PERSONAL REMITTANCES, BANKING SECTOR DEVELOPMENT AND ECONOMIC GROWTH IN ISRAEL: A TRIVARIATE CAUSALITY TEST

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Abstract

The current study investigates the causal relationship between personal remittances and economic growth using Israel time series data from 1975 to 2011. In a bid to contain the omission-of-variable bias not addressed in many past studies on this topic, this study included banking sector development as a third variable in the relationship between personal remittances and economic growth to create a tri-variate causality framework. Personal remittances as a ratio of GDP, domestic credit to private sector by banks as a ratio of GDP and GDP per capita were used as proxies for personal remittances, banking sector development and economic growth respectively for the purposes of this study. It used the Johansen co-integration test to examine the existence of the long run relationship and vector error correction model (VECM) to determine the direction of causality between personal remittances, banking sector development and economic growth both in the long and short run. The findings reveal that: (1) there is a significant long run causality relationship running from GDP per capita and banking sector development towards personal remittances, (2) there is an insignificant long run causality relationship running from personal remittances and GDP per capita towards banking sector development, (3) there is no long run causality relationship running from personal remittances and banking sector development towards GDP per capita and there is no short run causality relationship between the three variables that were under study in Israel. The author therefore recommends the authorities of Israel to speed up the implementation of banking sector development and economic growth programmes in order to increase the quantity of personal remittances inflows.

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1 Introduction

The relationship between personal remittances and economic growth has been a subject of extensive research in recent years. Despite few studies that are to the contrary, the empirical work done so far seem to overwhelmingly endorse the remittances-led growth hypothesis especially in developing and emerging economies. However, most of this previous empirical work mostly suffers from variable omission bias as they just focused on establishing the relationship between the two variables (remittances and economic growth) only.

For example, Salahuddin & Gow (2015) studied the causality between remittances and economic growth using error correction model (ECM) with panel data ranging from 1977 to 2012 in India, Bangladesh, Philippines and Pakistan. Their study confirmed the existence of a strong long run co-integration relationship between remittances and economic growth in all the four countries. The short run analysis however showed a very weak association between remittances and economic growth in all the four countries that were under study (Salahuddin & Gow, 2015:215).

Oshota & Badejo (2015) examined whether remittances had an impact on economic growth in

Nigeria using error correction model (ECM) with time series data from 1981 to 2011. Their study found out that (1) in the short run, remittances had a negative influence on economic growth and (2) remittances positively influenced economic growth in the long run in Nigeria. Using VECM framework with time series data from 1980 to 2010, Rahman (2014) observed that remittances Granger caused economic growth in Pakistan in the short run. The co-integration tests also revealed the existence of the long run relationship between remittances and economic growth in Pakistan.

In a study using the ordinary least squares (OLS) multiple regressions with time series data from 1991 to 2010, Shafqat et al (2014) noted that remittances was very instrumental in the economic growth of Pakistan. Belmimoun et al (2014) examined the impact of remittances on economic growth in Algeria using VECM framework. Contrary to most empirical work on the same topic, their study observed that remittances had a negative influence on the economy of Algeria both in the long and short run. The finding resonates with few other studies such as Adams (1991) and Chami, Fullenkamp & Jahjah (2003).

In summary, previous studies on the relationship between personal remittances and economic growth are characterised by the following: (1) variable-

omission bias as they just focused on the causality relationship between remittances and economic growth, (2) contradictions with regards to the direction of causality between remittances and economic growth although the overwhelming majority supports the remittances-led growth hypothesis, (3) not a single empirical investigation on the three variables (remittances, banking sector development and economic growth) that the author is aware of has been done on Israel despite huge amounts of remittances flowing into the country annually. All these concerns are addressed by this study as it investigates the causality between remittances, banking sector development and economic growth in Israel using Johansen co-integration test and vector error correction model (VECM) with time series data ranging from 1979 to 2011.

The study used personal remittances as a ratio of GDP as a proxy for personal remittances whilst domestic credit to private sector by banks as a ratio of GDP was used as an approximate measure of banking sector development. The study also used GDP per capita as an approximate measure of economic growth. The rest of the study is structured as follows: Part 2 discusses the trends of personal remittances, economic growth and banking sector development in Israel whilst part 3 reveals related literature. Part 4 explains the data, data sources, research methodology and reports the findings whilst part 5 provides a summary of the study. Part 6 list the references.

2 Personal remittances, economic growth and banking sector development in Israel

World Bank (2014) statistics shows that personal remittances as a ratio of GDP declined by 0.52 percentage points, from 1.34% in 1970 to 0.82% in 1975 whilst domestic credit to private sector as a ratio of GDP went up by 10.64 percentage points during the same time frame (refer Figure 1).

The five year period from 1975 to 1980 saw domestic credit to private sector as a ratio of GDP significantly going up by 30.22 percentage points to end year 1980 at 70.81%. The same period saw personal remittances as a ratio of GDP going up by 1.11 percentage points, from 40.82% in 1975 to 1.93% in 1980 before it took a knock by 1.06 percentage points to end the year 1985 at 0.87%. On the other hand, domestic credit to private sector as a ratio of GDP declined from 70.81% in 1980 to 59.96% in 1985, representing a 10.84 percentage decrease before further going down by 2.36 percentage points to end the year 1990 at 57.60%.

