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FROM MONEY TRANSFERS TO MEAL TABLES: UNRAVELLING THE NEXUS OF REMITTANCES, FOOD SECURITY, AND ECONOMIC GROWTH IN TURKEY

Abstract

The link between remittances, food security, and economic growth is a complex and important element of the economic development of the society. The study aims to explore the causality relationships between *Remittances, Food Security* and *Economic Growth* in the Turkish economy. The period of study from 1974 to 2018 and annual data of *Remittances*, *Calories intake* (as a proxy for the food security) and *Economic Growth* are used in the framework of time series. Techniques such as Zivot-Andrews (ZA) unit root, Toda-Yamamoto (TY), Breitung-Candelon (BCG), and Hatemi-J tests are used to detect the causality assessing the direction of it. The main findings consist of: (i) the presence of cointegration of rank two among series, the lack of linear TY time domain causality;

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(ii) the presence of BCG spectral causality from *Calories intake* to *Growth* only in medium period at 10% significance and, (iii) the presence of asymmetric causality from *Remittances* to *Growth* in positive changes, from *Growth* to *Calories intake* in negative changes and from *Calories intake* to *Remittances* in positive changes respectively at 1,5, and 1% significance. These results provide policymakers with valuable insights into the complexity nature of the relationship among remittances, food security, and economic growth, guiding them in designing effective strategies for poverty alleviation, sustainable development, and inclusive growth.

Key Words:

food security, remittances, economic growth, developing countries, asymmetric causality.

JEL: F24, C22, Q18.

2 figures, 8 tables, 52 references.

Problem Statement

International migration plays an important role in the global world as it generates massive effects in both sending and receiving countries economically, socially, and culturally (Abduvaliev & Bustillo, 2019). Personal transfers (cash and in kind) and compensation (money from border, seasonal, and other short-term jobs) sent to home countries by migrants who live and work in developed nations are referred to as remittances (Kumar *et al*., 2017). Remittances represent important injections to the sending countries of migrant workers, especially during times of economic recession when they provide a crucial source of income for their families in homeland (Huay *et al.,* 2019).

The main expectations from remittances are: (i) contributing to the increase of income levels and savings of individuals in the host country, (ii) increase in physical and human capital investments, (iii) reducing poverty and eliminating the

country's foreign exchange constraint. However, expectations are not always realized. In the case of people who receive remittances have low-income and high-consumption trends, this resource is generally used for consumption instead of investment and other growth-oriented activities. Therefore, although income increases with additional resources, savings rates do not increase, expected investment and growth does not occur. At the same time, the inflow of remittances makes the national currency more valuable. This makes the import cheaper, while negatively affecting export performance (Biçen, 2017).

According to the World Bank data, workers' remittance flows between countries increased especially in the 2000s. Remittances flows continue to increase exponentially. In many countries, remittances have increased significantly, both in quantity and in their share of GDP. According to the data of the World Bank, remittances inflows to developing countries are expected to reach 630 billion US dollars in 2022. It should also be underlined that the top five recipient countries for remittances in 2021 were developing countries (India, Mexico, China, the Philippines, and Egypt, respectively) (World Bank, 2022).

Food security is an essential component of the human security framework, and access to food by households is a fundamental human right. Food security can be divided into two major categories: Food stability and food availability. Because it is hard to measure modifying effects of environmental shocks, food availability is more preferred. Calorie intake is one of the components of food availability and it is often used in empirical analysis (Szabo *et al*., 2022).

Food insecurity may stifle developing countries' economic progress in a variety of ways (Ogundari & Aromolaran, 2017):

- by lowering life expectancy, which reduces the productive years expected of newly born children;
- by lowering disease resistance, which reduces available work time; and
- by impeding children's mental and physical development, which diminishes their potential production as adults. Briefly, food security helps contributing to human capital development.

Although it is particularly emphasized that remittances can boost a household's capacity to handle risks, improve their livelihoods, and improve their nutritional condition (Mabrouk & Mekni, 2018; Das, 2021), there is a strong belief that remittance recipients will be more prone to unhealthy diets and take out ready meals than those who do not get remittance income (Zezza, 2011; Szabo *et al*., 2022). Individuals change their consumption patterns with the increase in income, the increase in food consumption outside the home and easy-to-prepare food consumption is effective in increasing the obesity rate (Drewnowski & Specter, 2004). Increasing income, urbanization, changing life conditions in developing countries, globalization of food production and markets have an impact on obesity. In developing countries such as Mexico, China, and Thailand, the risk of be-

ing obese is higher in high socioeconomic classes. The reasons for the obesity increase in low-income groups are the low-income level, the preference of unhealthy foods with high calories and low prices and the increase in consumption. Individuals in this group want to increase or enlarge their budget share for food within their disposable income. In this case, weight gain occurs and an increase in obesity rate is observed (Sipahi, 2021).

