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Cyclical Properties of Moroccan Migrant Remittances: An Empirical Analysis

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Abstract Remittances constitute a major source of financing for most developing countries, due to their growing volume and their potential contribution to the growth and development of the countries of origin. Morocco is no exception to this dynamic. The literature on the cyclicality of these flows reveals that they can be procyclical or countercyclical. This cyclicality has major implications for economic and financial policies. A better understanding of these dynamics would make it possible to optimize the use of these funds in times of expansion as well as in times of crisis, thus strengthening their role as a stabilizer and shock absorber. In this context, this study analyzes the cyclicality of remittances to Morocco during the period 1980-2022, using appropriate econometric filters and a vector autoregressive model (VAR) incorporating impulse response functions (IRF) and variance decomposition, in order to study the interactions between these flows and economic cycles. This article argues that the cyclical nature of remittances must be assessed in a dynamic framework.

Keywords Remittances, cyclicality, econometric filters, Vector AutoRegressive (VAR) model, Impulse response functions (IRF)

AMS 2010 subject classifications 91G70, 62G05, 91B84.

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1. Introduction

Total variation The growing importance of migrant workers remittances for the national economy is attracting increased interest from researchers, policymakers, and international financial institutions. This is due to their increasing volume and their potential to promote growth and development in countries of origin, but also to the associated risks of macroeconomic destabilization ([5, 23]). These remittances now exceed foreign direct investment (FDI), export earnings, and official development assistance ([31, 68, 70]). Numerous studies have examined the impact of these flows on various aspects of development in recipient countries, including access to education ([4]), poverty reduction ([35, 6, 12]), human capital development ([10, 39]). Financial sector development ([1, 55, 11]). economic growth ([35, 38]), and inequality ([69, 30, 12]). The role of remittances in developing countries has been particularly highlighted during periods of economic crisis. Several studies have found a notable increase in the frequency and volume of remittances during times of crisis, suggesting that they constitute a form of informal aid in difficult times ([16, 50]). Unlike other external financial flows, such as official development assistance (ODA) or foreign direct investment (FDI), remittances, particularly in middle- and low-income economies, have proven remarkably resilient to economic shocks ([47]). They appear to be stable sources of finance ([36]) and are characterized by low volatility ([54]), making them a reliable source of financing for countries of origin. This is supported by research by De et al. [23], who found that remittances remained robust

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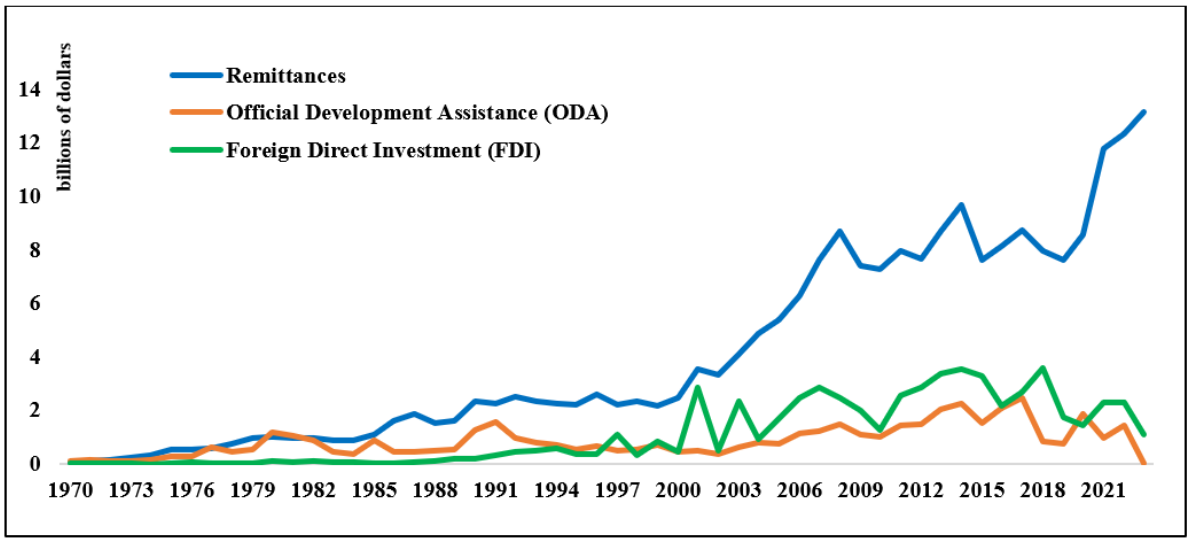

Figure 1. Migrant remittances and other financial flows to Morocco (in billions of dollars)

during financial crises, unlike other foreign financial flows, which tend to decline. For example, following the global economic slowdown caused by the COVID-19 pandemic, remittances to low- and middle-income countries declined by only 1,6% in 2020. In comparison, foreign direct investment (FDI) and global tourism receipts fell by 42% and 70% respectively, during the same period [75, 71]. Moreover, this decline is less pronounced than that observed during the 2009 global financial crisis. These data demonstrate the strong resilience of remittance flows to developing economies during periods of crisis or economic slowdown, suggesting that these transfers may have countercyclical characteristics. According to World Bank data, remittances to low- and middle-income countries reached $685 billion in 2024, up from $647 billion in 2023, an increase of 5,8%. However, this amount could be significantly higher if transfers made through informal channels were taken into account. Morocco constitutes a particularly rich and relevant field of analysis, as it is one of the main beneficiaries of remittances, both in terms of volume and as a proportion of its GDP ([33]). According to the Foreign Exchange Office, remittances from the Moroccan diaspora reached more than 9,45 billion dirhams ($950 million) at the end of January 2025, a slight increase from the 9,4 billion dirhams ($940 million) recorded in the same period in 2024. For the whole of 2024, remittances totaled 117,7 billion dirhams ($11,7 billion), up 2,1% compared to 2023, thus exceeding foreign direct investment (FDI) and official development assistance (ODA) (Figure 1). These flows represent a significant share of national GDP, estimated at around 7,7%, and help mitigate the negative effects of economic shocks, particularly by providing financial support to households that have remained in the country ([8]).

