TABLE OF CONTENTS

1. INTRODUCTION

The Philippines is most notably known as a country severely affected by typhoons, earthquakes, and volcanoes. It has also been failing to break the upper-middle income country threshold since 2018. Despite the challenges, Filipinos continue with strength to live their daily lives. Equally, our kapwa-tao abroad (Overseas Filipino Workers) remain resilient in their conditions overseas to continue providing for their families back home. While understanding the Philippine economy, this study aims to determine what drives their remittances sent to the country from environmental to economic reasons.

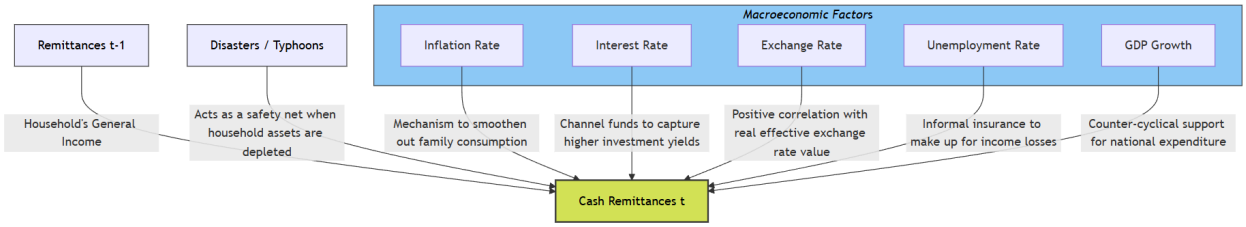
Generally, remittances are referred to as the act of sending money from a foreign worker to their home country. Analyzing the determinants of said remittances can be of big help for policymakers. After all, remittances reached upwards of $37.2 billion in 2023 (~8.5% of GDP) according to the Bangko Sentral ng Pilipinas (2024).

The prevailing body of research on OFW remittances are mostly qualitative by nature, with interviews hosted in the communities affected. While these papers give a more humanitarian and personal view on remittances, this study aims to understand the underlying relationships between different variables in shaping how remittances are sent, particularly through a more rigorous quantitative assessment. This paper aims to fill that gap by studying the statistical relationships of environmental and macroeconomic factors on their effect on cash remittances to the Philippines.

2. REVIEW OF RELATED LITERATURE AND THEORETICAL FRAMEWORK

This review synthesizes existing literature across several key areas: the definitions and framework of cash remittances, key influencing factors – including multiple macroeconomic variables, and findings from related literature.

Figure 1: Visualization on How Each Variable affects Remittances



2.1 Cash Remittances

Cash remittances are non-commercial transfers of money from a foreign worker to their country of origin. As such, cash remittances have long been a staple of Philippine macroeconomic activity. Cash inflows from abroad contribute to the growing supply of foreign denominations and are crucial in stimulating local consumption. According to data from the World Bank, foreign transfers to the Philippines made up 8.7% of the country's GDP in 2024, with a year-on-year growth rate of 3.17% from 2024-2025 in the months of January to October per the BSP. This shows the larger role these remittances play in not only shaping national expenditure, but also in the altruism of OFWs who send these cash transfers back to the country. It can be said that these remittances act as a "safety net" by which those affected by disasters can tap into if need be as when household assets are depleted, these transfers provide the necessary liquidity for recovery (Su, 2022; Cabuay & Resosudarmo, 2025; Bettin & Zazzaro, 2018). These studies

show the interplay between remittances and recovery from natural disasters, which the researchers aim to expand using thorough statistical analysis.

2.2 Factors Affecting Remittance Sending

2.2.1 Exchange Rate, Inflation Rate, Interest Rate

According to Carare et al. (2025), there is a positive correlation between remittance flows and the value of the real effective exchange rate. Namely, this effect ties into the fact that as the influx of cash increases, the demand for local goods causes prices to rise and the real exchange rate to appreciate, which causes an overvaluation in currency (Atta et al., 2025). This variable ties into the model as it suggests a potential trade-off wherein due to the influx of remittances sent after a typhoon, a region's overall export competitiveness may be affected due to a phenomenon known as the Dutch Disease, which ties into the appreciation of the real exchange rate.

