guiding this inquiry is whether the implementation of the Pay-As-You-Throw system can effectively reduce household waste generation and stimulate recycling within an emerging economic context such as Algeria. To address this question, the study advances several testable hypotheses: first, that the Pay-As-You-Throw system (DUM) exerts a statistically significant negative effect on the per capita quantity of household waste generated (LOGMSW); second, that economic growth (LOGGDP) positively influences waste generation; third, that household expenditure (LOGPCE) contributes to increased waste production; fourth, that urbanization (LOGUS) leads to higher levels of waste generation; and fifth, that the implementation of an environmental pricing policy fosters improved environmental behavior and reduces waste generation in the long run. Accordingly, the study aims to assess the econometric impact of PAYT on consumer environmental behavior in South Korea over the period 1990–2022, while also evaluating the feasibility of its adoption in Algeria by identifying the necessary conditions and determinants for successful implementation. Methodologically, the analysis relies on time series data spanning 1990–2022 and employs a vector autoregression (VAR) model to capture the dynamic interactions among the relevant economic and social variables. This empirical strategy allows for a nuanced understanding of how environmental pricing mechanisms influence behavioral change in waste management and provides a robust basis for assessing the transferability of the Korean model to the Algerian context.

I. Review of Applied Literature

Pay-As-You-Throw (PAYT) systems, under which households pay waste disposal fees according to the quantity of waste they generate, are among the widely used policy instruments aimed at encouraging waste reduction and promoting responsible environmental behavior. The following section provides an extended overview of empirical studies that address South Korea as a benchmark case, alongside evidence from other countries, as well as selected examples from emerging economies, including Algeria.

1. Studies from South Korea and Other Regions

Econometric studies in South Korea indicate that the implementation of the Volume-Based Waste Fee System (VWF) has significantly contributed to increasing municipal solid waste (MSW) recycling rates. Both economic incentives and environmentally friendly behaviors have played a central role in enhancing recycling rates and reducing the overall volume of waste generation (Park, 2018).

Studies conducted in Europe and North America have confirmed these findings, showing that Pay-As-You-Throw systems often lead to a significant decline in unsorted waste, an increase in recycling rates, and the realization of financial savings for municipalities (Colussi et al., 2022; Houtven & Morris, 1999; Messina & Tomasi, 2020).

However, the effectiveness of these systems varies across countries depending on system design (weight-based or volume-based), the level of public acceptance, and the availability of adequate infrastructure (Bilitewski, 2008; Emmanouil et al., 2022; Morlok et al., 2017; Reichenbach, 2008; Ukkonen & Sahimaa, 2021; Yao & Zhou, 2023).

Economic incentives, such as cost reductions through system-specific plastic waste bags, along with alleviating the financial burden on households, are among the main factors motivating positive recycling behavior.

Similar results have been observed in other Asian cities such as Taipei and Tokyo, where pricing policies have led to a substantial reduction in unsorted waste and an increase in recycling rates.

Pay-As-You-Throw systems in Europe and North America have also shown reductions in total waste generation of up to 40% and increases in recycling rates of up to 28%, in addition to achieving financial savings for municipalities (Colussi et al., 2022; Houtven & Morris, 1999; Messina & Tomasi, 2020).

The effectiveness of the system depends on the adopted pricing model (based on weight, volume, or number of bags), the level of public acceptance, and the availability of infrastructure supporting recycling and composting processes (Bilitewski, 2008; Emmanouil et al., 2022; Morlok et al., 2017; Reichenbach, 2008; Ukkonen & Sahimaa, 2021; Yao & Zhou, 2023).

Public awareness and transparent communication are also considered decisive factors for the successful implementation of the system (Emmanouil et al., 2022; Yao & Zhou, 2023).

The evidence clearly demonstrates the effectiveness of Pay-As-You-Throw systems in reducing unsorted waste and increasing recycling rates across various contexts, including South Korea, Europe, and North America (Colussi et al., 2022; Houtven & Morris, 1999; Messina & Tomasi, 2020; Ukkonen & Sahimaa, 2021).

The South Korean experience highlights that economic incentives, when combined with pro-environmental behaviors and robust infrastructure, can achieve high recycling rates and a tangible reduction in total waste generation (Park, 2018).