Figure 1. Personal remittances received (% of GDP) and Domestic credit to private sector by banks (% of GDP) for Israel (1970-2010)
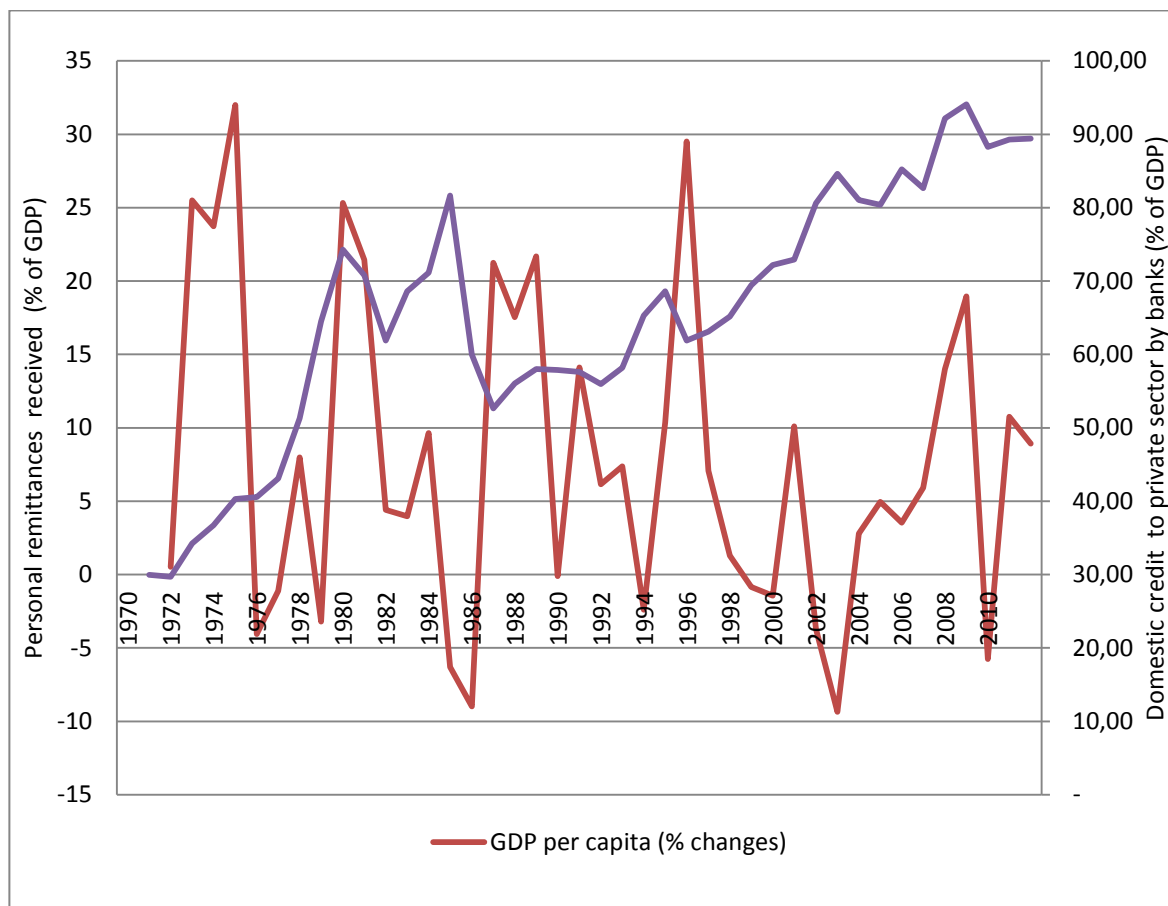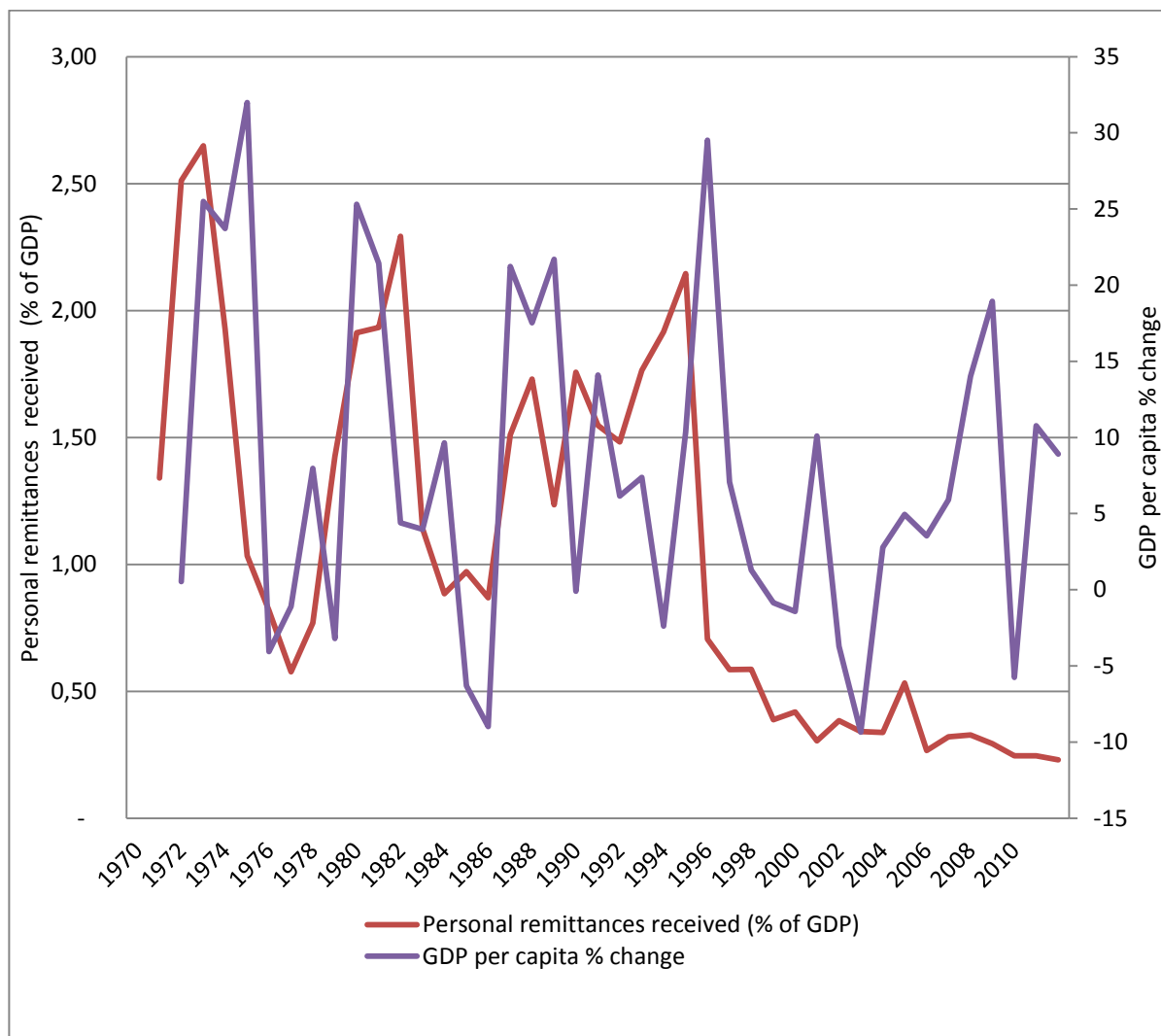