Compared to similar developed countries such as Poland, Romania, Russia, and Ukraine, we see that Turkey ranks fourth in the world in 2018 in terms of highest caloric intake (3,711 kcal per person), despite the low amount of remittance income (Our World in Data, 2021). For this reason, it is important for Turkey to know the reflections of calorie intake on economic growth and whether workers' remittances sent to Turkey influence consumption expenditures.

Literature review

Remittances and food security nexus

In the literature it is explored and evidenced that remittances have an impact on economic development especially in developing countries and on diet and nutrition of the population (Sadiddin *et al.*, 2019; Taylor & Castelhano, 2016; Thow *et al.*, 2016; Regmi & Paudel, 2017; Mabrouk & Mekni, 2018). It is a wide debated topic, and the implications of such studies are a useful tool for the policy makers to design policies related to food security, migration, and economic development.

In the existing literature, various researches have explored the remittances-food security link. While early studies in this area dealt with the general effects of migration theoretically, later studies specifically addressed the effect of national and international remittances on calorie consumption in an empirical way. For example, Zezza *et al.* (2011) argued for the first time theoretically that facilitating remittance flows and reducing the costs of migration will maximize the positive impacts on food and nutrition security in developing countries. Akçay & Karasoy (2017) investigated the causal nexus between remittances and calorie intake in Algeria over the period 1970-2008, using Johansen and Juselius cointegration tests, ARDL bounds testing approach and Granger causality test based on Vector Error Correction Model. They discovered that remittances had a long-term favorable and substantial effect on calorie consumption. Employing a comprehensive survey on farm households, according to Babatunde (2018), remittance-receiving households in Kwara State, Nigeria, are better off in terms of total income, calorie supply, micronutrient supply, and child nutritional status. Ogunniyi *et al.* (2020) used a panel data for 15 Sub-Saharan African countries for the period 1996-2015 to investigate the impact of remittances on food and nutrition security. They dis-

covered that remittances had a considerable and favorable influence on the average value of food output. Furthermore, they noted that remittances help to increase SSA's average dietary energy supply adequacy. Mora-Rivera & Van Gameren (2021) revealed that both internal and international remittances have significant effects on food insecurity in Mexico, using data from the CONEVAL Rural Households Surveys of 2013 and 2015. Das (2021) applied a time-series analysis to explore the nexus between calorie intake and remittances in Bangladesh over the period 1976-2013. The author discovered a long run cointegration between remittances, calorie consumption using Johansen cointegration, and Toda-Yamamoto causality tests. Furthermore, the Toda-Yamamoto test confirmed that there is unidirectional causation in Bangladesh from remittances to calorie consumption. McFarlane *et al.* (2022) used impulse response function analysis and Granger causality testing in Jamaica from 1976 to 2019 and discovered that remittances had a positive long-run effect on calorie consumption. They also observed that for Jamaica, there is a bidirectional Granger causation between calorie consumption and remittances. In another interesting study, Vo (2023) explored the effect of domestic migration on food security using data from Vietnam Household Living Standard Surveys. The author revealed that domestic migration in Vietnam increases calorie consumption and food expenditure. Finally, as recent research, Jayaweera & Verma (2024) explored the role of migrants and remittances on food consumption using the household income and expenditure data in 2016/17. They concluded that both migrants and remittances positively affect calorie consumption and food expenditure. However, they argue that remittances promote unhealthy food consumption while migrants stimulate wholesome food consumption.

Despite all this positive nexus between remittances and food security, Mabrouk & Mekni (2018) employed a panel data for the period 1990-2013 in African countries to investigate the linkage between remittances and food security. The study tested the effect of remittances on food security through four channels: availability, access, utilization, and stability. The authors determined that there is a positive relationship between access, stability, and utilization characteristics, but a negative relationship between availability.

Remittances and economic growth nexus

Remittances affect growth in three ways. First, remittances can serve to reduce the recipient country's cost of capital. This may aid in the stabilization of the economy and the reduction of volatility. Second, because remittance money is replaced by work income, it is possible that remittances have a negative impact on labour force participation. The third effect is that remittances influence TFP growth, which influences investment efficiency. The extant macro empirical research on remittances is primarily concerned with growth, poverty, production volatility, and inequality (Barajas *et al*, 2009; Salahuddin & Gow, 2015).