The ability of these remittances to mitigate the negative effects of economic shocks is strongly influenced by their evolution over the economic cycle. It is therefore essential to examine their relationship with key macroeconomic variables. With this in mind, host countries need to understand the cyclical dynamics of these flows in relation to the economic situation in the countries of origin, as well as their sensitivity to economic fluctuations. Given their cyclical characteristics, these transfers can serve as insurance and act as an economic stabilizer in the event of economic fluctuations ([48, 65]). It is therefore particularly important for countries that are heavily dependent on these funds to understand these cyclical characteristics. This understanding enables them to better anticipate the reactions of these financial flows in times of instability and to implement more resilient and better targeted economic policies ([72]). In addition, when remittances exhibit procyclical trends (increasing during periods of growth and decreasing during periods of slowdown), they risk exacerbating economic imbalances and can be likened to other forms of investment flows. In contrast, countercyclical behavior indicates a stabilizing role, mainly reflecting the altruistic intentions of migrants.

This study contributes to the existing literature by modeling the cyclical properties of remittances to Morocco. It seeks to answer a central question: do remittances from the Moroccan diaspora exhibit procyclical or countercyclical behavior? More specifically, it analyzes the response of these flows to internal economic shocks, particularly variations in national GDP. The article is structured as follows: Section 2 presents a review of the literature on the cyclicality of remittances; Section 3 describes the data used, the methodology employed, the empirical results, and their interpretation; finally, Section 4 presents the main conclusions drawn from the study, discusses the policy implications of the results, and offers suggestions and perspectives for future research.

2. Literature Review

The theoretical foundation of the debate on the cyclicality of remittances is based on literature exploring the motivations that drive migrants to send money. At the microeconomic level, the seminal research by Lucas and Stark [43] introduced a model analyzing the factors influencing migrant behavior, which subsequently inspired a substantial body of literature on the motivations behind remittances. According to Rapoport and Docquier [60], these flows are based on a complex set of motivations for sending money to the country of origin, including altruism, loan repayment, investment, and insurance agreements. Understanding these motivations can shed light on how migrants' behavior is expected to respond to cyclical variations in the country of origin's output.

Remittances can be motivated by altruistic reasons or personal interests; indeed, the coexistence of these two types of behavior is entirely plausible. Economists generally consider countercyclical remittances to be primarily motivated by altruistic motives. In contrast, when remittances are influenced by self-interest, they often exhibit procyclical tendencies and can be likened to other forms of investment flows ([64]). Previous macroeconomic studies have used various variables to analyze the different motivations behind remittances. These studies take into account factors specific to the countries of origin and destination, such as national income, unemployment rates, inflation, interest rates, currency volatility, and oil price fluctuations. Other factors include the size of the migrant population, the degree of development of the financial system, exchange control constraints, and the level of political risk. In addition to these economic considerations, various non-economic factors can influence remittance flows, including political instability and natural disasters, which frequently disrupt their regularity.

Due to the lack of adequate data and the diversity of migrants motivations, which vary from person to person and may change over time, it is difficult to identify precisely the main reason for remittances ([9]). Current evidence regarding the countercyclical function of remittances remains mixed. Some studies confirm their countercyclical nature ([27, 17, 59]), while others reach contradictory conclusions ([23, 22]). The results concerning the cyclicality of remittances can be significantly influenced by the period of analysis. For example, [32] examined the relationship between remittances and GDP in sub-Saharan African countries, finding that remittances were procyclical during the initial period (1980-1995) but became countercyclical in the subsequent period (1996-2006). Similarly, Ruiz and Vargas-Silva [63] noted that remittances sent to Mexico showed countercyclical trends in some periods and procyclical trends in others, highlighting the impact of the temporal context on their cyclical dynamics. Jackman ([37]) identified a procyclical trend in remittances in various countries, such as Barbados, Jamaica, and the United States. In contrast, Mughal and Ahmed ([52]) showed that remittances received by India and Pakistan exhibit countercyclical behavior relative to the economic activities of the recipient countries, while remaining acyclical relative to the economic conditions of the sending countries. In a more recent study, Gerlach and Ukraynets ([29]) demonstrated that remittances to Ukraine between 1999 and 2020 showed an overall procyclical trend. Similarly, Poghosyan ([58]), using a gravity model, reached similar conclusions when studying remittance flows to Russia and the countries of the Caucasus and Central Asia (CCA) over the period 2010–2017. Applying the same technique to annual panel data from 2010 to 2018, Kim et al. ([40]) showed that remittances to Asian and Pacific countries are countercyclical, with variations across subregions.

The choice of analytical method can lead to divergent results. For example, El Hamma ([26]) demonstrated, through a correlation analysis covering the period 1985-2010, that remittances are countercyclical in Algeria and Egypt, while they are procyclical in Morocco and Tunisia. In contrast, the VAR approach confirms the countercyclical nature of remittances for Algeria and Egypt and also indicates countercyclical behavior for

Morocco and Tunisia. For his part, Makhlouf ([45]), applying various econometric filters to data from Morocco between 1990 and 2010, concluded that remittances are also countercyclical. In the same vein, Marzovilla and Mele [49], using a VAR model estimated over the period 1980-2014, showed that they are procyclical. Applying the same modeling approach, Bentour ([14]) obtained similar results.