Domestic price instability, defined as the inflation rate, has a strong relationship with remittances as well. In a paper by Rivera et al. (2020), inflation was found to encourage more remittances and that remittances, by themselves, were not necessarily inflationary. The paper also touched upon remittances as having a buffering mechanism, wherein they responded to inflation with delays of up to two months. As such, the paper concludes that inflation is a strong mechanism by which foreign migrants take to smoothen out the consumption of their families in the Philippines, reinforcing a strong, positive, short-run relationship between the inflation rate and remittances sent. This suggests that inflation can be treated as an exogenous variable in the model.

Coincidentally, interest rate movements are also drivers behind remittance growth. According to Rivera et al. (2021), the interest rate shows some degree of lagged impact on remittances, citing that self-interested motivations such as investments cannot be fully eliminated, with the study further suggesting that remittances are often driven by altruistic motives motives rather than self-interested motivations. Migrants, through a higher domestic interest rate, may choose to channel their remittances into Philippine direct investments to capture higher yields in comparison to investments in their country of residence. This distinction highlights that by controlling the interest rate as a variable, it can serve as evidence that remittances are altruistically-driven.

2.2.2 Seasonality

Remittance flows are not random; they exhibit seasonality through Friedman's Permanent Income Hypothesis (1956), which shows that households prefer a stable consumption path which leads migrants to schedule transfers around peak, deterministic expense spikes in the Philippines. In a normal year, ceteris paribus, these cycles are rigid and unaffected by minor economic fluctuations. However, disasters act as shocks by which remittances then act, not as smoothing agents, but as a safeguard to one's welfare. According to Cabuay et al. (2025), remittances significantly increase in frequency and not amount during disaster shocks, implying that remittances do serve as an emergency response mechanism by which those affected can lean upon to address immediate liquidity concerns. This distinction leads the researchers to control this variable through the inclusion of a seasonal dummy variable, which serves to isolate the effects of a disaster shock, effectively barring any distinct seasonality changes.

2.2.3 Unemployment Rate

Remittances play a big role in both the presence of cyclical and structural unemployment. As OFWs are assumed to be naturally altruistic, spells of unemployment in the country are marred by a sudden injection in foreign transfers. Coincidentally, unemployment spikes in times of calamity, leading to a shortage of on-hand currency for the consumption shock caused by the typhoon. This shrinking of income leads to more hardship on those affected, as they are unable to regulate their consumption due to severe devastation caused by these typhoons. Tying into remittances, these transfers, as previously mentioned, create a cushion by which those affected can use to recover more effectively. According to Wu et al. (2023), an increase in remittances significantly decreases the unemployment rate, creating more opportunities for affected individuals, supporting both the labor market and job creation through a demand stimulus. Therefore, the unemployment rate serves as a variable that tests the responsiveness of a migrant to current unemployment fluctuations. A positive correlation confirms that a migrant who responds to unemployment caused by disasters responds with financial aid through remittances.

2.2.4 GDP Growth

According to Cazachevici et al. (2020), the economic impact of remittances is not uniform across the globe, with systematic “regional heterogeneity” showing that the growth effect of remittances is significantly larger in Asian economies. This suggests that in the Philippines, remittance inflows are more integrated, implying that remittances have a stronger influence on domestic output. Furthermore, Cazachevici et al. (2020) notes that studies that utilize time-series techniques tend to report larger and more significant positive effects which supports the methodological approach of the paper.

3. DATA AND ANALYTICAL FRAMEWORK

3.1 Research Objective

The objective of this paper is to determine the significant factors affecting cash remittances to the Philippines. We aim to determine the effect of typhoon shocks on remittance inflows while controlling and determining the significance of how other economic factors, specifically, exchange rate, unemployment rate, inflation rate, interest rate, seasonality, and gross domestic product growth, affect it given the frameworks and empirical evidence discussed in Section 2 of this paper. Since we are determining causal inference, we utilize an Autoregressive Distributed Lag (ARDL) approach to answer and quantify our objective.