Existing research usually show a favourable relationship between remittances and growth. Pradhan *et al.* (2008), for example, used data from 39 nations

from 1980 to 2004 and found that remittances have a positive impact on economic growth by using fixed effect models. Arı & Özcan (2011) investigated the remittances' impact on economic growth covering 30 developing countries for the period 1996-2009, by employing dynamic panel data analysis. They concluded that there is a positive relationship between remittances and economic growth. Eggoh *et al*. (2019), used Panel Smooth Transition Regression (PSTR) and the Generalized Method of Moments (GMM) and they reached positive findings. Specifically, the authors found that remittances have a positive and significant effect on economic growth in developing countries. Izevbigie *et al.* (2021), examined the impact of remittances on West African countries' economic growth using GMM panel technique for the period 2007-2019. According to the authors, remittance inflows have a considerable and favourable impact on growth in these nations. Depken *et al.* (2021) evaluated the relationship between remittances and growth in Croatia from 2000:Q1 to 2020:Q2. The findings showed that there is a unidirectional causal relationship between remittances and economic growth, and that remittances have a role in the Croatian economy. Recently, by employing ARDL bound test approach, Chaudhary (2022) revealed that remittances show a positive impact on GDP of Nepal.

Even while most research indicate the favourable impact of remittances in emerging nations, previous findings have been inconsistent and do not always corroborate this assumption (Piteli *et al*, 2019). Chami *et al*. (2003), found a negative relationship between remittances and economic growth in a study on 113 countries. Siddique *et al.* (2010) looked at the relationship between remittances and economic growth in three different countries: Bangladesh, India, and Sri Lanka. They used the Granger causality test to demonstrate that rise in remittances does not contribute to economic growth in India but does in Bangladesh. Over the period 1971-2010, Feeny *et al.* (2014) discovered no statistically significant relationship between remittances and economic development in a large sample of 136 developing nations. Using panel data methodologies, Sevinç *et al.* (2016) explored the relationships between remittances and growth in developing nations. The study found that migration has a negative impact on growth for Turkey, Iran, Gabon, Belize, Costa Rica, and Mexico but has a favourable effect on growth for Algeria, Botswana, China, Paraguay, Ecuador, and Peru. Chirila & Chirila (2017) analysed the impact of remittances on economic growth in Romania. They applied Toda-Yamamoto Granger causality approach and observed that remittances do not Granger cause of economic growth for Romania. Finally, Chowdhury & Dey (2022) used a Granger causality test based on VECM and discovered that remittances had no causation in both the short and long term for Bangladesh from 1976 to 2016.

Food security and economic growth

We see that there are only a few studies in the extant literature regarding food security and economic growth. Among them, Dube & Phiri (2015), analysed the asymmetric co-integration impact between nutrition and economic growth in

South Africa over the period 1961-2013. The authors found a positive bi-directional causality between nutrition and economic growth. Ogundari & Aromolaran (2017) used a dynamic panel causality test based on the Blundell-system Bond's GMM to investigate the link between nutrition and growth in Sub-Saharan Africa. The authors discovered long-run and short-run bidirectional causation between nutrition and regional economic growth. Using time series analysis, Ghosh (2018) studied the direction of causation between economic growth and calorie intake in India. According to the findings, economic growth Granger-causes nutritional consumption, while nutritional intake does not Granger-cause economic growth in India. Lastly, using quarterly data covering the period from 1990 to 2013, Raji (2020) discovered a reciprocal causal link between calorie consumption and Nigerian economic growth.

The purpose of this study is to investigate the connections between food security, economic growth, and remittances in Turkey. As far as we know, this is the first study to look at how remittances, economic growth, and food security interact in Turkey macroeconomically. Thus, absence of this interaction in the extant literature constitutes the original value of the study and it needs to be investigated empirically.

Methodology

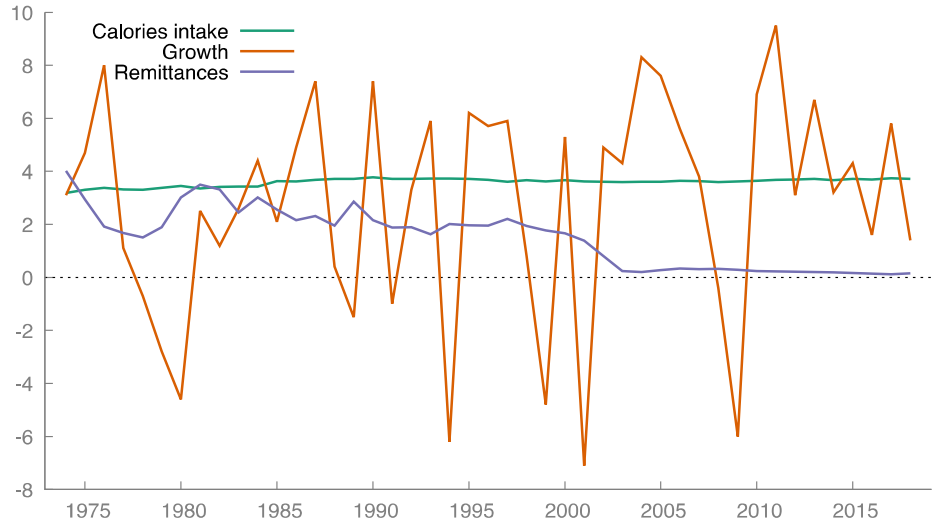
The data is comprised of annual time series data of food security, remittances, and economic growth. *Calories intake* presents the per-capita daily supply of calories in kilocalories, representing food security. *Remittances* are the remittance inflows to GDP for Turkey. Economic *Growth* is represented by the GDP per capital growth. The dataset ranges from 1974 to 2018; the availability of CI data limits its length. Data of remittances and economic growth are obtained from World Bank, while food security data is obtained from Food and Agriculture Organization of the United Nations. For the series, annual data will be utilized over the period 1974-2018 and different techniques of time series framework will be applied to identify, assess, and formalize the type of relationships between the variables, using cointegration and causality approaches.

