



On interactions between remittance outflows and Saudi Arabian macroeconomy: New evidence from wavelets



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ABSTRACT

The effect of workers' remittance outflows on macroeconomic variables of host countries is a controversial issue. The purpose of this paper is to study lead/lag interactions between workers' remittance outflows and macroeconomic leading variables in Saudi Arabia for 1980–2013 within a time–frequency framework. To this end, we perform three wavelet variants, namely, the wavelet power spectrum, the cross-spectrum wavelet, and the coherence wavelet. We show that remittance outflows are strongly associated with the main Saudi aggregates and that their relationships change across time scale and frequency bands. In the short- and mid-term, real output growth and government expenditures guide remittance outflows. More specifically, government expenditures positively affect remittance shares to real outputs. In addition, the wavelet analysis reveals a positive causality link from the active population to remittances over low-frequency bands. These outcomes have several prominent implications and point to practical recommendations in terms of monetary policy coordination and financial stability.

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1. Introduction

Immigration patterns and their effects on the economies of host countries are among the most controversial issues in economics. Those who oppose immigration fear its negative impacts on the labor market, on public finance, and on income distribution. Supporters of immigration, however, highlight the positive role it can play in helping remedy labor shortages and problems associated with aging populations.¹ Currently, remittances constitute a large source of foreign transfers to the developing world and are greater than foreign aid and private capital transfers. According to the World Bank (2014a, 2014b), in 2011, they represented three times the amount of aid sent from rich countries to poor ones.² Therefore,

international organizations and home and host country governments view remittance flows as an engine for development.

In some developing countries of origin, at the macroeconomic level, migrant remittances are viewed as altruistic and as one of the most important sources of financial growth and development. At the microeconomic level, remittances are considered to be motivated by self-interest. They alleviate poverty at the household level, improve family health, and expand durable goods ownership. Remittances can form a “family welfare system” that can help regulate consumption and alleviate liquidity constraints while also serving as a form of mutual assistance (see Orozco and Bryanna, 2007). World Bank Statistics (WB, 2014a, 2014b) show that in these countries, inflows of remittances increased from US\$52.6 billion during the 1990s to US\$204.3 billion during the 2000s and reached US\$297.3 billion in 2010 and US\$406 billion in 2013, and they reached a value of roughly US\$534 billion in 2015.

In regards to host countries, most studies have mainly focused on the effects of macroeconomic conditions on remittances. Few works have examined the effects of remittances on the macroeconomic variables of emigrant recipient countries. Theoretically speaking, remittances should be procyclical with host country economic growth. Nevertheless, empirical studies have failed to settle the debate on the cyclicity of remittances. For instance, in the case of the Germany–Turkey remittances corridor, some studies show that remittances are

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¹ In this vein, Hatton and Williamson (2002) identify four economic and demographic fundamentals that have driven migration over the past 150 years: (1) gaps between rich high-wage countries and poor low-wage countries, (2) poverty constraints that hinder migration in very poor sending countries, (3) the size of the young-adult share in sending and receiving country populations, and (4) the foreign-born migrant stock from sending countries currently residing in the receiving country.

² For some countries, remittances constitute as high a share of GDP as they represented in 2014 (31% for Tajikistan and 29% for Lesotho).

procyclical with respect to Turkish outputs and acyclical with respect to German outputs (see, for example, [Sayan, 2004](#); [Durdu and Sayan, 2010](#)). Other researchers show that remittances respond positively to German output, having no significant reaction to the economic situation in Turkey (see, among others, [Akkoyunlu and Kholodilin, 2008](#)). [Vargas-Silva \(2008\)](#) highlight that remittances vary counter-cyclically with Mexico's outputs, but the authors do not find any effects of the U.S. business cycle. For some authors, workers' remittance outflows, as a share of migrant saving transferred to the origin country, may decrease investment in the host country and then may be negatively linked to economic growth. In this vein, [Alkhatlan \(2013\)](#) argues that remittances may be regarded as withdrawals from circular flows of money, thus limiting economic activity and negatively affecting aggregate demand for the host country.

Therefore, our main research questions are as follows. How are workers' remittance outflows connected to macroeconomic aggregates of Saudi Arabia? Is this connection changing through time frequencies? How are causal lead/lag linkages evolving over time and in terms of frequency? We attempt to provide answers to all of the above listed questions by analyzing time–frequency relationships between workers' remittance outflows and leading macroeconomic variables for Saudi Arabia. More specifically, we examine lead/lag dynamic relationships between workers' remittance outflows and economic growth rates, employment rates, and government expenditures within a time–frequency framework. This investigation may give rise to additional economic and operational recommendations for policy makers and regulators in Saudi Arabia.

Empirically, we use three wavelet approach methods (the continuous wavelet power spectrum (hereafter, WPS), the cross-wavelet power spectrum (hereafter, CWPS), and the wavelet coherence (hereafter, WC)) to investigate lead/lag interactions in co-movements between workers' remittance outflows, real output growth, government expenditures, and active populations. The wavelet methodology is an engineering tool that is commonly used in the fields of image processing, engineering, astronomy, meteorology, and time series analysis. A key feature of wavelets pertains to their capacity to uncover latent processes with changing cyclical patterns, trends and non-stationarity features that generally characterize economic and financial time series. This method is also relevant for modeling economic processes where economic agents have different term (horizon) objectives (see, among others, [Aguilar-Conraria et al., 2013](#)).