Nevertheless, the success of the system depends largely on careful design, public acceptance, and the continuity of awareness-raising and effective communication efforts (Bilitewski, 2008; Emmanouil et al., 2022; Morlok et al., 2017; Reichenbach, 2008; Yao & Zhou, 2023).

The literature also emphasizes the importance of adapting Pay-As-You-Throw systems to local socio-economic characteristics and ensuring fairness in fee structures in order to secure social acceptance and institutional sustainability of the system (Arista et al., 2023; Emmanouil et al., 2022; Yao & Zhou, 2023).

2. Studies in Algeria

Studies conducted in Algeria and other emerging economies indicate that households show a willingness to adopt Pay-As-You-Throw systems, particularly when such systems are perceived as fair and transparent and are accompanied by effective communication and clear environmental awareness efforts (Arista et al., 2023; Lahoy & Rapiz, 2025; Lu et al., 2024; Taleb & Al Farooque, 2021).

Nevertheless, the implementation process faces several challenges, including administrative complexities, the potential increase in illegal dumping, as well as the need for robust infrastructure and effective participation from various stakeholders (Dunne et al., 2008; Emmanouil et al., 2022; Lahoy & Rapiz, 2025; Reichenbach, 2008).

Although the prospects for adopting the system in Algeria are promising, policymakers are required to address several challenges, most notably administrative complexities and the potential aggravation of illegal dumping, while taking into account local socio-economic factors, willingness to pay, and the need for effective communication and environmental education strategies, enhanced stakeholder participation, and the development of supporting infrastructure (Arista et al., 2023; Lahoy & Rapiz, 2025; Lu et al., 2024; Taleb & Al Farooque, 2021).

A review of the existing literature reveals a clear concentration of applied studies on Pay-As-You-Throw systems in developed countries, such as South Korea and European Union member states, whereas this topic remains scarcely examined in the context of emerging economies, particularly in the Arab world and Algeria specifically.

Moreover, most previous studies have focused on the environmental or technical aspects of the system, while largely overlooking quantitative economic analyses of consumer behavior under environmental pricing policies.

From this perspective, the present study seeks to fill this gap by applying an analytical econometric approach (VAR) to measure the impact of the system on consumer environmental behavior and to explore the possibility of adapting this system to Algeria in line with its economic and social specificities.

II. Econometric Analysis

In this section, we present the applied aspect of the study by examining the impact of the volume-based waste fee system in Korea on consumer environmental behavior. The objective is to identify and explain the relationship between the study variables over the period 1990–2022, as follows.

1. Study Variables and Data Sources

To analyze the impact of the volume-based waste fee system on consumer environmental behavior and to address the research question, annual time-series data consisting of 33 observations for the period 1990–2022 were used. All data were obtained from KOSIS, the OECD, the World Bank, and the Ministry of Environment (VBWF policy) for the variables included in the study.

1.1 Dependent Variable (Consumer Environmental Behavior)

Consumer environmental behavior is measured by the logarithm of the amount of household waste generated per capita. This variable is denoted as LOGMSW.

1.2 Independent Variables

Several independent variables are used, as follows:

- **LOGW:** Logarithm of waste per USD 1,000;
- **LOGGDP:** Logarithm of gross domestic product per capita;
- **LOGPCE:** Logarithm of household final consumption expenditure;
- **LOGUS:** Logarithm of the urban population share;
- **DUM:** A dummy variable representing the implementation of the environmental pricing policy, which takes the value 0 before the implementation of the environmental pricing policy (before 1995) and the value 1 after the implementation of the environmental pricing policy (starting from 1995).

2. Stationarity of the Study Variables

Through this test, the order of integration of the study variables is determined using the Augmented Dickey–Fuller (ADF) test. The results of this test can be summarized in the following table.