3.2 Cleaning and Obtaining the Dataset

Constructed primarily from monthly data, the final dataset uses a quarterly time series from 2014-Q1 to 2024-Q2 with a sample size of N = 44 observations per variable. Monthly data was supposedly to be used but was constrained by the availability of unemployment and gdp growth data which was primarily only available quarterly.

Data was downloaded for the following variables: Cash Remittances[1], Average Inflation rate[2], Average Interest Rates[3], Average Unemployment rate[4], Quarterly GDP Growth[5], and Typhoon Frequency[6].

Most of the raw data was aggregated from monthly to quarterly data. To stabilize the increasing variance over time, the logarithmic transformation was taken for remittances and exchange rate. This would also allow for percentage-point interpretations. Seasonality was taken into account

by adding a dummy variable for quarter 2-4, with quarter 1 as the base.

3.3 Exploratory Data Analysis

As presented in Table 1, quarterly remittances, the main variable of interest, average PHP 2.76 million in the raw dataset. The standard deviation is PHP 583,776, in terms of the fluctuations of transfers throughout the 10 year timeframe. Typhoon frequency averaged 4.25 per quarter but the dispersion is large (standard deviation of 3.46) with some quarters experiencing from 0 to 18 typhoons. One data point that can skew the results is the effect of the COVID pandemic, this can be seen in unemployment's spike of 17.6% during this time from the mean of 6.04%. This is quite the spike as its standard deviation is just 2.27%.

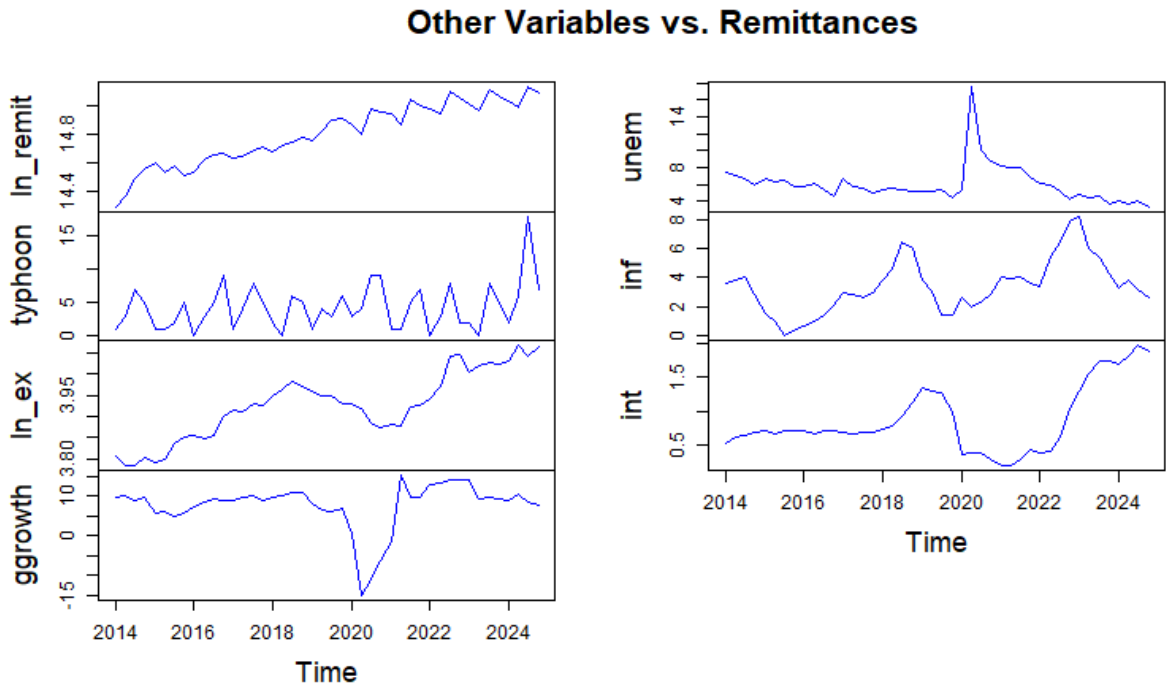
Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Remittances	2,755,982	583,776	1,608,714	3,767,782
Exchange rate	50.87	4.11	44.01	58.40
Typhoons	4.25	3.46	0.00	18.00
Inflation rate	3.40	1.91	-0.07	8.30
Interest rate	0.87	0.49	0.21	1.97
Unemployment	6.04	2.27	3.40	17.60
GDP Growth	7.57	5.98	-15.00	15.20