Source: World Bank (2014)

Furthermore, personal remittances as a ratio of GDP went up by 0.68 percentage points, from 0.87% in 1985 to 1.55% in 1990 before going down by 0.85 percentage points to end the year 1995 at 0.71%. The personal remittances as a ratio of GDP again declined from 0.71% in 1995 to 0.30% in 2000 before marginally losing another 0.04 percentage points to end the year 2005 at 0.27%. The subsequent five year period between 2005 and 2010 was characterised by a slight 0.02 percentage points decline before going down by the same margin from 0.25% in 2010 to 0.23% in 2011.

On the other hand, domestic credit to private sector as a ratio of GDP increased by 4.30 percentage points, from 57.60% in 1990 to 61.90% in 1995 before significantly increasing by 11.04 percentage points to end the year 2000 at 72.94%. The subsequent five year period between 2000 and 2005 saw domestic credit to private sector as a ratio of GDP further gaining another 12.29 percentage points before increasing by 4.07 percentage points, from 85.23% in 2005 to 89.30% in 2010. However, domestic credit to private sector as a ratio of GDP marginally gained a 0.09 percentage points during the year 2011 (see Figure 1).

Figure 2. Personal remittances received (% of GDP) and GDP per capita % change trends for Israel (1970-2010)

Source: World Bank (2014)

The personal remittances increased by 40.28%, from US$72 million in 1970 to US$101 million in 1975 before going up by a massive 316.83% during the subsequent five year period to end the year 1980 at US$421 million. On the other hand, GDP per capita went up by 97.67%, from US$1 806.42 in 1970 to US$3 579.74 in 1975 before it gained by 57.29%, from US$3 579.74 in 1975 to US$5 616.55 in 1980.

Figure 3. GDP per capita (% of GDP) and Domestic credit to private sector by banks (% of GDP) for Israel (1970-2010)
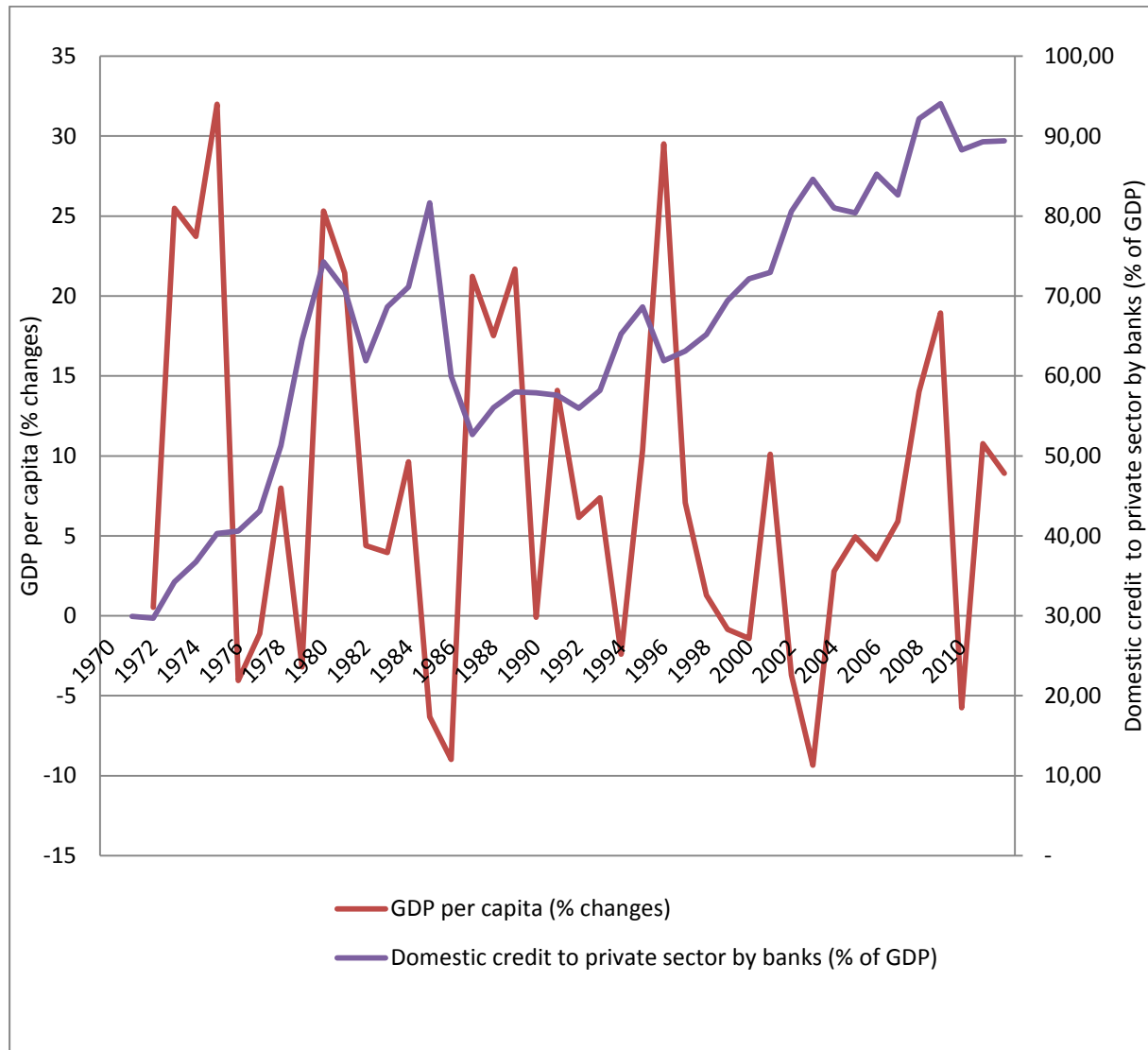
Source: World Bank (2014)