**Table 1 : « Summary of the Augmented Dickey Fuller (ADF) Test for Examining the Stationarity of Variables »**

Decision	At the second-difference			At the first-difference					Variable
	At the level of					With constant and trend	With constant	Without constant and trend	
	With constant and trend	With constant	Without constant and trend	With constant and trend	Without constant and trend				
	t-statistic probability								
(I1)	/	/	/	-6.0427	-	-	-3.4505	-	LOGMSW
				0.0001	4.0042	3.8687	0.0163	1.2620	
					0.0043	0.0004		0.1861	
(I1)	/	/	/	-5.5361	-	-	-5.3776	-	LOGWI
				0.0005	3.2796	2.5685	0.0001	5.0601	
					0.0247	0.0120		0.0000	
(I2)	-	-5.7928	-7.2955	-4.8256	-	-	-4.3290	-	LOGGDP
	7.0608	0.0001	0.0000	0.0031	5.4126	1.8255	0.0021	0.8237	
	0.0000				0.0001	0.0653		0.3850	
(I1)	/	/	/	-5.1832	-	-	-2.5379	0.7992	LOGPCE
				0.0012	5.3180	5.2594	0.1166	0.8803	
					0.0001	0.0000			
(I2)	-	-4.6590	-4.5643	-1.8044	-	-	-1.9160	0.0461	LOGUS
	4.7931	0.0008	0.0000	0.6773	2.0776	2.4304	0.3209	0.6988	
	0.0031				0.2545	0.0169			

Source: Prepared by the researcher based on outputs from EViews 12.

Based on the results presented in the table above, the time series of the study variables, according to the Augmented Dickey–Fuller (ADF) test, are non-stationary at level and therefore contain a unit root, as the significance levels are greater than 0.05. The variables LOGMSW, LOGWI, and LOGPCE become stationary at the first difference, since their significance levels are less than 0.05. In contrast, the variables LOGGDP and LOGUS become stationary at the second difference, as their significance levels are also below 0.05.

Given that the study variables are stationary at the first and second differences, it is appropriate to adopt a Vector Autoregression (VAR) model, which can be applied in such cases of stationarity. Furthermore, due to the difference in the orders of integration among the model variables (I(1) and I(2)), the necessary conditions for conducting a cointegration test are not met. Accordingly, it can be concluded that there is no possibility of cointegration among the study variables.

III. Estimation of the Vector Autoregression (VAR) Model

Before estimating the Vector Autoregression (VAR) model, it is necessary to determine the appropriate lag length. Based on a set of criteria used to identify the optimal number of lags, the results indicate that the suitable lag length for estimating the VAR model is two time lags (Lag = 2). The corresponding results are presented in the following table.

Table 2 : «Determining the Lag Length for the VAR(2) Model VAR Lag Order Selection Criteria»

Endogenous variables: LOGMSW LOGWI LOGGDPP LOGPCE LOGUS DU

Exogenous variables: C

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Sample: 1990 2022

Included observations: 31

Lag	LogL	LR	FPE	AIC	SC	HQ
0	368.4741	NA	2.81e-18	-23.38543	-23.10788	-23.29495
1	569.7201	311.6066	6.91e-23	-34.04646	-32.10363*	-33.41314
2	618.8871	57.0972*	3.92e-23*	-34.89594*	-31.28785	-33.71979*

Source: Prepared by the researcher based on outputs from EViews 12.

After determining the optimal lag times for the model, we move to the next methodological stage, which is model estimation. For this purpose, we will rely on the results of estimating a second-order autoregressive vector model (VAR(2)) using the Ordinary Least Squares (OLS) method. Equation 1 (derived from Appendix 1) shows the dynamic relationship of the logarithm of the amount of household waste produced per capita (LOGMSW) as a function of its lag values and the lag values of the independent variables in the model (LOGWI, LOGGDPP, LOGPCE, LOGUS, DUM) at two lag times. This equation can be expressed in its standard form as follows:

$$\begin{aligned}
 \text{LOGMSW} = & 0.988682 * \text{LOGMSW}(-1) - 2.733924 * \text{LOGMSW}(-2) \\
 & - 0.456884 * \text{LOGWI}(-1) + 2.823420 * \text{LOGWI}(-2) \\
 & - 0.336272 * \text{LOGGDPP}(-1) + 3.126494 * \text{LOGGDPP}(-2) \\
 & + 0.563317 * \text{LOGPCE}(-1) - 0.244654 * \text{LOGPCE}(-2) \\
 & + 5.422699 * \text{LOGUS}(-1) - 10.75150 * \text{LOGUS}(-2) \\
 & + 0.122940 * \text{DUM}(-1) + 0.015270 * \text{DUM}(-2) + 4.551810
 \end{aligned}$$

Based on Equation (1) and Appendix (1), the following results can be derived:

1. The results indicate the absence of statistically significant relationships between LOGMSW and its lagged values, as well as the lagged values of the variables LOGWI, LOGGDPP, LOGPCE, LOGUS, and DUM, at two time lags. This is because all calculated Student's *t*-values for these variables are lower than the corresponding critical *t*-values at the 5% significance level. This outcome is mainly attributed to the large number of estimated parameters resulting from the inclusion of lagged terms, which reduces the degrees of freedom and, consequently, weakens the statistical significance of the coefficients. However, the main importance of this type of model lies in analyzing the dynamic behavior of variables, as well as in studying shocks and impulse response functions.
2. The model exhibits overall statistical significance, as indicated by the Fisher test, given that the calculated probability value exceeds the tabulated value.
3. The coefficient of determination ($R^2 = 0.957331$) indicates that approximately 95.73% of the variations in LOGMSW are explained by its own lagged values and the lagged values of the variables LOGWI, LOGGDPP, LOGPCE, LOGUS, and DUM at two time lags. The remaining 4.27% is attributed to other factors that are not included in the model.

IV. Diagnostic Tests of the VAR(2) Model

After estimating the VAR(2) model, a set of diagnostic tests was conducted to assess the validity and adequacy of the model, as follows:

1. Normality Test

To examine whether the residuals follow a normal distribution, the Jarque–Bera test was applied. The results show that the probability value is greater than the 5% significance level. Accordingly, the null hypothesis is accepted, indicating that the residuals are normally distributed (see Appendix 2).

2. Autocorrelation Test

To detect the presence of autocorrelation in the residuals, the test based on the F-statistic probability value was used. Since this probability exceeds the 5% significance level, the null hypothesis is accepted, suggesting that there is no problem of autocorrelation in the residuals (see Appendix 3).

3. Heteroskedasticity Test

With regard to the stability of variance, the probability value of the F-statistic is also greater than the 5% significance level. Therefore, the null hypothesis of homoskedasticity is accepted, indicating that the variance of the residuals is stable (see Appendix 4).

4. Variance Decomposition

The importance of variance decomposition lies in measuring the proportion of the forecast error variance of a given variable that is attributable to shocks arising from each variable in the model, individually and over successive periods within the forecasting horizon. The following table presents the results of the forecast error variance decomposition for the logarithm of household waste generated per capita (consumer environmental behavior) over a ten-year forecast period.

Table 3 : «Fractionation of the prediction error variance for the logarithm variable of the amount of household waste produced per individual»

Period	S.E.	LOG MSW	LOG WI	LOGG DPP	LOG PCE	LOG US	DUM
1	0.03 3433	100.0 000	0.000 000	0.0000 00	0.000 000	0.000 000	0.000 000
2	0.04 1673	76.88 530	3.298 725	2.7533 63	8.377 527	3.199 917	5.485 166
3	0.04 8795	66.85 609	7.513 741	2.1514 90	12.28 623	6.241 833	4.950 613
4	0.05 3499	58.29 132	13.23 259	4.3317 67	12.24 910	7.631 639	4.263 582
5	0.05 6288	53.27 008	17.87 816	5.6834 21	11.38 013	7.224 176	4.564 024
6	0.05 9866	47.63 575	21.98 903	9.3937 44	10.13 824	6.426 182	4.417 051
7	0.06 3133	43.22 423	24.37 131	13.286 82	9.128 462	5.997 852	3.991 328
8	0.06 6075	39.73 363	25.80 258	16.655 68	8.420 252	5.742 954	3.644 917
9	0.06 8373	37.21 220	26.61 879	18.605 29	8.439 345	5.718 133	3.406 236
10	0.07 0493	35.06 997	27.16 122	19.390 47	9.141 499	5.995 351	3.241 490

Source: Prepared by the researcher based on the outputs of (Eviews 12)

Based on Table (03), it is clear that when a shock occurs in the variables LOGWI, LOGGDPP, LOGPCE, LOGUS, and DUM, no immediate fluctuations are observed in the logarithm of household waste generated per capita (LOGMSW). Instead, fluctuations in LOGMSW are initially explained entirely by shocks to the variable itself, accounting for 100% of its forecast error variance.