1. Source taken from *Bangko Sentral ng Pilipinas.* https://www.bsp.gov.ph/SitePages/Statistics/External.aspx?TabId=8 under Personal and Cash Remittances filtered to only U.S.A. / United States of America
2. Source taken from *Bangko Sentral ng Pilipinas.* https://www.bsp.gov.ph/SitePages/Statistics/Prices.aspx?TabId=1 under Monthly Inflation 1990s-2025 using 2018 as the base year
3. Source taken from *Bangko Sentral ng Pilipinas.* https://www.bsp.gov.ph/SitePages/Statistics/Financial%20System%20Accounts.aspx?TabId=14 under selected domestic interest rates. The specific rate chosen was the Savings Deposit Rate of the BSP.

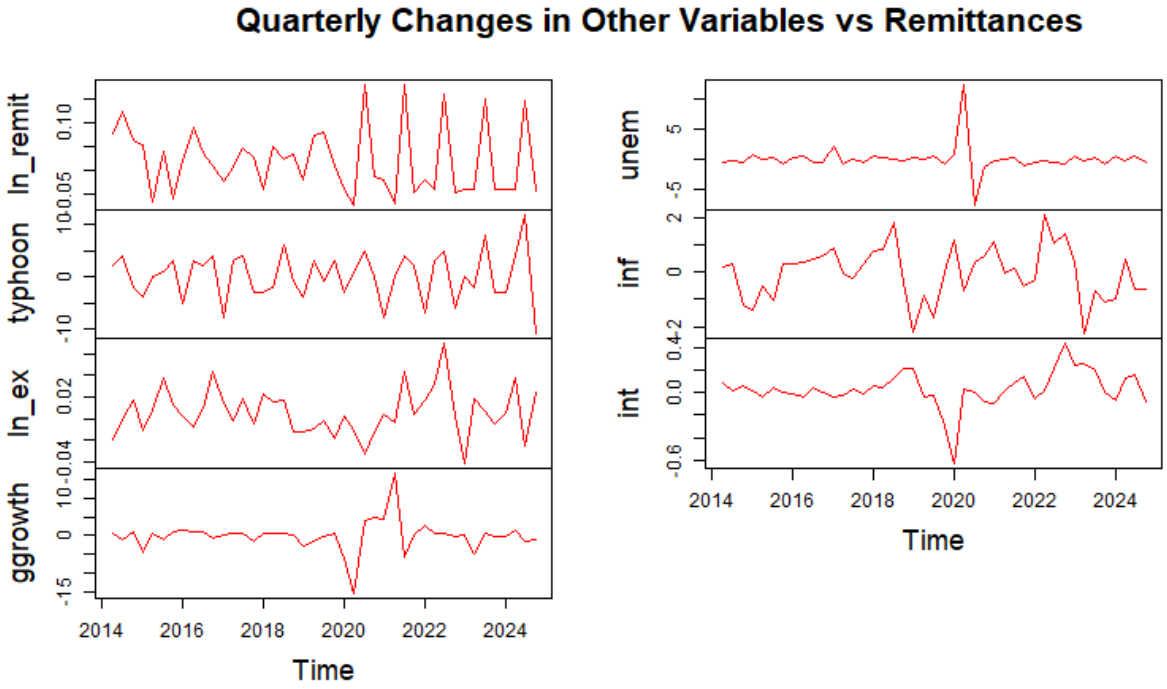
As seen in Figure 2, remittances and exchange rate have a naturally upward trend hence the logarithmic transformation. The COVID pandemic shock's effect is also clearly seen in interest rate, unemployment, and gdp growth. Typhoons and the exchange rate seem to be resilient to it. Based on Figure 3 with the different graphs, it is visually a bit hard to see correlated patterns in the time series patterns. There is a seemingly seasonality pattern at around quarter 3 which hints at the effect of the typhoon season during that time in the Philippines or preparation of the holiday season.