Personal remittances took a 50.26% knock, from US$421 million in 1980 to US$209,4 million in 1985 before massively gaining by 287.73% to end the year 1990 at US$811.9 million. However, personal remittances declined by 13.63%, from US$811.9 million in 1990 to US$701.2 million in 1995 before further going down by 42.91% to end the year 2000 at US$400.3 million. The period between 2000 and 2005 saw personal remittances nose-diving by 5.85% before increasing by 51.63%, from US$376.9 million in 2005 to US$571.5 million in 2010. Last but not least, the one year period between 2010 and 2011 was characterised by a 4.04% increase in personal remittances to close the year 2011 at US$594.6 million.

GDP per capita gained by 1.46%, from US$5 616.55 in 1980 to US$5 698.72 in 1985 before massively increasing by 97.66% to end the year 1990

at US$11 264.02. The subsequent five year period between 1990 and 1995 saw GDP per capita gaining another 59.02% before appreciating by 16.69%, from US$17 911.55 in 1995 to US$20 901.77 in 2000. However, GDP per capita declined by 2.51%, from US$20 901.77 in 2000 to US$20 378.06 in 2005 before a 49.92% rebound during the subsequent five year timeframe to close the year 2010 at US$30 551.12. Lastly, the GDP per capita further increased by 8.92%, from US$30 551.12 in 2010 to US$33 275.16 in 2011.

3 Literature review

Investigating the impact of remittances on economic growth using the auto-regressive distributive lag (ARDL) bounds procedure with annual data from 1980 to 2012, Kumar & Stauvermann (2014) showed

that personal remittances, output and capital per worker were co-integrated in Lithuania. The same study noted the existence of a uni-directional causality relationship running from personal remittances to output per worker thus supporting the remittances-led growth hypothesis. This was buttressed by Kumar (2013) whose study using Toda-Yamamoto revealed that remittances Granger caused output per worker whilst output per worker positively influenced the tourism sector in Kenya. Akano & Jamiu (2013) also found a long run relationship between remittances inflows, gross domestic product and openness of the economy of Nigeria. However, the causality relationship was found to be from capital formation to remittances, from gross domestic product to remittances inflows and from remittances to openness of the Nigerian economy.

On the contrary, Gjini (2013) using balanced panel data analysis observed that remittances negatively affected economic growth in Central and Eastern European (CEE) countries during the period from 1996 to 2010. This was buttressed by Driffield & Jones (2013) whose study noted that both FDI and remittances had a positive influence on economic growth in developing countries. The same study revealed that the importance of remittances on economic growth was of the same magnitude as that of FDI in developing countries, thus buttressing the remittances-led growth hypothesis.

The findings by a study carried out by Imai et al (2014) is twofold: (1) remittances played a critical role in boosting economic growth and reducing poverty levels in Asian and Pacific countries and (2) high level of volatility of FDI and remittances flows negatively impacted on the economies of Asian and Pacific countries. However, using dynamic panel data analysis, Catrinescu et al (2009) argued that remittances had a long run positive impact on economic growth only in countries whose political and economic policies were of higher quality. This was buttressed by Stratan & Chistruga (2012) whose studies observed that high levels of economic activity is a pre-condition that must be satisfied in order to accelerate more remittances inflows.

On the other hand, their study argued that for a country to benefit from remittances and enjoy sustainable growth levels, the macro-economic fundamentals of the receiving country have to be very stable (Stratan & Chistruga, 2012:1195). Using, dynamic empirical models to investigate the relationship between remittances and economic growth in Sub-Saharan African countries, Lartey (2013) found results that generally can be classified into three categories. (1) a uni-directional causality relationship running from remittances to economic growth or from remittances to increased financial development and then to economic growth, (2) financial development must exceed a certain minimum threshold levels before remittances can begin to have

an impact on economic growth and (3) remittances stabilizes the macro-economic environment and provide a enabling climate for economic growth to take place.

On the other hand, Atabaev et al (2014) investigated the relationship between imports, exchange rates, economic growth and remittances in Kyrgyz Republic using the vector auto-regression approach (VAR). Their study showed that remittances negatively impacted on exchange rates and had a positive impact on economic growth and imports levels in the short run in Kyrgyz Republic. "Economic growth is positively affected in the long run if remittances money is invested in the long term projects", argued Atabaev et al (2014:68).

Jouini (2015) examined the causality between remittances and economic growth in Tunisia using auto-regressive distributed lag (ARDL) with time series data from 1970 to 2010. The study revealed that the two variables under study were co-integrated, characterized by the feedback effect in the short run and long run uni-directional causality running from remittances to economic growth. Apart from foreign direct investment (FDI), trade openness and infrastructure providing a foundation for economic growth, Azam (2013:701) argued that remittances boost aggregate expenditures through consumption and investment thereby enhancing the economy of the Asian developing countries that were under study.