Research Results

As seen in Figure 1, *Calories intake* follow a stable path during the whole period of study. There is a decrease and a volatile pattern in the *Remittances* percentage over GDP, up to the year 2000 conserving an almost flat behaviour after. *Growth* represents the most volatile variable, revealing graphically the stationary behaviour during the chosen period of study.

Figure 1

Calories intake, growth, and remittances from 1974 to 2018 in Turkey



Source: World Bank and FAO. Developed by the authors.

Remittances flows declined in the early 1980s due to a military takeover, but they steadied in the second half of the 1980s and progressively increased in the second half of the 1990s, following the 1994 economic crisis. Surprisingly, following a major earthquake calamity, *Remittances* fell precipitously in 1999. The economic and financial crises of November 2000 and February 2001 resulted in significant decreases in output and employment. The crisis erodes migrants' trust

in the economy, forcing them to remit through illegal channels or simply not remit at all, at least for investment purposes. Following the 2001 crisis, there was a significant decline in the flow of *Remittances* from Turkish employees. This might be due to demographic changes in sociological structure and immigrants' business skills. It is also probable that the third generation of Turkish migrants in Western Europe do not consider sending their money back home. Furthermore, among Western European Turkish migrants, entrepreneurship has been more common in recent years. This tendency reduces *Remittances* in the second half of the 2000s and the early part of the 2010s.

We can also understand how crisis years (1980 military coup, 1994 economic crisis, 1999 Istanbul earthquake, 2001 economic crisis, 2008 global financial crisis) made a sharp decline in *Growth* rate. Although Turkey recovered very quickly from the effects of the 2008 global crisis and achieved high growth, it faced economic and political problems towards the middle of the 2010s, and macroeconomic problems such as low foreign investment rate, unemployment and inflation continue.

Table 1

Summary statistics for series

Variables	Obs.	Mean	Std. error	Skewness	Kurtosis	Min	Max	Jarque-Bera
Series								
Calories intake	45	3.592	.148	-1.112	3.072	3.187	3.775	9.298***
Growth	45	2.773	4.150	-.745	2.847	-7.1	9.5	4.213
Remittances	45	1.508	1.114	.185	1.978	.122	4.01	2.217
Series as a change (t/t-1)								
Calories intake	44	1.003	.0158	.943	5.488	.9698201	1.061	17.88***
Growth	44	.588	2.956	2.236	14.587	-6	15	282.9***
Remittances	44	.957	.228	.279	4.518	.2878412	1.589	4.796*

Note: *p<0.1, ** p<0.05, ***p<0.01
Source: Own calculations.

The Table 1 shows the first descriptive information about our series. *Growth* shows more volatility than the rest. High kurtosis values resulted; the asymmetric behaviour of the series is shown by the skewness values, Jarque-Bera test shows the non-normal distribution of the calories intake series, and for all the series if we consider their change as values.

Table 2

Pearson's correlation coefficients for series

	Series		
	Calories intake	Growth	Remittances
Calories intake	1		
Growth	0.1226	1	
Remittances	-0.5117***	-0.1930	1

Note: *p<0.1, ** p<0.05, ***p<0.01.
Source: Own calculations.

As an additional step to the Table 1, in Table 2 are summarized the values of Pearson correlation test for our series. Besides the negative strong correlation (significant) between calories intake and remittances, for the rest there are no significant correlation between series for the period of study.

Methods

When dealing with time series, we must first determine their (non)stationarity before proceeding with the analysis. Stationarity is checked using a variety of unit root tests. The Augmented Dickey Fuller ADF (Dickey & Fuller, 1984) and Phillips-Perron PP (Phillips & Perron, 1988) tests have been widely utilized in the literature to determine the series' stationarity status. Due to their limited size and power characteristics, both tests may be ineffective for small sample data sets (DeJong *et al.*, 1992). Moreover, they do not account for the presence of structural breaks in our series. The Zivot-Andrews (1992) unit root test is applied in additional, as a modified version of the original Perron's test. The crucial assumption here was the assumption of an unknown breakpoint. They suggested three models, we will use the one that allows one-time series slope trend change.