Figure 2: Time Series Plots (Raw)



4. Source taken from *Bangko Sentral ng Pilipinas.* https://www.bsp.gov.ph/SitePages/Statistics/OtherRealSectorAccounts.aspx?TabId=6
5.Source taken from *Bangko Sentral ng Pilipinas.* https://www.bsp.gov.ph/SitePages/Statistics/RealSectorAccounts.aspx?TabId=1
6. Source taken from Kaggle https://www.kaggle.com/datasets/denvermagtibay/philippines-monthly-typhoon-trend-2014-2024 only Typhoon Monthly Frequency was used.

Figure 3: Time Series Plots (First-Difference)



3.4 Model Rationale

We use the Autoregressive Distributed Lag (ARDL) model for our time series analysis. The dataset has a quarterly sample of N = 44, while Vector Autoregression (VAR) comes to mind; it requires larger datasets. The primary reason for choosing this model is the low sample size we have. The variables also transformed to stationary data using first order differencing which is the standard for the ARDL framework. The theoretical framework from section 2 also implies lag structures to assign each variable which can be done in the ARDL model.

3.5 Pre-Model Tests

To estimate the time series model, we require the variables to be stationary at integration order 0 or 1. We use the Augmented Dickey-Fuller (ADF) tests on all variables. From the results in

Table 2, initially, all variables were non stationary ($p > 0.05$). Upon first differencing, remittances, typhoons, inflation, unemployment, and gdp growth became stationary at I(1). Because exchange rate ($p = 0.3869$) and interest rate ($p = 0.3092$) failed to become stationary after first differencing, taking the second difference I(2) would violate an assumption of the ARDL model and so they were excluded. Further research on this topic could find enough data points to employ a different model that would include all variables.

Table 2: Pre-Modelling Tests (Augmented Dickey-Fuller Unit Root Tests)

Hypothesis: H_o: Non Stationary, H_1: Stationary		
Variable	I(0); t-stat (p-value)	I(1); t-stat (p-value)
ln(Remittances)	-1.738 (0.677)	-5.138 (0.010)*
ln(Exchange rate)	-2.173 (0.505)	-2.473 (0.387)
Typhoons	-1.579 (0.741)	-4.402 (0.010)*
Inflation rate	-3.275 (0.088)	-4.684 (0.010)*
Interest rate	-2.192 (0.498)	-2.670 (0.309)*
Unemployment	-1.845 (0.635)	-4.164 (0.012)*
GDP Growth	-2.965 (0.192)	-4.308 (0.010)*

3.6 Final Model and Equation

Throughout the manual model selection process[7] the final equation (Equation V3) specifies remittances with an autoregressive order (2) and includes values of 1 lag of the other variables that are theorized to affect remittances. The equation is expressed as:

$$ln(Remit)_t = \alpha_0 + \sum_{i=1}^{2} \phi_i ln(Remit)_{t-i} + \sum_{j=0}^{1} \beta_{1+j} Typhoon_{t-j} +$$

$$+ \sum_{j=0}^{1} \beta_{3+j} GGrowth_{t-j} + \sum_{j=0}^{1} \beta_{5+j} Unem_{t-j} + \sum_{j=0}^{1} \beta_{7+j} Inf_{t-j} +$$
$$+ \sum_{k=2}^{4} \delta_{k-1} D_{Qk} + \epsilon_t$$

Equation V3: ARDL Model of Philippine Remittances

Where $ln(Remit)_t$ is the natural logarithm of Cash Remittances at quarter t. ϕ_i denotes the coefficients for the autoregressive terms. β_{n+j} represents the coefficients of the other variables affecting remittances, specifically, number of typhoons, gdp quarterly growth, average quarterly unemployment and average quarterly inflation rate. $D_{Qk}$is the dummy variable representing quarter seasonality. ϵ_t represents the white noise error term.