De et al. ([23]) analyzed the dynamics of remittances in relation to the economic cycle, using a sample of 109 developed, emerging, and developing countries from 1980 to 2015. Their results indicate that remittances exhibit acyclical behavior in recipient countries, less procyclical than financial flows but more procyclical than official development assistance. Using a Hamiltonian filter, Vatsa et al. ([74]) analyzed remittances to the Philippines. Their results reveal that these flows are procyclical, suggesting that they are primarily driven by profit rather than altruistic motives. Similarly, Padhan et al. ([56]) conducted an analysis of the cyclicality of remittances between India and 31 partner countries from 2010 to 2016, using ordered logit and probit models. They found that these flows are countercyclical to the incomes of the countries of origin but procyclical to the countries of destination. For their part, Cismas et al. ([22]), in their study of 11 Central and Eastern European countries between 1996 and 2017, found that remittances are acyclical in five countries, procyclical in four, and countercyclical in two. Using data on bilateral transfers between Italian provinces and developing countries, Bettin et al. ([17]) observed a strong countercyclical behavior of remittances. With regard to sub-Saharan Africa, Lartey ([42]) found that remittances are procyclical in 36 countries, contrary to Singh et al. ([67]), who observed countercyclical behavior.

Boussalem and Bouziane ([19]) used a VAR model applied to the period 1970-2023 to show that remittances to Algeria are countercyclical. These financial flows act as a shock absorber in the face of external economic shocks and strengthen the resilience of the national economy. Bonga ([18]) observed that remittances from the diaspora to Zimbabwe over the period 2009-2019 are procyclical, with migrants directing their remittances primarily toward investments rather than for purely altruistic reasons. However, the cyclical properties of remittances are not stable and may change over time depending on economic conditions. For example, in Morocco, Makhlouf and Kasmaoui [46], applying the time-varying coefficients method to quarterly data covering the period from the first quarter of 2004 to the first quarter of 2015, showed that these flows tend to become countercyclical during periods of economic crisis and exchange rate depreciation. In this regard, Adesoji and Eunice ([2]), applying the ARDL method and the Hodrick-Prescott filter, found that, for the entire period from 2009 to 2019, remittances to Nigeria are initially countercyclical in the short term, become procyclical after three months, and then tend toward acyclical behavior in the long term, with their countercyclical nature intensifying as their contribution to GDP increases.

According to Ruiz and Vargas-Silva ([63]), the cyclicality of remittances may vary depending on the recipient country or sending corridor. In summary, the empirical literature on the cyclical behavior of remittances reveals mixed results, which vary by country, migration corridor, period studied, and methodology used.

3. Data and Methodology

Drawing on existing literature, this study analyzes the cyclical properties of remittances to Morocco. The methodology adopted allows us to understand both the static and dynamic dimensions of the phenomenon. It consists of three stages. First, we use various common filters, including the Hodrick-Prescott filter ([34]), the Baxter and King filter ([13]), and the Christiano-Fitzgerald filter ([21]), to extract the cyclical components of remittances and economic activity in the country of origin. The cyclical components obtained are then analyzed using the augmented Dickey-Fuller (ADF) unit root test, which allows us to retain only those filters that produce stationary cycles. Second, after obtaining the cyclical component of the indicators, we apply the methodology used by Sayan ([64]), which consists in calculating contemporary cross-correlations and asynchronous correlations in order to assess the comovement between the remittance cycle and that of the main economic variables of interest.

Table 1: Descriptive Statistics

	GDP	Remit
Mean	24,67081	21,97899
Median	24,56267	21,91702
Maximum	25,67781	23,23217
Minimum	23,41956	20,57582
Std. Dev.	0,723156	0,818880
Skewness	-0,18827	-0,17354
Kurtosis	1,695118	1,717234
Jarque-Bera	3,304728	3,164001
Probability	0,191596	0,205564
Sum	1060,845	945,0966
Sum Sq. Dev.	21,96408	28,16368
Observations	43	43

Finally, we use a vector autoregressive model (VAR) to analyze the dynamic interactions between remittances and economic activity.

3.1. Data and Descriptive Statistics

The database used in this study covers the period 1980-2022 and is based on annual time series for remittances and GDP. These data are from the World Bank. The choice of annual data is due to constraints on the quality and accessibility of statistical series, in particular, the lack of quarterly data on remittances over a long period. Table 1 provides a brief description of the variables used in this study.

The data presented in this table show that the average GDP (24,67) is slightly higher than that of remittances (21,98), which is expected, as GDP represents total economic output, while remittances are a subset of incoming financial flows. In addition, remittances (0,818) are more volatile than GDP (0,723). This increased volatility can be explained by the sensitivity of remittances to external economic shocks, such as crises in migrant host countries, exchange rate fluctuations, or changes in migration policies, etc. Moreover, the variables examined are normally distributed, as suggested by the Jarque-Bera test probability of greater than 5%. These results indicate that the study of remittances could be expanded to take economic cycles into account, in particular by exploring their relationship with GDP.

3.2. Obtaining Cyclical Components

When examining cyclical variations in a macroeconomic series, it is common to use a filter that divides the series into two distinct components: a cyclical component and a trend component. This relationship is expressed by the equation:

$$Y_t = T_t + C_t$$

Y_t denotes the observed series (such as remittances), T_t represents the trend component, while C_t corresponds to the cyclical component.

The choice of a filter suitable for analyzing economic cycles continues to be debated, as there is no consensus on a single method. Some studies combine several filters simultaneously [3, 28], revealing a strong similarity in the conclusions obtained. Among the most frequently used techniques for trend-cycle decomposition are the Hodrick-Prescott filter ([34]) and the bandpass filters developed by Baxter and King ([13]) and refined by Christiano and Fitzgerald ([21]). Unlike linear decomposition, these methods treat trends as stochastic processes, thus offering a more dynamic perspective. The HP filter is used to obtain a smoothed estimate of the long-term trend component of a series. Once the trend has been estimated, the remaining series forms the cyclical component of the series. This filter is often used to detect cycles lasting between one and ten years [73]. Despite the many criticisms levelled at

the Hodrick-Prescott filter, it remains a widely used method in empirical work, particularly for the analysis of GDP series [61, 24]. The Baxter-King filter, meanwhile, is known for its ability to remove both low- and high-frequency components. It is based on the assumption that economic cycles last between 6 and 32 quarters, in line with the classic definition proposed by Burns and Mitchell ([20]). With this in mind, Baxter and King ([13]) define the cycle as an alternation of periods of expansion and recession that follow this periodicity. Finally, the Christiano-Fitzgerald filter, like the Baxter-King filter, belongs to the bandpass filter family. However, it offers another approximation that corrects certain limitations of the BK filter. This filter is particularly suitable for analyzing non-stationary time series. It allows the underlying trend to be extracted with flexibility, particularly when the data exhibit stochastic trends [53, 41]. In summary, none of these three filtering techniques is perfect, as each has its own limitations. It is advisable to compare the results using several filters to ensure a more robust analysis. In the rest of this paper, the cyclical components of remittances (CRemit) and GDP (CGDP) will be extracted using the Hodrick-Prescott, Baxter-King, and Christiano-Fitzgerald filters (Figure 2). Furthermore, for annual data, the smoothing parameter of the HP filter is set at 6,25, in accordance with Ravn and Uhlig ([62]).