Table 3

ADF, PP, ZA unit root tests for series

	ADF statistics in levels	ADF statistics in first difference	PP statistics in levels	PP statistics in first difference	ZA statistics in levels	ZA statistics in first difference
Calories intake	-1.834 (0.6883)	-5.574*** (0.0000)	-2.459 (0.3490)	-8.516*** (0.0000)	-3.199 [1988]	-8.869*** [1988]
Growth	-4.580*** (0.0011)	-7.263*** (0.0000)	-6.468*** (0.0000)	-12.669*** (0.0000)	-6.599*** [1981]	-7.580*** [1983]
Remittances	-3.251* (0.0746)	-5.016*** (0.0002)	-3.438** (0.0465)	-5.886 *** (0.0000)	-3.859 [1983]	-5.851*** [2004]

Note: In parenthesis are the p-values, in brackets are the break dates; *, **, *** are the significance level respectively for 10, 5, and 1%.
Source: Own calculations.

Using three of the unit root (Augmented Dickey-Fuller, Phillips-Peron and Zivot-Andrews) tests we check for the stationarity of the series. Our series resulted I(0) and I(1).

Table 4

Johansen trace test (with trend included) results for series

Max. rank	Critical value 5%	LRtrace
0	34.55	57.2276
1	18.17	20.0344
2	3.74	3.2738*

Note: *selected rank.
Source: Own calculations.

From Johansen (1991) trace test, cointegration of second order resulted for our series. There are two cointegrating equations; our series move together in the long-run. The cointegration presence among our series allows us to apply a Vec-

tor Error Correction VECM model and try to assess some sort of long-run and short-run causality along with formalizing through equations the long-run relationships between the series.

Toda-Yamamoto (1995) developed a method that allows the existence of a Granger (1969) causal relationship between the variables to be estimated with the VAR (k+dmax) model with an augmented lag. Since our series are I(1) and I(0), the TY causality test method will be used, allowing to work with the level values of the series. After determining the lag length (k) and maximum integration degree (d_{max}) of the model, a VAR (k+dmax) model is created, and the test is performed. The equations of the Toda-Yamamoto (1995) causality test are as follows:

$$Y_t = \beta_o + \sum_{i=1}^{k+dmax} \beta_{1i} Y_{t-1} + \sum_{i=1}^{k+dmax} \beta_{2i} X_{t-1} + \varepsilon_{1t}, \quad (1)$$

$$X_t = \alpha_0 + \sum_{i=1}^{k+dmax} \alpha_{1i} X_{t-1} + \sum_{i=1}^{k+dmax} \alpha_{2i} Y_{t-1} + \varepsilon_{2t}. \quad (2)$$

The hypotheses tested using a Wald statistic are as follows:

Ho: $\sum_{i=1}^{k+dmax} \beta_{2i}=0$, X_{t-1} *does not Granger cause* Y_t,
Ha: $\sum_{i=1}^{k+dmax} \beta_{2i} \neq 0$, X_{t-1} *does Granger cause* Y_t,

Ho: $\sum_{i=1}^{k+dmax} \alpha 2i = 0$ Y_{t-1} *does not Granger cause* X_t,
Ha: $\sum_{i=1}^{k+dmax} \alpha 2i \neq 0$, Y_{t-1} *does Granger cause* x_t.

The rejection of the null hypothesis gives us information about the Granger causality between the series. Complementary with TY causality test the spectral Breitung & Candelon (2006) causality test is applied. The approach allows decomposition of total linkage between variables into a sum of causality terms. This test by imposing linear restrictions for the parameters of the Vector Autoregression VAR model, trace causality in any frequency (translated into period) between the series.

Hatemi-J (2012) asymmetric causality test evaluates the causality relationship between the variables by separating the changes of the variables into positive and negative components. The test was developed because the assumption of symmetric causality tests that the effect of positive and negative shocks in the series is the same is insufficient to explain the existence of a causal relationship between the variables. The random walk model created to distinguish the negative and positive shocks of Hatemi-J (2012) y_{1t} and y_{2t} series is as follows:

$$y_{1t} = y_{1,t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t} \varepsilon_{1i}, \; y_{2t} = y_{2,t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t} \varepsilon_{2i}, \quad (3)$$

where: t = 1, 2, …, T specified in the model, $y_{1,0}$ and $y_{2,0}$ are the initial values, ε_{1i} and ε_{2i} are the white noise error terms. In the test, negative and positive shocks are expressed as follows:

$\varepsilon_{1t}^{-} = \min(\varepsilon_{1t}, 0), \varepsilon_{2t}^{-} = \min(\varepsilon_{2t}, 0); \varepsilon_{1t}^{+} = \max(\varepsilon_{1t}, 0), \varepsilon_{2t}^{+} = \max(\varepsilon_{2t}, 0)$. (4)

Thus, we find $\varepsilon_{1t} = \varepsilon_{1t}^{+} + \varepsilon_{1t}^{-}$, and $\varepsilon_{2t} = \varepsilon_{2t}^{+} + \varepsilon_{2t}^{-}$; the equations are rearranged as follows:

$$y_{1t} = y_{1,t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t}(\varepsilon_{1t}^{+} + \varepsilon_{1t}^{-}),$$

$$y_{2t} = y_{2,t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t}(\varepsilon_{2t}^{+} + \varepsilon_{2t}^{-}). \quad (5)$$

When the negative and positive shocks in the series are considered cumulatively, we find:

$$y_{1t}^{-} = \sum_{i=1}^{t}\varepsilon_{1i}^{-}, y_{1t}^{+} = \sum_{i=1}^{t}\varepsilon_{1i}^{+}, y_{2t}^{-} = \sum_{i=1}^{t}\varepsilon_{2i}^{-}, y_{2t}^{+} = \sum_{i=1}^{t}\varepsilon_{2i}^{+}. \quad (6)$$

The first technique to assess the long-run relationships between our series is to fit a VECM model (our series resulted nonstationary and cointegrated).

Table 5

VECM results

	D. Calories intake	D. Growth	D. Remittances
Error correction terms			
α_1	-0.1381646**	-3.929673	1.502237***
α_2	0.0003758	-.9987927***	-.0196019
EC1= Calories intake -0.2382398*** x Remittances -0.0235137 x time – 2.74907			
EC2 = Growth +0 .171219 x Remittances -0.0487816 x time -1.713907			

Note: The optimal lag length p=1, cointegration rank r(2), *p<0.1, ** p<0.05, ***p<0.01.
Source: Own calculations.

The two long-run relationships between the variables are formalized through the two equation EC1 and EC2. In the first long-run equation, the long-run coefficient is -0.238 which means that 1% change in *Calories intake* is a response to a 0.24% change in *Remittances*. In the second long-run equation, the long-run coefficient is +0.171 which means that 1% change in Growth is a response to a 0.17% change in *Remittances*. *Calories intake* is an exogeneous variable for *Remittances*. This is shown by the significant EC coefficient in the *Remittances* equation (1.5023***). The significant EC terms in the first equation (-0.1382) is the adjustment term (significant at 5% level) shows that previous

year's error or deviation for the long-run equilibrium are corrected within the current year at a convergence speed of 13.8%, at the second equation the convergence speed is 99.9% and at the third one is 150%.

At Table 6, are represented the results for TY causality test, for p=1 lags through Akaike's (1969) information criterion AIC. No linear causality relationships are detected from this test at 1, 5, and 10%.

Table 6

TY causality test for series

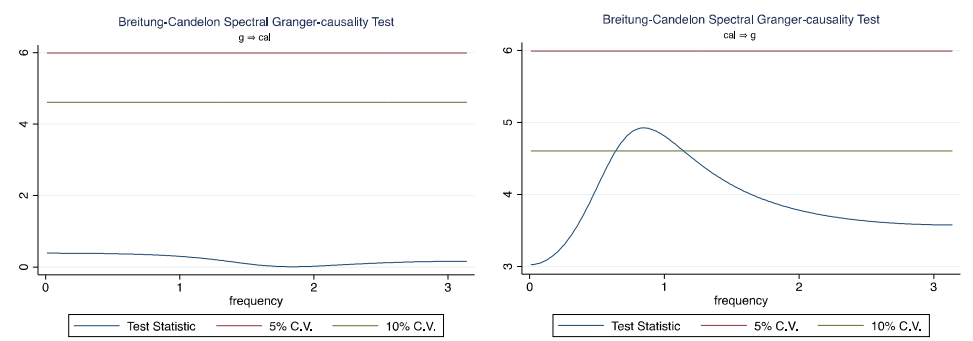
Direction of causality	Chi^2 statistics	Result
Calories intake ⇏ Growth	0.00386 (0.950)	No linear causality
Growth ⇏ Calories intake	0.38538 (0.535)	No linear causality
Calories intake ⇏ Remittances	0.00016 (0.990)	No linear causality
Remittances ⇏ Calories intake	1.9756 (0.160)	No linear causality
Growth ⇏ Remittances	0.57752 (0.447)	No linear causality
Remittances ⇏ Growth	0.25726 (0.612)	No linear causality

Note: In parenthesis are the p-values; *, **, *** are the significance level respectively for 10, 5, and 1%.; ⇏lack of Granger causality null hypothesis.
Source: Own calculations.