Mwangi & Mwenda (2015) investigated the influence of international remittances on the economy of Kenya using the ordinary least squares (OLS) approach with time series data ranging from 1993 to 2013. The findings from the study resonated with the remittances-led growth hypothesis. On another note, Gaaliche & Zayati (2014) investigated the relationship between remittances and poverty in Bangladesh using the non-stationary dynamic panel data analysis with time series data from 1980 to 2012. The study found out that remittances overall reduced poverty levels in Bangladesh. Feedback effect between remittances and poverty reduction was also discovered in Bangladesh. This was buttressed by Satti et al (2015) whose study using vector error correction model (VECM) observed a bi-directional causality relationship between remittances and poverty reduction in Pakistan.

Paranavithana (2014) studied the impact of remittances on economic growth of Sri Lanka using VECM framework with time series annual data from 1977 to 2012. In the short run using Wald test, the study noted that there was no causality relationship between remittances and economic growth whilst remittances Granger caused economic growth in the long run in Sri Lanka.

Marzovilla & Mele (2015) investigated the relationship between remittances, exchange rates and economic growth in Morocco using the VAR framework. Their finding buttressed the remittances-led growth hypothesis and also noted that remittances

inflows into Morocco stabilized or strengthened the local currency. Also using the VAR model, Nyeadi & Atiga (2014) noted a uni-directional causality running from remittances to economic growth marginally whilst causality from economic growth to remittances was found not to exist in the long run in Ghana. However, Ruiz & Vargas-Silva (2014) revealed the relationship between remittances and output was not stable in Mexico in the long run. During certain time periods, remittances had a pro-cyclical effect on output and counter-cyclical impact on output in other periods (Ruiz & Vargas-Silva, 2014:471).

Salas (2014) investigated the impact of remittances towards the investment decision whether or not to send children back home in Peru to either private or public schools. The finding is that despite the absence of parents, remittances had a positive influence on the probability to send children to private schools in Peru.

Dahal (2014) investigated the influence of remittances on economic growth in Nepal and found results that are threefold: (1) remittances positively influenced financial sector development and human capital development, (2) remittances negatively impacted on foreign trade and productivity levels in Nepal and (3) remittances boosted the enrolment rates at secondary schools, increased the life expectancy levels and lowered the child mortality rates in Nepal. On the other hand, Abida & Sghaier (2014) studied the relationship between economic growth, remittances and financial sector development in North African countries (Tunisia, Algeria, Egypt and Morocco) using the Generalised Method of Moment (GMM) panel data analysis with data ranging from 1980 to 2011. Their study observed that remittances had a strong positive impact on the growth of the economy and complimented financial development as a catalyst for economic growth. "The positive influence of remittances on economic growth was more pronounced when combined with financial development", argued Abida & Sghaier (2014:160).

Garip (2014) examined how migration and remittances affected wealth of the rural people in Thailand during the period from 1994 to 2000. Migration and remittances resulted in the rural poor people managing to acquire some productive assets which had a long term effect on economic growth of Thailand. However, the rich rural people of Thailand lost some the productive assets to the poor who acquired these assets using remittances thus the wealth distribution in the Thailand rural areas (Garip, 2014:692).

Shahbaz et al (2014) studied the connection between remittances, economic growth and income inequality in Pakistan using time series data from 1976 to 2006. The results are fourfold: (1) the F-bounds co-integration test revealed the existence of a long run relationship among the three variables that were under study, (2) income inequality and remittances Granger caused economic growth, (3) remittances Granger caused economic growth without any feedback effect and (4) remittances and income inequality affected each other. Using VECM, Dhungel (2014) observed that the impact of remittances on gross domestic product was very weak thereby showing that the greater portion of remittances flowing into Nepal is consumed and not being used for productive purposes. The same study noted that gross domestic product Granger caused remittances in Nepal both in the long and short run.

Masuduzzaman (2014) investigated the inter-linkages between remittances, financial development and economic growth using Johansen co-integration test and VECM with time series data from 1981 to 2013 in Bangladesh. Remittances were found to have Granger caused both gross domestic product and financial sector development both in the long and short run in Bangladesh. This was buttressed by Ojapinwa & Bashorun (2014) whose studies using GMM observed that remittances significantly influenced financial development in Sub-Saharan African (SSA) countries. The same study also noted that remittances boosted the financial sector development's ability to positively influence economic growth in SSA countries.

Using the OLS regression analysis, Kalaj (2015) revealed that remittances flows significantly increased medical and other health facilities access in the rural areas as compared to the urban areas of Albania. Furthermore, remittances flows into Albania were found to have lowered the likelihood of chronicle and sudden illness (Kalaj, 2015:672).

4 Methodology

This section includes data description, stationarity tests, Johansen co-integration tests, estimation techniques and Granger causality tests using VECM approach.

4.1 Data description

The study used Israel's time series data from 1975 to 2011 extracted from World Bank (2014) Development Indicators. The reason why the study preferred this source of data is that it is credible and figures have been standardized into the same currency (United States Dollar). GDP per capita, domestic credit to private sector as a ratio of GDP and personal remittances as a ratio of GDP were the proxies used for economic growth, banking sector development and personal remittances respectively.

4.2 Stationarity Tests

As per procedure when dealing with time series data, the study tested all the three variables for stationarity so as to do away with statistical inferences that are

misleading and to ensure that the data is not volatile. Augmented Dickey Fuller (ADF), Philips-Perron (PP) tests and Dick-Fuller GLS were used to determine the order of integration at which all the three data variables are stationary. Table A shows that all the three variables were non-stationary at level whilst Table B reveals that they became stationary at first difference.