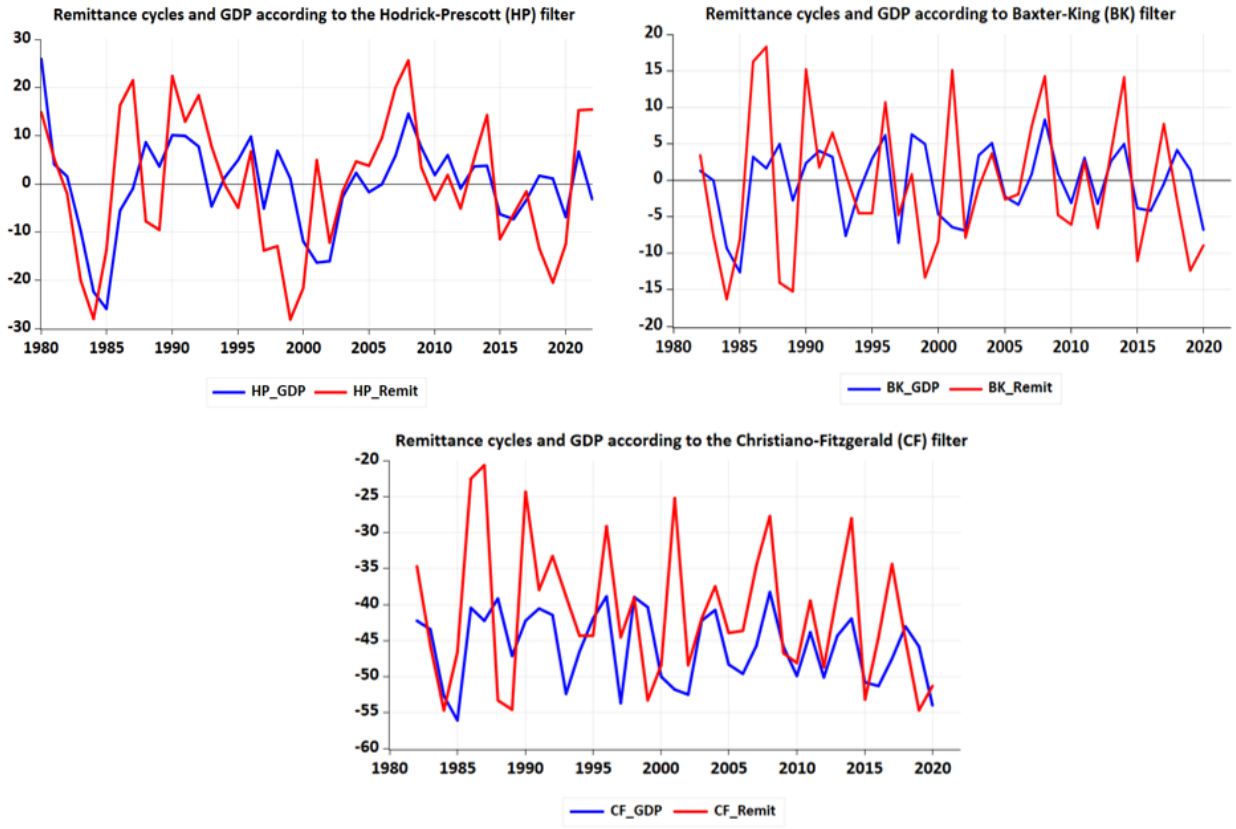

Figure 2. Remittance cycles and GDP according to HP, BK, and CF filters

Figure 2 superimposes the filtered series of remittances received by Morocco and its GDP, using various cyclical decomposition methods. A visual inspection of the cyclical components reveals that remittances exhibit more pronounced fluctuations than GDP, with a generally higher amplitude. The degree of synchronization with the economic cycle varies depending on the filter applied: it appears stronger with the Baxter-King (BK) filter, moderate with the Hodrick-Prescott (HP) filter, and relatively weak with the Christiano-Fitzgerald (CF) filter. Indeed, the cycles extracted by the CF filter show more pronounced amplitudes, weaker synchronization between remittances and GDP, and more visible time lags. This lower consistency can be explained by the nature of the filter, which assumes that the time series follow a random walk and uses the entire series to estimate each filtered

point. However, Moroccan macroeconomic series, such as remittances and GDP, are short in length, subject to structural breaks (changes in economic policy or external shocks) and persistent trends, which accentuate edge effects and cyclical noise. Conversely, the Hodrick-Prescott (HP) and Baxter-King (BK) filters, which are smoother and better suited to this type of data, produce more stable and better correlated cycles.

Furthermore, this graphical analysis does not allow definitive conclusions to be drawn about the sign or intensity of the cyclical relationship between the two series. These findings highlight the complexity of the link between remittances and economic activity and justify further investigation using econometric methods such as VAR analysis or cross-correlations.