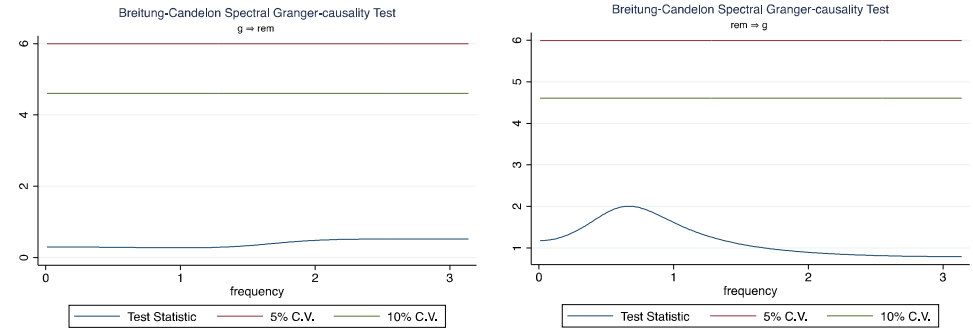
The same results emerged also from BC spectral causality test.

Figure 2

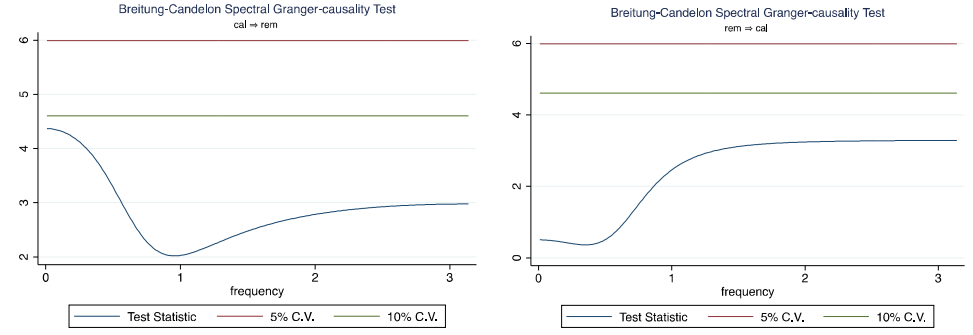
Breitung – Candelon spectral GC between:
(a) Calories intake and Growth;
(b) Growth and Remittances;
(c) Calories intake and Remittances



(a)



(b)



(c)

Source: Own calculations.

Only at 10% significance was identified a spectral frequency causality from *Calories intake* to *Growth* for the frequency $\omega = 1$, representing the medium period. Table 7 summarized in detail the results of BC spectral causality test for all the six chosen frequencies.

Table 7

Frequency domain Breitung – Candelon causality test for different frequencies

Direction of causality	Long-term		Medium term		Short-term	
	$\omega = 0.01$	$\omega = 0.05$	$\omega = 1$	$\omega = 1.5$	$\omega = 2$	$\omega = 2.5$
Calories intake ⇏ Growth	3.0238 (0.2205)	3.0336 (0.2194)	4.8109* (0.0902)	4.1323 (0.1267)	3.7812 (0.1510)	3.6307 (0.1628)
Growth ⇏ Calories intake	0.3870 (0.8241)	0.3868 (0.8241)	0.2980 (0.8616)	0.0932 (0.9545)	0.022 (0.9888)	0.1145 (0.9444)
Calories intake ⇏ Remittances	3.2837 (0.1936)	4.3594 (0.1131)	2.0272 (0.3629)	2.4768 (0.2899)	2.7841 (0.2486)	2.9244 (0.2317)
Remittances ⇏ Calories intake	0.5027 (0.7777)	0.4976 (0.7797)	2.4602 (0.2923)	3.1145 (0.2107)	3.2406 (0.1978)	3.2732 (0.1946)
Growth ⇏ Remittances	0.2957 (0.8625)	0.2957 (0.8626)	0.2757 (0.8712)	0.3335 (0.8464)	0.4827 (0.7856)	0.5221 (0.7703)
Remittances ⇏ Growth	1.1726 (0.5564)	1.1801 (0.5543)	1.6137 (0.4463)	1.0878 (0.5805)	0.8927 (0.6400)	0.8159 (0.6650)

Note: p=3 automatically; in parenthesis are p-values, *, **, *** are the significance level respectively for 10, 5, and 1%; ⇏ lack of Granger causality in this direction.
Source: Own calculations.

Since any linear causality relationships were detected, Hatemi-J (2012) asymmetric causality test is applied to identify the presence or not of asymmetric causality between series. After considering the series' decomposition in their positive and negative components, we run the test, and the results are as follows.