In the second period, a shock to the logarithm of waste per USD 1,000 (LOGWI) explains about 3.29% of the forecast error variance of LOGMSW, which represents a very weak contribution. Similarly, a shock to the logarithm of GDP per capita (LOGGDPP) contributes approximately 2.75%, which is also relatively low. In

contrast, a shock to the logarithm of household final consumption expenditure (LOGPCE) explains about 8.37% of the variance, a comparatively acceptable contribution relative to the other independent variables. The contribution of the logarithm of the urban population share (LOGUS) is around 3.19%, while the dummy variable representing the implementation of the environmental pricing policy (DUM) contributes approximately 5.48%, which remains weak but acceptable when compared to the other explanatory variables. Meanwhile, the contribution of LOGMSW itself remains high at about 76.88%.

In the long run, a shock to LOGWI explains approximately 27.16% of the forecast error variance of LOGMSW, making it the most influential independent variable. This is followed by LOGGDPP, which contributes around 19.39%. The contribution of LOGPCE reaches about 9.14%, while that of LOGUS is approximately 5.99%. The contribution of the dummy variable DUM, which captures the implementation of the environmental pricing policy, declines in the long run to about 3.14%. Although the contribution of shocks to LOGMSW itself decreases over time, it remains the most important source of variation in the long run, accounting for approximately 35.06% of the total variance.

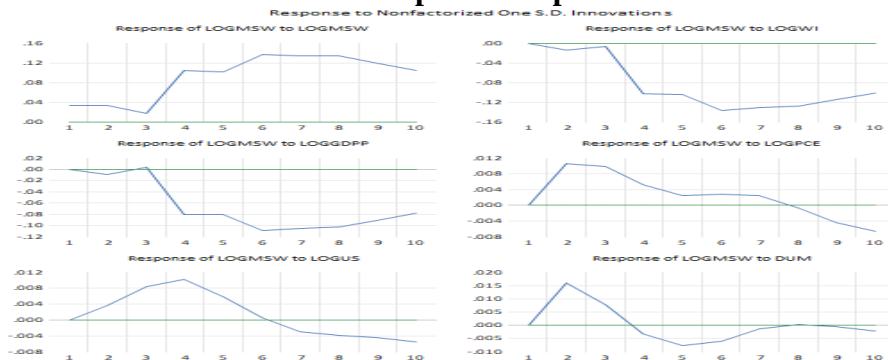
5. Impulse Response Function Analysis

The impulse response function analysis aims to examine the dynamic behavior of the logarithm of household waste generated per capita (LOGMSW) by measuring the effect of a one-standard deviation shock in one of the model variables on the current and future values of all variables in the system.

The results confirm the same findings obtained earlier from the variance decomposition analysis. They show that LOGMSW is mainly affected by shocks to its own values, as well as by changes in LOGWI and LOGGDPP. In contrast, the response of LOGMSW to shocks in the remaining variables appears to be relatively weak.

The following figure illustrates these dynamic responses.

Fig 1 : «Response functions for the variable logarithm of the amount of household waste produced per individual»



Source: Prepared by the researcher based on the outputs of (Eviews 12)

Conclusion

This study concludes that the Pay-As-You-Throw system stands among the most effective policy instruments for fostering responsible environmental behavior and curbing household waste generation, as evidenced by South Korea's experience over the period spanning 1990 to 2022. Estimations derived from the Vector Autoregression model reveal that the system exerts a meaningful positive influence on reducing unsorted waste volumes and strengthening environmental awareness over the long run, though its effects remain comparatively modest in the short term. The analysis further demonstrates that macroeconomic variables, particularly GDP and household expenditure, account for a considerable share of the observed variation in environmental behavior, albeit to differing degrees across the estimation horizon.

With respect to hypothesis testing, the empirical findings lend robust support to the central hypothesis, confirming a statistically significant inverse relationship between the application of environmental pricing mechanisms and per capita waste generation. This outcome reinforces the systemic capacity of the Pay-As-You-Throw model to induce behavioral change at the household level. The subsidiary hypotheses are likewise validated, as economic growth and household consumption patterns are shown to correlate positively with increased waste output, while urbanization, though directionally consistent with expectations, produces a relatively subdued effect.

Turning to the Algerian context, the study suggests that the adoption of a Pay-As-You-Throw framework is not only technically viable but holds considerable policy promise. Nevertheless, translating this potential into tangible outcomes presupposes the development of adequate physical infrastructure, the establishment of equitable waste pricing structures, and the sustained delivery of environmental education initiatives. Equally critical is the active engagement of local stakeholders across institutional and community levels, without which broad public acceptance and long-term program sustainability would be difficult to secure.