3.3. Cycle stationarity test

Table 2: Unit root and stationarity tests of the series

Variable	Filter	ADF	PP	KPSS	Stationarity
CRemit	Hodrick-Prescott	-3.7279**	-3.6538**	0.0561**	I(0)
	Baxter-King	-5.9563**	-10.5002**	0.0805**	I(0)
	Christiano-Fitzgerald	-7.3004**	-11.2841**	0.0777**	I(0)
CGDP	Hodrick-Prescott	-4.1994**	-4.1994**	0.0442**	I(0)
	Baxter-King	-6.1283**	-8.7869**	0.0724**	I(0)
	Christiano-Fitzgerald	-6.3502**	-8.1939**	0.0689**	I(0)

*Note: ***significance at 1%, **at 5%, *at 10%. The null hypotheses for ADF and PP are that the series has a unit root. The test is based on the one-sided p-values of Mackinnon [44]. The null hypothesis for the KPSS test is that the series is stationary. The test is based on the work of Kwiatkowski, Phillips, Schmidt, and Shin (1992). I(0) indicates no unit root/stationary at the levels.*

The cyclical components of remittances (CRemit) and GDP (CGDP) were subjected to Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root tests in order to retain only those filters producing stationary cycles. The results of these stationarity tests are presented in the table below (table 2).

The results show that, regardless of the filtering method used, the CRemit and CGDP series are stationary. This leads us to retain the three filters in the rest of the analysis.

3.4. Correlation approach

Once the cyclical components of the indicators have been extracted, we apply the methodology proposed by Sayan [64], which consists of calculating contemporary cross-correlations and asynchronous correlations (calculated after shifting the remittance series back or forward by one or more periods) in order to assess the dynamics of co-movement between the remittance cycle and the GDP cycle. Remittances are said to be procyclical and synchronous if the contemporary correlation (i.e., the cross-correlation at time t=0) between the cyclical component of remittances and that of GDP is positive and statistically significant. Conversely, if the correlation is negative and significant at time t = 0, then the fund transfers are said to be countercyclical. Furthermore, a nonsignificant correlation or one close to 0 means that the transfers are acyclical. This reasoning also applies to asynchronous correlations. The asynchronous correlation coefficients indicate when, relative to the contemporary period, the relationship between the two cycles is strongest [57, 7].

Table 3 presents the correlation coefficients between the cyclical components of remittances and GDP, calculated using three filters (Hodrick-Prescott, Baxter-King, Christiano-Fitzgerald) and considering different time lags (T-3 to T+3). Statistically significant coefficients at the 5% threshold are marked with an asterisk, while those with the highest absolute value are shown in bold. When the latter are also significant at 95%, they appear both in bold and marked with an asterisk. In this context, cyclicality is defined as the correlation between the detrended series

of GDP and remittances. The evidence in this table clearly indicates that the cyclical components of remittances and GDP are positively and significantly correlated (i.e., when one variable increases in value, the other also increases). Remittances to Morocco therefore appear to be procyclical. Indeed, while the sign of the correlation coefficient between remittances and economic activity is important, the magnitude of the impact is even more significant (table 3).

Table 3: Correlations between remittance cycles and GDP cycles

Filter	T − 3	T − 2	T − 1	T	T + 1	T + 2	T + 3
Hodrick-Prescott	0,26	$0,4^*$	$\mathbf{0,55}^*$	$0,52^*$	0,1	$-0,05$	$-0,04$
Baxter-King	$-0,05$	0,03	0,12	$\mathbf{0,38}^*$	$-0,32$	$-0,18$	0,20
Christiano-Fitzgerald	$-0,06$	0,02	0,13	$\mathbf{0,39}^*$	$-0,28$	$-0,14$	0,21

*Statistically significant coefficient at a 5% significance level.

3.5. Constraints and limits of correlation

The correlations calculated above provide only a superficial and limited analysis of the cyclical relationship between the variables studied, but they remain limited in their analytical scope. Although correlations are informative, they are simple bivariate statistics and do not provide information on causality between variables. Moreover, they only assess the simultaneous links between two variables, without taking into account their evolution over time. They only detect linear dependencies, ignoring possible non-linear forms. To overcome these limitations and draw more robust conclusions about the underlying relationship between the variables, the use of a vector autoregressive model (VAR) is required. This model allows for the capture of dynamic relationships among multiple endogenous variables without imposing a predefined causal structure. Through impulse response functions and variance decomposition, the VAR model provides an in-depth analysis of the short- and medium-term effects of economic shocks on remittances, while specifying the nature, direction, and intensity of cyclical interactions.

3.6. Approach Using a VAR Model and Impulse Response Functions

The VAR model has become an essential technique in econometrics to analyze the impact of shocks on economic variables in the short and medium term [25, 51]. The use of the VAR model makes it possible to overcome certain problems, particularly those of endogeneity, by considering all the variables in the system as endogenous. This methodology offers a major advantage over traditional bivariate analyses, insofar as remittances are often endogenously linked to the economic activity of the country of origin.

$$X_t = \sum_{(i=1)}^{P} B_i X_{t-1} + \epsilon_t$$

In the context of our study, two VAR models to be estimated are written as follows:

$$CRemit_t = \alpha_1 + \sum_{i}^{P} a_{1i} CRemit_{t-p} + \sum_{i}^{p} b_{1i} CGDP_{t-p} + \epsilon_{t,1}$$

$$CGDP_t = \alpha_2 + \sum_{i}^{n} a_{2i} CRemit_{t-n} + \sum_{i}^{n} b_{2i} CGDP_{t-n} + \epsilon_{t,2}$$

With p and n denoting the lags, we have $var(\epsilon_{t,1}) = \sigma^2_{\epsilon_{t,1}}$, $var(\epsilon_{t,2}) = \sigma^2_{\epsilon_{t,2}}$, and $cov(\epsilon_{t,1}, \epsilon_{t,1}) = k \neq 0$. CRemit and CGDP refer respectively to the cyclical component of remittances and that of GDP in the country of origin (Morocco).

CRemit and CGDP refer respectively to the cyclical component of remittances and that of GDP in the country of origin (Morocco).

3.6.1. Determining the optimal delay number The optimal lag is determined by estimating the VAR model for different lag values p based on the Akaike information criterion (AIC).

The results in figure 3 show that, for the three filters analyzed, the optimal lag order selected is p = 2, in accordance with the results of the Akaike (AIC), Hannan-Quinn (HQ), and final prediction error (FPE) information criteria, which reach their minimum at this level.