Table 8

Series asymmetric causality results

Direction of causality	Wald statistics	10% CV	5% CV	1% CV
Calories intake (+) to Growth (+)	0.067	3.340	5.132	11.631
Calories intake (-) to Growth (-)	1.641	11.659	17.322	41.639
Calories intake (+) to Remittances (+)	63.617***	13.223	22.070	52.558
Calories intake (-) to Remittances (-)	0.178	2.912	4.417	9.218
Growth (+) to Calories intake (+)	0.005	3.173	4.781	9.567
Growth (-) to Calories intake (-)	33.786**	14.863	21.013	57.242
Growth (+) to Remittances (+)	1.390	13.160	19.293	38.251
Growth (-) to Remittances (-)	2.800	14.782	21.037	58.212
Remittances (+) to Growth (+)	43.944***	12.917	19.040	34.349
Remittances (-) to Growth (-)	2.812	14.546	20.470	38.183
Remittances (+) to Calories intake (+)	3.151	14.165	21.593	47.079
Remittances (-) to Calories intake (-)	0.248	3.047	4.619	10.725

Note: *, **, *** denotes the significance at 10, 5, and 1% significance levels respectively. CV denotes the critical value; (+) and (-) represent positive and negative changes.
Source: Own calculations.

It resulted that at 1% there is an asymmetric causality from positive changes of *Remittances* to positive changes of *Growth* meaning that an increase in *Remittances* does Granger cause an increase to *Growth*. At 5%, there is asymmetric causality from negative changes of *Growth* to negative changes of *Calories intake*, meaning that a decline in Growth does Granger cause a decrease in *Calories intake*. And the last is the asymmetric causality from positive changes of *Calories intake* to positive changes of *Remittances* at 1% significance meaning that an increase in *Calories intake* does Granger cause an increase to *Remittances*.

Conclusions

This study explores the complex relationship among remittances, food security, and economic growth within the context of Turkey's economic reality, employing cointegration, linear, and asymmetric causality methodologies. Our findings provide several significant insights. Firstly, we traced the presence of cointegration among the series, indicating that these macro variables move together over the long term, necessitating comprehensive policy frameworks addressing

their link. Their synchronized movements across extended periods underline the importance of considering their aggregated impact on policy formulation process. Policymakers should prioritize initiatives that integrate these factors to ensure sustainable and inclusive economic development.

Secondly, our analysis reveals the absence of linear TY time domain causality, implying that historical values of one variable do not effectively forecast the behaviour of the others, challenging conventional forecasting approaches. Policymakers must acknowledge the limitations of linear causality models and explore alternative forecasting methods that account for the complex dynamics among remittances, food security, and economic growth. In this context, the formulation of adaptive policy frameworks that are responsive to non-linear relationships for evolving economic realities. Additionally, our investigation identifies a weak (at 10%) BCG spectral frequency domain causality from calorie intake to growth during the medium period. This nuanced discovery highlights the relevance of dietary and nutritional policies, as past calorie intake patterns appear to influence future subsequent growth trends within specific time frames. Policymakers should give priority to interventions aimed at improving access to nutritious food and addressing dietary deficiencies, particularly during periods when past calorie intake patterns have a significant influence on future growth trends. By aligning dietary and nutritional policies with economic objectives, policymakers can increase the resilience and productivity of the population, contributing to sustained economic growth. By translating frequency into months, we shed lights on the temporal dynamics of this relationship, offering policymakers valuable insights into the timing and efficacy of intervention strategies.

Lastly, our Hatemi-J asymmetric causality test reveals an asymmetric linkage from positive changes in remittances to positive changes in growth, displaying the allocation patterns of Turkish migrants' remittances. This finding suggests that remittances are not only allocated for consumption but also contribute to productive investment activities, potentially giving incentives for economic growth and development. Indeed, entrepreneurship has been more common in recent years among Turkish migrants. Policymakers should use this finding to design policies that encourage productive investment activities that are financed by remittance inflows. Fiscal facilities, better infrastructure for the new entrepreneurs (former or current Turkish migrants), legal and support and assistance for new start-ups should be considered and implemented. By facilitating channels for remittance recipients to invest in education, entrepreneurship, and infrastructure, policymakers can captive the transformative potential of remittances to drive inclusive economic growth and development.

In conclusion, the key insight our work should be transmitted, is that due to the complexity of the relationships among remittances, food security, and economic growth, policymakers should adapt a holistic approach that recognize this fact and give priority to initiatives tailored in promoting sustainable and inclusive economic development and targeting the resilience, productivity, and well-being of individuals and communities in Turkey.

Appendix A

Table A1

VECM robustness tests results.

LM test	JB test	Eigenvalue stability condition
Checked	Checked	Checked

Note: Langrange-multiplier LM test, null hypothesis accepted: no autocorrelation at 5% Jarque-Bera test, null hypothesis is not rejected: residuals are symmetric.
Source: Own calculations.

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