Drawing on the econometric evidence and the lessons distilled from comparative international experience, the South Korean model in particular, the study advances a set of policy recommendations tailored to Algeria's current waste management landscape. Priority should be given to designing a graduated environmental pricing scheme that is sensitive to socioeconomic disparities among households, thereby ensuring both distributional fairness and broad social acceptability. Parallel investment in waste management infrastructure, encompassing selective collection networks, recycling facilities, and composting capacity, is equally indispensable to the operational effectiveness of the system. Beyond infrastructure, sustained public awareness and environmental literacy campaigns are essential to cultivating the community engagement necessary for meaningful behavioral transformation. The study further underscores the importance of institutionalizing robust monitoring and evaluation frameworks capable of tracking system performance and informing adaptive policy adjustments grounded in efficiency and sustainability criteria. Mobilizing public-private partnerships to co-finance and co-manage waste-related

ventures would not only relieve fiscal pressure on public authorities but also stimulate innovation and catalyze investment in green technologies. Finally, harmonizing national environmental legislation with prevailing international standards is imperative to ensuring coherence between domestic policy frameworks and the imperatives of the 2030 Sustainable Development Goals.

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Appendices:**Appendix 1 : Estimation of Model (2)VAR**

Vector Autoregression Estimates

Date: 10/23/25 Time: 21:13

Sample (adjusted): 1992–2022

Included observations: 31

Standard errors in () & t-statistics in []

Variable	LOGMSW	LOGWI	LOGGDPP	LOGPCE	LOGUS	DUM
LOGMSW(-1)	0.988682 (2.14669) [0.46056]	-1.118898 (2.05200) [-0.54527]	1.777731 (1.76679) [1.00619]	1.142727 (1.20165) [0.95097]	0.023809 (0.04265) [0.55821]	12.79645 (8.29682) [1.54233]
LOGMSW(-2)	-2.733924 (2.58157) [-1.05902]	-4.764114 (2.46770) [-1.93059]	1.547234 (2.12471) [0.72821]	-2.026222 (1.44508) [-0.70115]	0.086916 (0.05129) [1.69446]	13.87793 (9.97761) [1.39091]
LOGWI(-1)	-0.456884 (2.11460) [-0.21606]	1.655130 (2.02133) [0.81883]	-1.783075 (1.74038) [-1.02453]	-1.156658 (1.18369) [-0.97717]	-0.032639 (0.04202) [-0.77681]	-12.81159 (8.17281) [-1.56579]
LOGWI(-2)	2.823420 (2.58784) [1.09103]	5.006323 (2.47369) [2.02383]	1.695688 (2.12987) [0.79615]	1.044828 (1.44859) [0.72127]	-0.083581 (0.05142) [-1.62550]	-15.51157 (10.0018) [-1.55087]
LOGGDPP(-1)	-0.336272 (2.24924) [-0.14950]	1.342656 (2.15003) [0.62448]	-1.346157 (1.85120) [-0.72718]	-1.129224 (1.25905) [-0.89688]	-0.033095 (0.04469) [-0.74052]	-13.81799 (8.69318) [-1.58952]
LOGGDPP(-2)	3.126494 (2.67203) [1.17008]	4.872675 (2.55417) [1.90773]	-1.281843 (2.19916) [-0.58288]	1.011282 (1.49572) [0.67612]	-0.084518 (0.05309) [-1.59193]	-15.44291 (10.3272) [-1.49536]
LOGPCE(-1)	0.553317 (0.44854) [1.25590]	0.524718 (0.42875) [1.22383]	0.021084 (0.36916) [0.05711]	0.656080 (0.25108) [2.61308]	0.015100 (0.00891) [1.69438]	0.057755 (1.73356) [0.03332]
LOGPCE(-2)	-0.244654 (0.47083) [-0.51962]	0.121121 (0.46006) [0.26912]	-0.365228 (0.38751) [-0.94250]	-0.445476 (0.26356) [-1.69025]	0.013816 (0.00936) [1.47680]	-0.761507 (1.81974) [-0.41847]
LOGUS(-1)	5.422699 (8.57770) [0.63219]	-7.695112 (8.19934) [-0.93850]	13.35680 (7.05971) [1.89198]	6.147530 (4.80152) [1.28033]	1.731249 (0.17043) [10.1579]	51.18257 (33.1523) [1.54386]
LOGUS(-2)	-10.75160 (9.01662) [-1.19241]	0.083389 (8.61891) [0.00968]	-10.86216 (7.42096) [-1.46371]	-5.144313 (5.04722) [-1.01924]	-0.774931 (0.17915) [-4.32548]	-36.48662 (34.8487) [-1.04700]
DUM(-1)	0.122940 (0.05700) [2.15691]	0.181950 (0.05448) [3.33498]	-0.061356 (0.04691) [-1.30791]	0.008374 (0.03191) [0.26245]	-0.005289 (0.00113) [-4.67045]	0.077648 (0.22030) [0.35247]
DUM(-2)	0.015270 (0.07406) [0.20618]	0.027098 (0.07080) [0.38277]	-0.007669 (0.06096) [-0.12581]	0.030874 (0.04146) [0.74471]	0.003342 (0.00147) [2.27107]	-0.229322 (0.28624) [-0.80114]
C	4.551810 (16.5327) [0.27532]	-10.54503 (15.8035) [-0.66726]	15.59945 (13.6070) [1.14643]	-0.401247 (9.25449) [0.04336]	0.828510 (0.38250) [2.16521]	142.7813 (63.8984) [2.23452]