3.6.2. Impulse response functions Impulse response functions are commonly used in VAR analysis to examine how variables react to exogenous shocks. They make it possible to track the dynamics of a variable after an impulse (a shock or disturbance) has occurred on another variable in the system. More specifically, an impulse response traces the effect of a one-off shock affecting an innovation on the present and future values of the endogenous variables in the system. To ensure the comparability and independence of these innovations, an orthogonalization process is performed by structural decomposition, in accordance with the methodologies established by Sims [66] and Bernanke [15]. In our study, we use impulse response functions to examine the dynamics of remittance cycles and identify the direction of causal relationships. These functions allow us to analyze the response of remittances to macroeconomic shocks and predict their evolution in times of economic crisis.

Figure 4 illustrates the impulse response functions of fund transfer cycles (CRemit) to a shock on GDP growth cycles (CGDP) in Morocco, estimated using a VAR(2) model and after extracting cyclical components via Hodrick-Prescott (HP), Baxter-King (BK), and Christiano-Fitzgerald (CF) filters. As previously mentioned, we have retained the stationary cycles. Indeed, with the Hodrick-Prescott filter, a positive shock to the GDP of the country of origin has an immediate negative effect on remittances received. This effect gradually diminishes and completely disappears after six periods, illustrating the transitory nature of remittances in relation to economic fluctuations. In contrast, analysis using the Baxter-King filter shows that after the initial negative shock, there is a slight recovery, followed by a further decline. The dampening is slower than that observed with the HP filter, with a gradual return to equilibrium around the ninth period. Finally, the Christiano-Fitzgerald filter indicates that the initial effect of the shock is strongly negative, followed by a rebound and a positive peak around the fourth period, before falling again. The return to equilibrium is observed around the tenth period. In general, regardless of the filter applied, impulse response functions show that an initial positive shock to the GDP cycle has a negative effect on remittances, confirming their countercyclical behavior. However, the specific characteristics, nature, intensity, and duration of this effect are strongly influenced by the filter used. Consequently, remittances generally decline when the economy of the country of origin is expanding and increase during periods of economic slowdown. Finally, the results from the VAR model indicate that remittances from the Moroccan diaspora are countercyclical. These results confirm the conclusions of Makhlouf [45], El Hamma [26], and Makhlouf and Kasmaoui [46] for the case of Morocco. They contrast with those of Bentour [14] and Marzovilla and Mele [49]. This analysis reveals a certain contradiction in the results obtained: although the correlation analysis suggests that remittances exhibit procyclical behavior, the VAR model approach indicates a countercyclical relationship. Several factors may explain the contradictory results observed. First, there is a fundamental difference between the two methodologies: the first offers a superficial and static analysis, limited to examining the correlation between two points at a given moment. Conversely, the second adopts a dynamic perspective, considering the relationships between variables in the present and the past with time lags. Consequently, initially procyclical remittances may evolve over time, a change explained by shifts in migrants' motivations. Indeed, their decisions to send funds result from a combination of diverse factors, which vary depending on the economic context and environment, individual circumstances, the degree of attachment to their home country, and the socio-economic conditions of their families remaining in the country, particularly during times of crisis. Moreover, their remittance behavior can also be influenced by national migration policies. These seemingly contradictory results do not indicate a methodological error; rather, they highlight the complex and multidimensional nature of the relationship between remittances and economic cycles.

3.6.3. Variance Decomposition Analysis According to Zakiyyah and Thoriq [76], the purpose of decomposing the variance of forecast errors is to determine the share of each innovation in the total variance of the error.In other words, it allows us to estimate the proportion of influence exerted by the independent variables on the dependent variable. In our study, innovation analysis is used to examine the dynamic responses of the GDP cycle (CPIB) and

VAR Lag Order Selection Criteria
Endogenous variables: HP_GDP HP_REMIT
Exogenous variables: C
Date: 09/08/25 Time: 22:34
Sample: 1980 2025
Included observations: 40

Lag	LogL	LR	FPE	AIC	SC	HQ
0	68.00947	NA	0.000126	-3.300473	-3.216030	-3.269941
1	83.23036	28.15865*	7.22e-05	-3.861518	-3.608186*	-3.769921*
2	87.42015	7.332125	7.16e-05*	-3.871007*	-3.448788	-3.718346
3	89.25686	3.030568	8.02e-05	-3.762843	-3.171735	-3.549117

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Order Selection Criteria
Endogenous variables: BK_GDP BK_REMIT
Exogenous variables: C
Date: 09/08/25 Time: 22:21
Sample: 1980 2025
Included observations: 36

Lag	LogL	LR	FPE	AIC	SC	HQ
0	94.32140	NA	2.03e-05	-5.128967	-5.040994*	-5.098262
1	96.93813	4.797328	2.19e-05	-5.052118	-4.788198	-4.960003
2	108.0098	19.06795*	1.49e-05*	-5.444991*	-5.005125	-5.291466*
3	108.7965	1.267345	1.79e-05	-5.266470	-4.650658	-5.051535

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

VAR Lag Order Selection Criteria
Endogenous variables: CF_GDP CF_REMIT
Exogenous variables: C
Date: 09/08/25 Time: 22:31
Sample: 1980 2025
Included observations: 36

Lag	LogL	LR	FPE	AIC	SC	HQ
0	93.61932	NA	2.11e-05	-5.089962	-5.001989*	-5.059257
1	95.95694	4.285627	2.32e-05	-4.997608	-4.733688	-4.905493
2	106.8902	18.82955*	1.58e-05*	-5.382790*	-4.942924	-5.229265*
3	107.3539	0.746999	1.94e-05	-5.186327	-4.570514	-4.971391

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Figure 3. Hodrick-Prescott filter (HP), Baxter-King filter (BK), and Christiano-Fitzgerald filter (CF)