To the extent that our study is concerned with lead–lag relationships between workers' outflows and key macroeconomic variables for Saudi Arabia across time scales, the wavelet analysis based on the WPS, CWPS, and CW is particularly interesting. Three main factors support our methodological choice. First, as a nonparametric free model, the CW allows for an insightful analysis of potentially nonlinear time series characteristics of aggregates and their lead–lag relationships across different time scales (i.e., short, medium, and long horizons). For instance, some researchers including [Alkhatlan \(2013\)](#) note that the relationship between remittance outflows and output growth in Saudi Arabia is changing across time horizons. This relationship has been found to be negative over short-term horizons but non-significant over long-term horizons. Conversely, [Alkhatlan's \(2013\)](#) study does not consider for lead/lag causality and its changes across different frequencies. Second, the wavelet approach allows for the analysis of power and causality between selected variables in the time–frequency domain. Third, one of the principal features of the wavelet methodology pertains to the way in which it expands underlying time series into a time–frequency space where it will be possible to visualize time and frequency variations of remittances, output growth, government expenditures, and unemployment rates in a highly comprehensive way. More specifically, wavelet coherence and phase differences allow us to jointly assess co-movements and causality linkages over time and frequency levels. Indeed, some main aspects related to lead–lag relationships between remittances and output growth, unemployment, government expenditures, and their time–

frequency varying patterns remain undefined in the literature. We argue that such factors require further attention due to ambiguities in existing evidence presented in the remittance literature. Using the wavelet tool, we can effortlessly understand potential lead–lag causal relationships between time series for concurrently high-frequency bands (short-term) and low-frequency bands (long-term). Finally, as [Rouef and Sachs \(2011\)](#) note, the wavelet methodology can be used to effectively extract time and frequency localized information, and it can be applied to non-stationary series, to locally stationary series, and to time series with eventual structural changes. Therefore, when a time series is related to output growth or when other macroeconomic variables are non-stationary or present eventual structural changes, standard empirical methodologies may generate inaccurate results and may therefore point to incomprehensive economic policy recommendations.

Despite the growing body of literature that applies wavelets to economics and finance, no previous studies have focused on the relationship between remittances and macroeconomic variables. To the best of our knowledge, this is the first study that uses continuous wavelets to provide novel insight into the dynamic relationships between workers' remittance outflows and leading macroeconomic variables. [Alkhatlan \(2013\)](#) is the most similar existing study to our paper in terms of research questions. However, our study is unique in its use of the wavelet method to analyze lead–lag dynamics of remittance outflows and other macroeconomic leading variables in the time–frequency domain. [Andersson and Karpestam \(2013\)](#) use a maximum overlap discrete wavelet transform to estimate a Keynesian consumption function where real per capita outputs and real per capita remittances are used as explanatory variables. Their main objective is to determine whether the altruism or insurance hypothesis is supported by data on 50 low- and middle-income countries for 1980–2006. Their results provide more support for the altruism hypothesis than for the insurance hypothesis.

In this work, we investigate the case of Saudi Arabia to determine the economic implications of the wavelet–remittances association. The case of Saudi Arabia is worth examining for at least three main reasons. First, Saudi Arabia is one of the most prominent host countries in terms of immigrant numbers (roughly 10 million and 30% of the total population by the end of 2014), remittances (USD35 billion in 2013, the second country after the USA), and the GDP share. According to the [WB Report \(2014a, 2014b\)](#), workers' remittance outflows accounted for 6.9% of GDP on average from 1980 to 2013. Second, the aging motive cannot explain immigration strategies witnessed in Saudi Arabia since in 2010, with 27.6% of the population being <15 years of age and with 67.6% being 15–64 years of age. Third, the rate of unemployment is relatively high (12.1% by the end of 2014) and may reach roughly 20% among those holding a university diploma. Given these realities of the Saudi economy, a study on lead/lag linkages between remittance outflows and macroeconomic variables in the time–frequency domain can offer new insights into relationships between these variables.

The wavelet analysis shows that co-movements between worker outflows and leading macroeconomic variables for Saudi Arabia are evolving through time and frequency. More specifically, we find a strong positive relationship between remittance outflows and output growth for Saudi Arabia in the high-frequency domain (short-term). This result can be explained by the fact that non-Saudi workers immediately remit their money to their home countries in the high-frequency band (1–4 years).³ Furthermore, we find strong positive coherence between remittances and real public expenditures per capita for the 1- to 4-year frequency band. The two variables are largely in phase with workers' remittances as a leading variable. In addition, our wavelet analysis shows high levels of time-varying co-evolution between

³ Three main factors may explain this behavior. First, foreign workers cannot obtain local citizenship in any of the Gulf Cooperation Council (hereafter, GCC) countries. Second, foreigners are not allowed to own property in most GCC countries. Finally, the majority of low-skilled workers are not allowed to bring their families in.

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