Table A. Stationarity Tests of Variables in Levels

Variable	Test Statistic – Trend & Intercept	Critical Values	
Stationarity Tests of Variables on levels - Augmented Dickey-Fuller - Test			
y/N	-1.0584	-4.1985***	-3.5236**
PREMMIT	-3.1249	-4.1985***	-3.5236**
DC/GDP	-2.3590	-4.1985***	-3.5236**
Stationarity Tests of Variables on levels – Phillips-Perron (PP) Test			
y/N	-1.1200	-4.1985***	-3.5236**
PREMMIT	-3.3347	-4.1985***	-3.5236**
DC/GDP	-2.4207	-4.1985***	-3.5236**
Stationarity Tests of Variables on levels – Dickey-Fuller GLS (ERS) Test			
y/N	-1.2481	-3.7700***	-3.1900**
PREMMIT	-3.0372	-3.7700***	-3.1900**
DC/GDP	-2.2269	-3.7700***	-3.1900**

Note: 1) Critical values for Dickey-Fuller GLS test are based on Elliot-Rothenberg-Stock (1996, Table 1).

2) *** and ** denotes 1% and 5% level of significance respectively.

Table B. Stationarity Tests of Variables on first Difference

Variable	Test Statistic – Trend & Intercept	Critical Values	
Stationarity Tests of Variables on first Difference - Augmented Dickey-Fuller - Test			
Dy/N	-7.6120	-4.2191***	-3.5331**
DPREMMIT	-6.8292	-4.2191***	-3.5331**
DC/GDP	-6.7039	-4.2350***	-3.5403**
Stationarity Tests of Variables on first Difference – Phillips-Perron (PP) Test			
Dy/N	-22.6123	-4.2119***	-3.5298**
DPREMMIT	-11.2062	-4.2119***	-3.5298**
DC/GDP	-19.8322	-4.2119***	-3.5298**
Stationarity Tests of Variables on levels – Dickey-Fuller GLS (ERS) Test			
Dy/N	-7.7420	-3.7700***	-3.1900**
DPREMMIT	-8.0013	-3.7700***	-3.1900**
DC/GDP	-5.7215	-3.7700***	-3.1900**

Note:
Note: 1) Critical values for Dickey-Fuller GLS test are based on Elliot-Rothenberg-Stock (1996, Table 1).

2) *** and ** denotes 1% and 5% level of significance respectively.

Table B shows that all the three variables were integrated of the same order 1. This condition should be satisfied before the Johansen co-integration tests are done.

4.2 Co-integration Tests

The results of the Akaike Information Criterion (AIC) and the Schwartz Information Bayesian Criterion tests (reported in Table C) shows that the optimal lag of personal remittances, banking sector development and GDP per capita is 1.

Table C. VAR Lag Order Selection Criteria

Endogenous variables: GDPPERCAPITA DC PREMMIT

Lag	LogL	LR	FPE	AIC	SC
0	-577.7137	NA	1.72e+09	29.78019	29.90816
1	-470.3347	192.7316*	11113278*	24.73511*	25.24698*
2	-466.5636	6.188443	14671577	25.00326	25.89902
3	-463.9609	3.870690	20848811	25.33133	26.61099

* 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

The co-integration test used in this study to examine the existence of a long-run relationship between personal remittances, banking sector development and economic growth is based on the Johansen & Juselius (1990) co-integration test procedure. The approach tests the existence and the number of co-integration vectors (Mukhtar & Rashhed, 2010).

The approach employs the maximum eigen-value (LR_{max}) test and trace test (LR_{tr}) to find out the number of co-integration vectors. According to Odhiambo (2005) and Dutta & Ahmed (1997), the study should choose maximum eigen-value (LR_{max}) in the event that the findings from the two likelihood ratio tests conflict each other.

The tri-variate co-integration test is represented by equation [1].

$$Z_t = K_0 + K_1 \Delta Z_{t-1} + K_2 \Delta Z_{t-2} + \text{................}+ K_{p-1} \Delta Z_{t-p} + \grave{n} Z_{t-p} + \mu_t \qquad [1]$$

Where:

(a) Z_t = (PREMMIT, DC, Y/N) standing for personal remittances, domestic credit to private sector by banks and GDP per capita respectively.

(b) Z_t is a 3 x 1 vector of variables are integrated of order 1 (see section 4.2).

(c) K is a 3 x 3 matrix of co-efficients.

(d) μ_t stands for the vector of normally and independently distributed error term.

(e) $\grave{n}$ represents a 3 x 3 matrix of parameters.

(f) $\grave{n}$ is of the rank r (0< r<3).

The results of the co-integration tests are presented in Table D & E.

Table D. Unrestricted Co-integration Rank Test (Trace)

Eigenvalue	Trace Statistic	5% Critical Value	Hypothesized No. of CE(s)	Probability**
0.2354	12.7066	15.4947	At most 1	0.1260

Notes:
1) The lag structure of VAR is determined by the highest values of the Akaike information criterion and Schwartz Bayesian Criterion.

2) **MacKinnon-Haug-Michelis (1999) p-values

Table E. Unrestricted Co-integration Rank Test (Maximum Eigenvalue)

Eigenvalue	Maximum Eigen Statistic	5% Critical Value	Hypothesized No. of CE(s)	Probability**
0.2354	10.7379	14.2646	At most 1	0.1678

Notes:
1) The lag structure of VAR is determined by the highest values of the Akaike information criterion and Schwartz Bayesian Criterion.
2) **MacKinnon-Haug-Michelis (1999) p-values

Table D and E show that there is a unique co-integrating vector between personal remittances, banking sector development and GDP per capita. The trace statistic is less than the critical value at 5% significance level and probability is also more than 5% in both Table D and E. Therefore the study cannot reject the null hypothesis which says that there is a co-integrating vector between personal remittances, banking sector development and GDP per capita or that the three variables share a common stochastic trend.