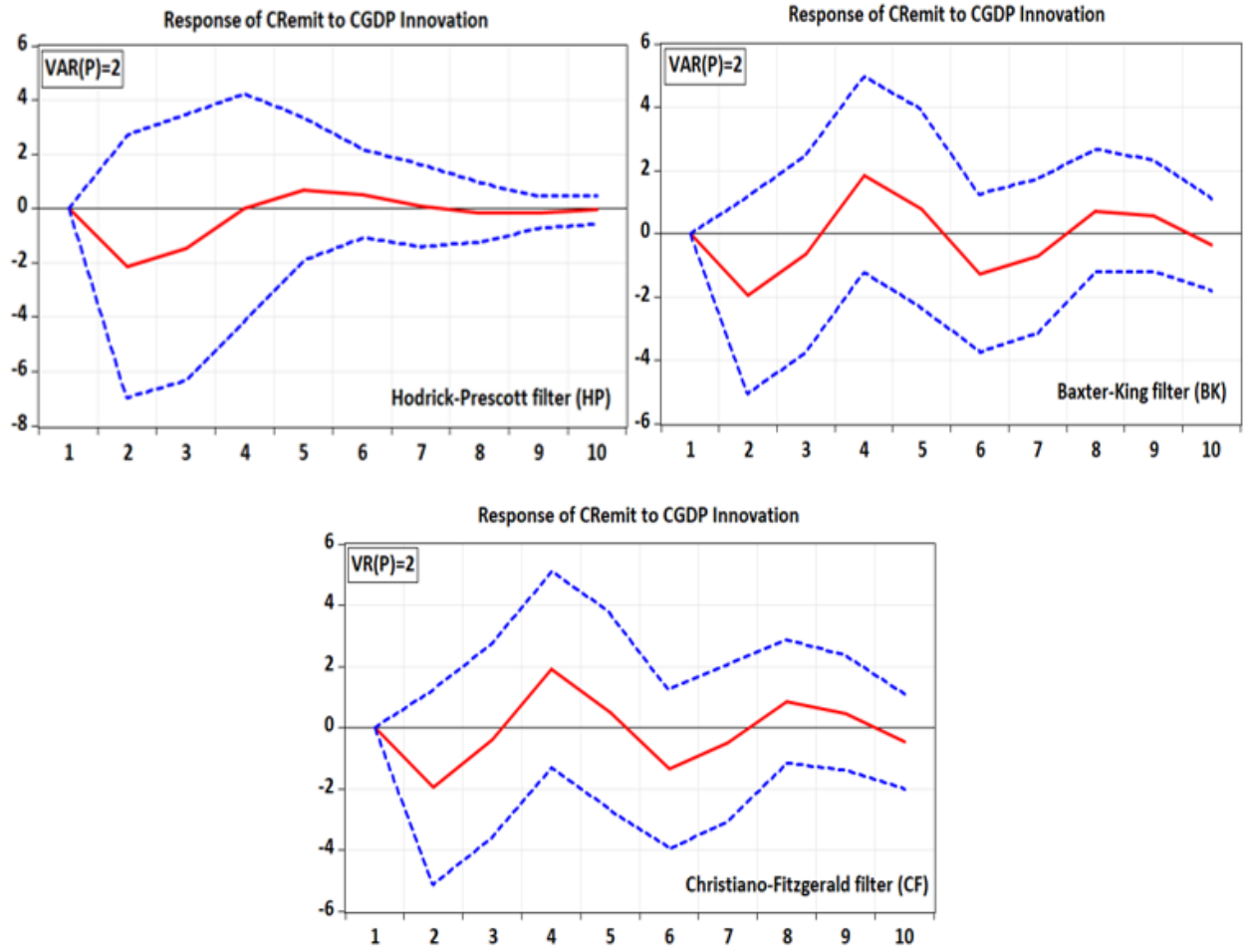

Figure 4. Responses of remittance cycles following the shock of GDP cycles

Variance Decomposition of CGDP:

Period	S.E.	CGDP	CRemit
1	0.071736	100.0000	0.000000
2	0.083685	97.75191	2.248091
3	0.090237	88.97445	11.02555
4	0.092901	84.34421	15.65579
5	0.093100	84.02701	15.97299
6	0.093282	83.85031	16.14969
7	0.093486	83.52452	16.47548
8	0.093519	83.46562	16.53438
9	0.093526	83.46320	16.53680
10	0.093540	83.44143	16.55857

Variance Decomposition of CRemit:

Period	S.E.	CGDP	CRemit
1	0.125657	33.40653	66.59347
2	0.147068	28.18207	71.81793
3	0.148075	27.82478	72.17522
4	0.149047	27.88078	72.11922
5	0.150083	27.60596	72.39404
6	0.150227	27.55464	72.44536
7	0.150267	27.57004	72.42996
8	0.150344	27.55438	72.44562
9	0.150363	27.54747	72.45253
10	0.150364	27.54863	72.45137

Figure 5. Variance Decomposition of the GDP Cycle and the Remittances Cycle (HP Filter)

the remittance cycle (CRemit) over a ten-year horizon. This is based on cycles extracted using the Hodrick-Prescott (HP), Baxter-King (BK), and Christiano-Fitzgerald (CF) filters.

Variance Decomposition of CGDP:			
Period	S.E.	CGDP	CRemit
1	0.048454	100.0000	0.000000
2	0.048624	99.53720	0.462801
3	0.052791	96.86061	3.139388
4	0.053069	96.61686	3.383145
5	0.054120	94.20849	5.791510
6	0.054346	94.20451	5.795489
7	0.054730	92.93421	7.065794
8	0.054859	92.96731	7.032687
9	0.055017	92.44730	7.552700
10	0.055078	92.44770	7.552297

Variance Decomposition of CRemit:			
Period	S.E.	CGDP	CRemit
1	0.085778	29.50460	70.49540
2	0.087640	32.36523	67.63477
3	0.098338	34.15891	65.84109
4	0.099582	35.36131	64.63869
5	0.102330	36.47527	63.52473
6	0.102894	36.65174	63.34826
7	0.103681	37.23526	62.76474
8	0.103922	37.15111	62.84889
9	0.104165	37.41001	62.58999
10	0.104269	37.33688	62.66312