7. See RMarkdown output under Appendix section or RMarkdown PDF file for previous Models (V1 and V2) and their outputs.

Table 3: ARDL Model V3 Regression Results

Dependent Variable: Log of Cash Remittances ln(Remit)					
Variable	Coefficient	Std. Error	t-Statistic	Prob. (p)	Significance
(Intercept)	1.5414	(0.7122)	2.164	0.0391	*
Remittances (t-1)	0.6276	(0.1623)	3.866	0.0006	***
Remittances (t-2)	0.2611	(0.1499)	1.742	0.0925	.
Typhoon (t)	0.0063	(0.0031)	2.013	0.0538	.
Typhoon (t-1)	0.0024	(0.0032)	0.741	0.4648	
GDP Growth (t)	-0.0019	(0.0026)	-0.726	0.4739	
GDP Growth (t-1)	0.0034	(0.0026)	1.307	0.2018	
Unemployment (t)	-0.0061	(0.0053)	-1.156	0.2574	
Unemployment (t-1)	0.0127	(0.0055)	2.292	0.0296	*
Inflation (t)	-0.0034	(0.0082)	-0.411	0.6845	
Inflation (t-1)	0.0090	(0.0081)	1.110	0.2764	
Q2 Dummy	0.0075	(0.0259)	0.291	0.7734	
Q3 Dummy	0.0723	(0.0313)	2.309	0.0285	*
Q4 Dummy	-0.0006	(0.0311)	-0.018	0.9855	
Residual Standard Error	**Multiple R-squared**	**Adjusted R-squared**	**F-statistic**	**F-statistic p-value**	
0.04576 (df = 28)	0.9633	0.9463	56.54 (df = 13; 28)	< 2.2e-16	

Note: Significance codes: ' *****’ 0.001 ‘***'' 0.01 ‘*’ 0.05 '.' 0.10.

4. RESULTS AND DIAGNOSTICS

4.1 Results

The results of the ARDL specification (Model V37) are summarized in Table 3. The model has an R2 = 0.9633 with an F-Statistics of 56.54 meaning that the model explains a significant amount of the variation in quarterly cash remittances. Table 3 shows the specific coefficients for the variables and autoregressive terms. The first lag of remittances $\beta = 0.6276$ ($p < 0.001$) is strongly significant, second lag $\beta = 0.2611$ is only significant at the 10% level. This is also true for the variable of interest, typhoon frequency $\beta = 0.0063$ ($p = 0.0538$) and lagged typhoons $\beta = 0.0024$ ($p = 0.4648$). The only other variables that are statistically significant at 5% level is the first lag of unemployment $\beta = 0.0127$ ($p = 0.0296$) and the seasonal dummy of quarter 3, $\beta = 0.0723$ ($p = 0.0285$). The other variables showed statistical significance.

4.2 Diagnostics (Post Regression)

After estimating the model, we do post model diagnostics for correlation, normality of residuals, cointegration, and structural stability. The results of these tests are seen in Table 4.