4.3 Empirical Model Specification and Estimation Techniques

The current study investigates the causality relationship amongst personal remittances, banking sector development and economic growth in Israel using the tri-variate Granger causality test, based on the VECM approach which is represented by the following equations.

$$\Delta \text{PREMMIT}_t = \alpha_1 + \sum_{i=1}^{l} \beta_{1i} \Delta \text{PREMMIT}_{t-1} + \sum_{i=1}^{m} \gamma_{1i} \Delta \text{GDPPERCAPITA}_{t-1} + \sum_{i=1}^{n} \delta_{1i} \Delta \text{DC}_{t-1} + \sum_{i=1}^{r} \Theta_{1i} \text{ECT}_{r,t-1} + \varepsilon_{1t} \qquad [2]$$

$$\Delta \text{GDPPERCAPITA}_t = \alpha_2 + \sum_{i=1}^{l} \beta_{2i} \Delta \text{PREMMIT}_{t-1} + \sum_{i=1}^{m} \gamma_{2i} \Delta \text{GDPPERCAPITA}_{t-1} + \sum_{i=1}^{n} \delta_{2i} \Delta \text{DC}_{t-1} + \sum_{i=1}^{r} \Theta_{2i} \text{ECT}_{r,t-1} + \varepsilon_{2t} \qquad [3]$$

$$\Delta \text{DC}_t = \alpha_3 + \sum_{i=1}^{l} \beta_{3i} \Delta \text{PREMMIT}_{t-1} + \sum_{i=1}^{m} \gamma_{3i} \Delta \text{GDPPERCAPITA}_{t-1} + \sum_{i=1}^{n} \delta_{3i} \Delta \text{DC}_{t-1} + \sum_{i=1}^{r} \Theta_{3i} \text{ECT}_{r,t-1} + \varepsilon_{3t} \qquad [4]$$

Where:
PREMMIT= Personal remittances as a ratio of GDP.
DC= Domestic credit to private sector by banks as a ratio of GDP. Δ is the first difference operator whilst ECT is the error correction term.
ε_{1t}'s (for i=1,2,3) are serially uncorrelated random error terms whose mean is zero.

Equation [2] tests the causality relationship running from GDP per capita and banking sector development to personal remittances. Equation [3] tests the causality from personal remittances and banking sector development to GDP per capita whilst equation [4] tests the causality relationship running from personal remittances and GDP per capita to banking sector development.

4.4 Analysis of granger-causality test based on vector error-correction model

The VECM not only does it show the causality direction but it also distinguish between the long and short run causality amongst the variables. The negative and significant error-correction term shows that there is a long run causality relationship between or among the variables. The Wald test and the explanatory variables show the short run causality relationships among the variables.

Three models are used for the purposes of this study. The first is where personal remittances is a dependent variable, in the second model, GDP per capita is a dependent variable whilst banking sector development is used as a dependent variable in the third model (see 4.4.1; 4.4.2 & 4.4.3).

4.4.1 Personal Remittances as a dependent variable

Table F. Dependenr Variable: D (PRemit)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.475031	0.137496	-3.454861	0.0015
C(2)	0.318438	0.155977	2.041575	0.0488
C(3)	-0.003157	0.010014	-0.315278	0.7544
C(4)	4.37E-05	5.17E-05	0.845509	0.4036
C(5)	-0.075072	0.072293	-1.038435	0.3062
R-squared	0.261762	Mean dependent var		-0.057000
Adjusted R-squared	0.177392	S.D. dependent var		0.424042
S.E. of regression	0.384596	Akaike info criterion		1.043223
Sum squared resid	5.176998	Schwarz criterion		1.254333
Log likelihood	-15.86446	Hannan-Quinn criter.		1.119554
F-statistic	3.102545	Durbin-Watson stat		2.112170
Prob(F-statistic)	0.027551			

Source: E-Views 8

C(1) is the co-efficient of the co-integrated model whilst C(2), C(2), C(3), C(4) and C(5) are short run co-efficients. C(1) must be significant and negative for a significant co-integrating relationship is to exist between the three variables. In Table F, the long run co-efficient is negative whilst the p-value is less than 5%. This means that there is a significant long run causality running from banking sector development and GDP per capita towards personal remittances. In other words, GDP per capita and banking sector development had a long run influence on the quantity of personal remittances flowing into Israel during the period under study.

4.4.2   GDP per capita as a dependent variable

Table G. Dependent Variable: D(GDP Per Capita)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.034811	0.020389	1.707376	0.0966
C(2)	0.039090	0.179050	0.218320	0.8284
C(3)	-55.28421	539.8142	-0.102413	0.9190
C(4)	-23.09985	34.65653	-0.666537	0.5094
C(5)	791.1636	250.1968	3.162165	0.0032
R-squared	0.111246	Mean dependent var		786.4808
Adjusted R-squared	0.009674	S.D. dependent var		1337.520
S.E. of regression	1331.034	Akaike info criterion		17.34177
Sum squared resid	62007848	Schwarz criterion		17.55288
Log likelihood	-341.8354	Hannan-Quinn criter.		17.41810
F-statistic	1.095243	Durbin-Watson stat		1.968335
Prob(F-statistic)	0.374136			

Source: E-Views 8

As can be seen in Table G, the long run co-efficient (C1) is positive and not significant. This means that there is no long run causality running from personal remittances and banking sector development to GDP per capita.