Figure 6. Variance Decomposition of the GDP Cycle and the Remittances Cycle (BK Filter)

Variance Decomposition of CGDP:			
Period	S.E.	CGDP	CRemit
1	0.048034	100.0000	0.000000
2	0.048195	99.41117	0.588830
3	0.052395	96.82456	3.175443
4	0.052632	96.43201	3.567992
5	0.053750	94.01439	5.985611
6	0.053942	93.93037	6.069626
7	0.054371	92.57231	7.427688
8	0.054485	92.59240	7.407598
9	0.054666	91.97909	8.020906
10	0.054724	91.99363	8.006367

Variance Decomposition of CRemit:			
Period	S.E.	CGDP	CRemit
1	0.087235	31.32383	68.67617
2	0.088972	33.82943	66.17057
3	0.099639	34.73955	65.26045
4	0.100891	35.86248	64.13752
5	0.103631	36.53768	63.46232
6	0.104260	36.73441	63.26559
7	0.105052	37.14609	62.85391
8	0.105346	37.07357	62.92643
9	0.105594	37.28610	62.71390
10	0.105729	37.20444	62.79556

Figure 7. Variance Decomposition of the GDP Cycle and the Remittances Cycle (CF Filter)

Table 5 shows that 83.44% of the variance in the GDP cycle forecast error is due to its own innovations and 16.56% to those of the transfer cycle, while 27.54% of the variance in the transfer cycle forecast error is due to the GDP cycle and 72.45% to its own innovations. Table 6 shows that 92.45% of the variance in the GDP cycle forecast error is due to its own innovations and 7.55% to those of the fund transfer cycle, while 37.34% of the variance in the transfer cycle forecast error is due to the GDP cycle and 62.66% to its own innovations. Finally, Table 7 reveals that 91.99% of the variance in the GDP cycle forecast error is explained by its own innovations and 8.01% by those of the remittance cycle. In contrast, 37.20% of the variance in the remittance cycle forecast error is due to the GDP cycle and 62.80% to its own innovations. In summary, the results of the variance decomposition indicate that, although a large part of the variance in remittances is explained by their own innovations (62 to 72%), they remain sensitive to fluctuations in the GDP cycle (27 to 37% depending on the filter applied). This sensitivity reflects an interaction between migrant behavior and economic fluctuations.

4. Conclusion and perspectives

The question of the cyclicality of remittances is complex, as it is closely linked to the motivations that drive migrants to send these funds, namely altruism or self-interest. In the former case, remittances generally tend to be countercyclical. In the latter, they are procyclical. The empirical literature reveals varied results, depending

on the country, migration corridors, periods analyzed, and methodologies used. This cyclical characteristic of remittances is explained by the complex interaction of economic, political, and social factors specific to the countries of origin and host countries, as well as by the specific motivations of the migrants themselves. This study examines the cyclical dynamics of remittances to Morocco, particularly their response to national economic shocks, including fluctuations in national GDP. To achieve this, we mobilized appropriate econometric tools to analyze the dynamics of these flows. This study uses annual data covering the period 1990–2022 and relies on two complementary methodological approaches: bilateral correlations and the VAR (Vector Auto-Regressive) model. The results revealed a certain contradiction: while the correlation analysis indicates procyclical remittance behavior, the VAR model estimates suggest a countercyclical relationship. This divergence can be explained by the methodological differences between the two approaches, the evolution of migrants' motivations over time, and changes in the macroeconomic environments of both sending and receiving countries. We argue that the cyclicality of remittances must be examined in a dynamic context, as this relationship is likely to evolve over time.

The results of the VAR model lead us to conclude that remittances from the Moroccan diaspora exhibit countercyclical behavior. This observation implies that these financial flows are primarily motivated by altruistic considerations. These results are consistent with those reported by Makhlouf [45], El Hamma [26], and Makhlouf and Kasmaoui [46], but contradict the findings of Bentour [14] and Marzovilla and Mele [49]. The countercyclical characteristics of these transfers highlight their ability to mitigate the effects of macroeconomic shocks. Consequently, they function as a macroeconomic and social stabilization mechanism, serving as a buffer against domestic economic volatility. The lessons learned from this study offer several policy implications for stakeholders and policymakers. One of the main lessons is the resilience demonstrated by remittances to Morocco in times of economic hardship. This resilience requires strengthening formal transfer channels, reducing associated costs, and improving the quality of financial services in terms of the products and services offered. Given the countercyclical nature of remittances, the government could mobilize diaspora bonds as a fiscal instrument to support the economy during downturns. At the same time, financial authorities should incorporate these countercyclical flows into their macroprudential policies to limit their potential effects on credit cycles and exchange rate stability. Furthermore, it is essential to refine data collection methods to better monitor and anticipate the evolution of these flows, as well as the implementation of incentives to encourage and facilitate remittances. Furthermore, proactive strategies must be put in place to manage their volatility, anticipate their dynamic response to shocks, strengthen the resilience of beneficiaries and direct these financial flows towards more productive applications contributing to the economic development of Morocco.

Looking ahead, future studies should examine the cyclical patterns of remittances through a dynamic and comparative perspective across different countries and migration corridors. A notable limitation of using aggregate data is that it does not allow us to fully capture the specificities of these flows or to accurately discern their cyclical characteristics relative to production within each country. In this regard, the use of dynamic panel data or disaggregated quarterly data would provide more detailed and rigorous analyses. Furthermore, future studies would benefit from moving beyond the traditional approach to the cyclicality of remittances, which is often limited to a simple distinction between procyclical and countercyclical behaviors, to focus more on analyzing the underlying economic, social, and institutional factors that explain the changes and evolution of this cyclicality over time. Furthermore, it would be relevant to identify the macroeconomic indicators most affected by remittances, as well as the way in which households use these funds (consumption, savings or investment) in order to better understand their effects on the well-being of beneficiaries and on overall economic development.

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