R-squared:						
Adjusted R-squared:	0.957331	0.996342	0.996072	0.701881	0.999409	0.889085
Sum of squared residuals	0.928884	0.993904	0.993454	0.503135	0.999015	0.815142
Standard error of equation:	0.020120	0.018384	0.013629	0.006304	7.94E-06	0.300543
F-statistic:	0.033433	0.031958	0.027516	0.018715	0.000664	0.129216
Log likelihood:	33.65396	408.6034	380.4011	3.531553	2535.998	12.02391
Akaike AIC	69.78356	71.18202	75.82117	87.77080	191.2594	27.87326
Schwarz Criterion (SC):	-3.663456	-3.753679	-4.052979	-4.823922	-11.50561	-0.959565
Mean dependent variable:	-3.062106	-3.152329	-3.451629	-4.222573	-10.89926	-0.358215
S. D of dependent variable:	5.975007	2.505822	9.969695	4.168232	4.387793	0.903226
	0.125369	0.409317	0.340092	0.026550	0.021164	0.300537
Determinant of residual covariance (degrees of freedom adjusted):	4.80E-24					
Determinant of residual covariance:	1.84E-25					
Log likelihood:	618.8871					
information criterion: Schwarz	-34.89594					
criterion: Number of coefficients:	-31.28785					
	78					

Source: Prepared by the researcher based on the outputs of (Eviews 12).

Appendix 2 : Results of the normal distribution

VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: Residuals are multivariate normal

Date: 10/23/25 Time: 21:00

Sample: 1990 2022

Included observations: 31

Component	Skewness	Chi-sq	df	Prob.*
1	0.079631	0.032762	1	0.8564
2	0.800504	3.310834	1	0.0688
3	0.324952	0.545567	1	0.4601
4	0.168901	0.147392	1	0.7010
5	-0.498047	1.244811	1	0.2645
6	-0.163284	0.137753	1	0.7105
Joint		5.419119	6	0.4913

Source: Prepared by the researcher based on outputs from EViews 12.

Appendix 3 : Results of self-association

VAR Residual Serial Correlation LM Tests

Date: 10/23/25 Time: 20:59

Sample: 1990 2022

Included observations: 31

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	Df	Prob.
1	51.44902	36	0.0458	1.646942	(36, 33.5)	0.0745
2	33.05769	36	0.6093	0.860194	(36, 33.5)	0.6717
3	23.24543	36	0.9504	0.543964	(36, 33.5)	0.9623

Source: Prepared by the researcher based on outputs from EViews 12.

Appendix 4 : Results of self-association

VAR Residual Heteroskedasticity Tests (Levels and Squares)

Date: 10/23/25 Time: 21:01

Sample: 1990 2022

Included observations: 31

Joint test:

Chi-sq	df	Prob.
460.1674	462	0.5153

Source: Prepared by the researcher based on outputs from EViews 12.