4.4.3 Banking sector development as a dependent variable

Table H. Dependent Variable: D(DC)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.067155	0.035414	-1.896293	0.0662
C(2)	0.063430	0.160675	0.394774	0.6954
C(3)	3.070628	2.502695	1.226928	0.2280
C(4)	0.000472	0.000830	0.569186	0.5729
C(5)	1.142505	1.159966	0.984947	0.3314
R-squared	0.100873	Mean dependent var		1.492500
Adjusted R-squared	-0.001885	S.D. dependent var		6.165156
S.E. of regression	6.170963	Akaike info criterion		6.594056
Sum squared resid	1332.828	Schwarz criterion		6.805166
Log likelihood	-126.8811	Hannan-Quinn criter.		6.670386
F-statistic	0.981658	Durbin-Watson stat		1.939498
Prob(F-statistic)	0.430139			

Source: E-Views 8

The long run coefficient C(1) is negative but not significant. This means that there is a weak long run causality relationship running from GDP per capita and personal remittances towards banking sector development.

Table I summarises the short run causality (Wald tests) among the three variables.

Table I. Short run causality (Wald Tests)

Test Statistic	Value	Probability
Short run causality from GDP per capita to personal remittances		
t-statistic	0.845509	0.4036
F-statistic	0.714885	0.4036
Chi-square	0.714885	0.3978
Short run causality from banking sector development to personal remittances		
t-statistic	-0.315278	0.7544
F-statistic	0.099400	0.7544
Chi-square	0.099400	0.7526
Short run causality from GDP per capita towards banking sector development		
t-statistic	0.569186	0.5729
F-statistic	0.323972	0.5729
Chi-square	0.323972	0.5692
Short run causality from personal remittances towards banking sector development		
t-statistic	1.226928	0.2280
F-statistic	1.505353	0.2280
Chi-square	1.505353	0.2198
Short run causality from personal remittances towards GDP per capita		
t-statistic	-0.102413	0.9190
F-statistic	0.010489	0.9190
Chi-square	0.010489	0.9184
Short run causality from banking sector development towards GDP per capita		
t-statistic	0.666537	0.5094
F-statistic	0.444271	0.5094
Chi-square	0.444271	0.5051

Source: Author compilation

The findings from the short run causality Wald tests can be summarized as follows: There is no short run causality running: (1) from GDP per capita to personal remittances, (2) from banking sector development to personal remittances, (3) from GDP per capita to banking sector development, (4) from

personal remittances to banking sector development, (5) from personal remittances to GDP per capita and (6) from banking sector development to GDP per capita (refer to Table I).

Table J tell us whether there are any statistical errors in the models or not. In other words, it summarises the level of efficiency of the model used.

Table J. Checking the efficiency of the models

Checking the efficiency of the model in which personal remittances is a dependent variable			
Normal distribution test	Jarque-Bera =1.455785	P-value	= 0.0482926
Serial correlation test	Observed R-squared=0.58367	P-value	=0.04449
Heteroskedasticity test	Observed R-squared=2.51096	P-value	=0.1131
Checking the efficiency of the model in which GDP per capita is a dependent variable			
Normal distribution test	Jarque-Bera =5.099240	P-value	= 0.078111
Serial correlation test	Observed R-squared=0.12938	P-value	=0.7191
Heteroskedasticity test	Observed R-squared=10.7087	P-value	=0.0011
Checking the efficiency of the model in which banking sector development is a dependent variable			
Normal distribution test	Jarque-Bera =68.81757	P-value	= 0.000000
Serial correlation test	Observed R-squared=0.60165	P-value	=0.4379
Heteroskedasticity test	Observed R-squared=11.7082	P-value	=0.0688

Source: Author compilation

As shown in Table J, the model in which personal remittances is a dependent variable does not have serial correlation, is free from heteroskedasticity and the residual of the model is normally distributed. In a model in which GDP per capita is the dependent variable, Table J indicates that there is no serial correlation, the residual of the model is normally distributed and there is heteroskedasticity.

Furthermore, there is no serial correlation and heteroskedasticity in a model where banking sector development is the dependent variable. The same model is not normally distributed (see Table J).

Table K summarises the causality relationships between personal remittances, banking sector development and economic growth in Israel.

Table K. Summary of the long and short run causality in the VECM framework for Israel – Personal remittances, banking sector development and GDP per capita

	PREMIT→GDP PER CAPITA	GDP PER CAPITA→ PREMIT	DC→ PREMIT	PREMIT→ DC	DC→ GDP PER CAPITA	GDP PER CAPITA → DC
Long run	-	✓ (strong)	✓ (strong)	✓ (weak)	-	✓ (weak)
Short run	-	-	-	-	-	-

Source: Author compilation

5 Conclusion

The current study investigates the causal relationship between personal remittances and economic growth using Israel time series data from 1975 to 2011. In a bid to contain the omission-of-variable bias not addressed in many past studies on this topic, this study included banking sector development as a third variable in the relationship between personal remittances and economic growth to create a tri-variate causality framework. Personal remittances as a ratio of GDP, domestic credit to private sector by banks as a ratio of GDP and GDP per capita were used as proxies for personal remittances, banking sector development and economic growth respectively for the purposes of this study. Majority of the literature reviewed supports the remittances-led growth

hypothesis although other empirical studies say that it is economic growth that attracts remittances into the home country. The literature that says there is no relationship at all between remittances and economic growth (neutrality hypothesis) is very scant whilst the bi-directional view between remittances and economic growth is well supported by the empirical studies. The study used the Johansen co-integration test to examine the existence of the long run relationship and vector error correction model (VECM) to determine the direction of causality between personal remittances, banking sector development and economic growth in the long and short run. The findings reveal that: (1) there is a significant long run causality relationship running from GDP per capita and banking sector development towards personal remittances, (2) there is an insignificant long run causality relationship running

from personal remittances and GDP per capita towards banking sector development, (3) there is no long run causality relationship running from personal remittances and banking sector development towards GDP per capita and there is no short run causality relationship between the three variables that were under study in Israel. The author therefore recommends the authorities of Israel to speed up the implementation of banking sector development and economic growth programmes in order to increase the quantity of personal remittances inflows.

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