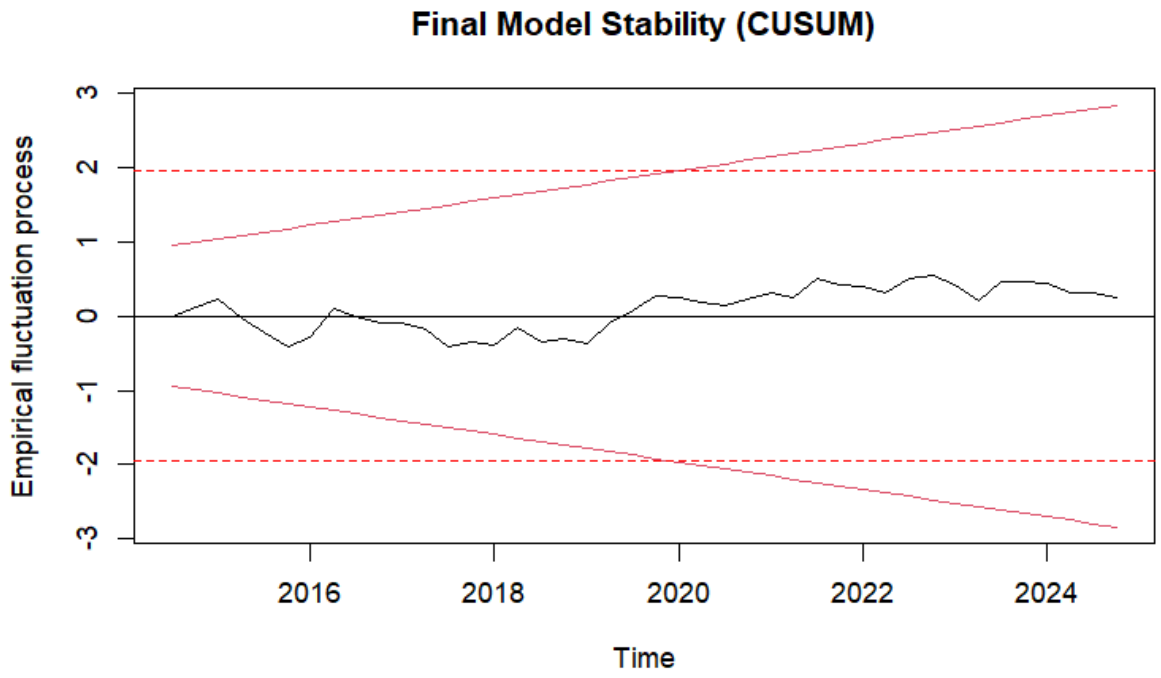
Table 4: Post-Model Diagnostics

Diagnostic Test	Test	Null Hypothesis: H_o	Statistic	p-value
Breusch-Godfrey LM Test	Serial Correlation	No Serial Correlation	LM = 0.037	0.8475
Shapiro-Wilk Test	Normality of Residuals	Residuals are Normal	W = 0.958	0.1943
Bounds Test (F-Test)	Cointegration	No long-run relationship	F = 3.537	$p < 0.05$

Table 4: Post-Model Diagnostics

Diagnostic Test	Test	Null Hypothesis: H_o	Statistic	p-value
CUSUM Test	Visualization	Plot within the Bounds	*Looks like it.*	

Figure 4: CUSUM



The result of the Breusch-Godfrey LM Test for serial correlation yielded a p-value of 0.8475. The null hypothesis is that there is no serial correlation and we do not reject Ho. The residuals are confirmed to be independent of each other. Using the Shapiro-Wilk test, Ho is that the residuals are normal, the p-value is 0.1943 failing to reject this null hypothesis. We can confirm that the residuals of the model are normally distributed. Third, the Pesaran, Shin, and Smith (2001) Bounds Test for cointegration yielded an F-statistic of 3.537, rejecting the Ho of no cointegration. This confirms that the time series in the model indeed have a relationship. Lastly,

the visualization of the Cumulative Sum of Recursive Residuals Plot shows that they maintain within boundaries near zero, implying no structural breaks of the coefficients even with COVID 19 shock happening during the timeframe of the dataset.

5. DISCUSSION

5.1 Results Discussion

From the results, lagged remittances remain to be the strongest and most significant predictor. This suggests that remittances are more structural by nature rather than a reactive mechanism – that it is more of the long-term arrangement of how the household gains income.

The strong significance coefficient of the Q3 Seasonal dummy implies that outside of shocks or other reactive mechanisms, remittance is tied to household expenditures. For example, Q3 can be the start of the academic year, or expenses during the rainy season. Particularly, the seasonal dummy can imply a migrant's schedule tied to long-term familial lifestyle.

The results also lend support to the "Consumption smoothing and Insurance Hypothesis" explained in earlier sections of the paper for Typhoon Frequency. Although the statistical significance is a little weak ($p = 0.538$), it aligns with the theory that the remittances serve as a buffer from disasters experienced by close households, in the Philippines' case, typhoons, as a mechanism for support.

5.2 Implication on Policy and Economics

In terms of policy, disaster policy makers can consider remittances as another layer of disaster aid. In terms of remittances' reaction to unemployment, policymakers can consider improving the transfer, easing the lag, to cushion the effects of unemployment for the population. For future researchers of the same topic, the methodology could be improved in terms of incorporating typhoon damage costs, improving data gathering and modelling it against more determinants on

the household or family level and further improving the nuances by aggregating samples into geographical clusters. Lastly, major improvements in sampling could be improved by using a larger size of monthly data once available in the future of Philippines data.

6. REFERENCES

Atta, O., Mughal, M., & Rey, S. (2025). Migrant remittances and real exchange rate dynamics in developing countries: Evidence of a U-shaped relationship. Economic Modelling, 148, 107085. https://doi.org/10.1016/j.econmod.2025.107085

Bangko Sentral ng Pilipinas. (2024, February 14). Personal remittances set a new record high in December 2023 at US$3.6 billion; Full-year level of US$37.2 billion highest to date. https://www.bsp.gov.ph/SitePages/MediaAndResearch/MediaDisp.aspx?ItemId=7005

Bettin, G., & Zazzaro, A. (2018). The impact of natural disasters on remittances to low-and middle-income countries. The Journal of Development Studies, 54(3), 481–500.

Cabuay, C. J. R., & Resosudarmo, B. P. (2025). Insuring against disasters and poor institutions: Remittances as aid and informal family insurance during Typhoon Haiyan in the Philippines. The Journal of Development Studies. https://doi.org/10.1080/00220388.2025.2453514

Carare, A., Celis, J., & Hadzi-Vaskov, M. (2025). How Do Remittances Affect the Real Exchange Rate? An Empirical Investigation. IMF Working Paper, International Monetary Fund.

Cazachevici, A., Havranek, T., & Horvath, R. (2020). Remittances and economic growth: A meta-analysis. World Development, 134, 105021. https://doi.org/10.1016/j.worlddev.2020.105021

Friedman, M. A. (1957). A Theory of the Consumption Function. Princeton: Princeton University Press.

Rivera, J. P. R., & Tullao, T. S. (2020). Investigating the link between remittances and inflation: Evidence from the Philippines. South East Asia Research, 28(3), 301–326. https://doi.org/10.1080/0967828X.2020.1793685

Rivera, J. P. R., & Tullao, T. S. (2022). Estimating the impact of selected macroeconomic indicators on remittance inflows in the Philippines. Journal of Southeast Asian Economies, 39(3), 273–290. https://www.jstor.org/stable/27193070

Su, Y. (2022). Networks of recovery: Remittances, social capital and post-disaster recovery in Tacloban City, Philippines. International Journal of Disaster Risk Reduction, 67, 102641. https://doi.org/10.1016/j.ijdrr.2021.102641

Wu, W., Hon-Wei, L., Yang, S., et al. (2023). Nexus between financial inclusion, workers' remittances, and unemployment rate in Asian economies. Humanities and Social Sciences Communications, 10, 692. https://doi.org/10.1057/s41599-023-02133-8

Yang, D., & Choi, H. (2007). Are remittances insurance? Evidence from rainfall shocks in the Philippines. The World Bank Economic Review, 21(2), 219–248. https://doi.org/10.1093/wber/lhm003

7. APPENDIX

The following pages are results of an outputted RMarkdown file of the code used in the paper.