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Nexus Between Public Debt, Financial Development, and The Volatility of Economic Growth in Emerging Markets

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ABSTRACT

This paper examines the impact of government debt and financial development on the volatility of economic growth in an emerging market namely, Jordan. In this research, we examine the impact of both government debt and financial development on the volatility of (macro-level) economic growth in Jordan by implementing estimation methods for time series analysis involving VECM and GARCH models for sample data. Based on previous empirical research, we test the empirical prediction of GDP Volatility persistence. Using annual data for the period 1990 - 2018 and also using quarterly data for real GDP per capita and gross public debt for the period 2000 - 2018. The empirical analysis is based on employing a Vector Error Correction Model (VECM) to study the short-term dynamics of the long-run relationship within the cointegration framework. In addition, we utilize the GARCH and ARCH models to measure the volatility. However, the empirical results indicate that there are no clear significant effects for public debt and financial development on the volatility of economic growth, and hence there is no persistence of past volatility in elucidating the current volatility of the GDP. These empirical findings contribute to the continuing debate on the intricate dynamics between public debt, financial development, and macroeconomic stability, which is a matter of scholarly attention. It is revealed that the research considers different facets and the complexity of the Jordan economy.

INTRODUCTION

Researchers often use a generalized autoregressive conditional heteroskedasticity (GARCH) model in order to study the real GDP growth volatility. Nevertheless, the majority of these studies presuppose a volatile fluctuation-capturing stable GARCH or exponential GARCH (EGARCH) model. In addition, the standardized residuals should have a normal distribution if GARCH models capture unconditional skewness and leptokurticity (Fang and Miller, 2009). To determine the uncertainty and examine the presence and direction of potential causal links, the analysis used time series techniques in conjunction with GARCH modelling.

Moreover, the paper also deals with situations where the fluctuation of economic growth is affected by the amount of debt which is public and financial development by using time series data analysis. Thus, the proposed paper is guided by the following questions: A. What is the influence of the aggregate public debt and financial development on the turbulence of growth in the Jordan economy? B. Does the public debt in Jordan bring down the vulnerability in the growth rates of GDP in the country?. C. Is financial development considered to sustain economic growth rates as well as to mitigate its volatility in Jordan? The paper will be concluded with a summarizing and careful examination of public debt and financial development influence on volatility of the economic growth. Finally, the results of the proposed research would serve as the first step towards doing more explorations of the subject. The outcome showed no relationship between public debt and financial maturity on the volatility of growth.

1. LITERATURE REVIEW

The recent studies have focused on the relationship between public debt and financial development, and also on how financial development can generate economic growth and its volatility, especially in the less developed economies. The ideas pointed above have been the subject of several researches which have become very attractive because of the persistent yet contradictory character of these them inside economic theory. For these reasons, this section provides an overview of theoretical and empirical research on these issues. Primarily the fundamental relationship between government debt, financial performance, and economic growth volatility.

1.1 Public Debt effect on economic growth volatility

The empirical research shows that high debt levels are not always linked with poor medium-term growth. However, large public debt levels may have consequences for GDP volatility, as the following literature explains:

A. Pescatori et al. (2014) provides some evidence that more debt is associated with less stable growth. Also, volatile growth could be harmful to economic welfare. Data are primarily based on the database of gross government debt-to-GDP ratios from the IMF fiscal department, which spans almost the entire IMF membership until 1875. Specifically, countries tend to have considerably larger volatility as the debt rises over the mean of the sample (56%). Note that reverse causality should have less influence on the relationship between debt and output volatility because it isn't clear how an increase in output volatility will significantly affect debt.

The initial findings of J. León et al. (2019) indicate that 75% public debt-says GDPR will result to a slow-down of growth. Even though the volatility of the income growth for the economy has heightened by 35 percent in value. The influence of public debt on economic growth was also studied using the panel VAR analysis. It revealed that external factors like external capital flow and terms of trade react to each other. Usually, the higher the public debt levels are, the more the economy is at risk; on the other hand, growth in the long perspective is perpetual for the fiscal sustainability. The results of this research establish a unanimity that the supposed public debt ceiling is in accordance with the forecast. So it is logical to suppose that economies achieved greater debt levels than those predicted, and particularly they were found (to be) higher than those make growth more volatile. Volatility, except for GDP respectively, would increase by 35% with the public debt. A blow-up caused by the findings discussed previously means that Latin American finance is now at risk, so monetary authorities should suggest ways on how to decrease deficit levels relative to GDP.

The public debt which levels economic growth of the Latin American countries is much smaller than that of developed economies, since their abilities to take debt is at a less level (because of the per capita income). Additionally, the potential for their funds attrition is thereby higher for foreign investors and local investors alike. Therefore, the purpose level of volatility of the exchange rate can be higher as well and it can be the same situation to the stability of the countries. They have the same development in the economy.

1.2 Financial Development effect on economic growth volatility

Comparatively, scant research investigates the linkage between financial sector development and growth volatility. While without sound conclusions, the influence of the financial sector development on economic volatility has been examined extensively in the inability of existing studies to break volatility down into distinct components. However, the following literature explains that financial development might have GDP volatility consequences:

M. Ibrahim and P. Alagidede (2017) examined the impact of financial development on components of volatility and on channels by which finance in 23 sub-Saharan African nations impacts volatility over the period 1980–2014. The study employed the newly established panel estimate technique for cointegration to show that while financial development impacts non-linear business cycle volatility, its influence on long-term fluctuations is minimal. In addition, the standard deviation of GDP per capita was used as proxy volatility. In particular, advanced financial sectors are mitigating volatility. Further results demonstrate that, while monetary shocks have a substantial volatility lengthening impact, their short-term influence is tiny. Besides, this study shows that the developed financial sector lowers the influence of trade shock conditions on both the business cycle and the continuation of volatility in more open countries while trade openness increases macroeconomic fluctuations.

The study also showed that, even after controlling monetary and real shocks, financial growth helps alleviate macroeconomic volatility, therefore encouraging the financial sector to play a role in fostering risk diversification and creating liquidity within the economy. Regardless of the component, monetary shock volatility is more enduring than actual shocks and underdevelopment.

Y. Ma and K. Song (2018) used GMM estimators to examine the effect of financial development on macroeconomic volatility. Contrary to the linear association found in most prior research, this paper offers compelling evidence that financial development has a non-linear and U-Shaped effect on macroeconomic volatility. More precisely, at low levels of financial development, the increases in financial development appear to be inversely related to GDP volatility.

Using cross-country panel data over the period 1996–2012, the World Development Indicators database is the source used to collect the data for All macroeconomic and financial development variables used in the study, while the World Bank's Worldwide Governance Indicators database is the source used to collect the data for the institutional variables. The primary variable used to proxy macroeconomic volatility is output (GDP) volatility, denoted by the 5-year rolling window standard deviations of real GDP growth rate (A 5-year rolling standard deviations of the annual growth rate of real per capita GDP), and the other key variable is financial development which is measured as the private sector credit to GDP ratio,

J. Acedański and J. Pietrucha's (2019) investigation indicates that financial depth levels have non-linear impacts and that higher financial deepness growth rates are significantly linked to higher output volatility. In terms of explanations for the variance compared to the influence on private credit, the role of the latter factor is significantly more substantial. The GDP volatility is measured by growth rates of standard deviations of GDP during five-year periods (5-year rolling standard deviations of the annual growth rate of real per capita GDP). The study examined the relationships between the level and dynamics of financial depth measured as private credit to GDP ratio and volatility of GDP.

Acedański and Pietrucha's (2019) results are consistent with the literature regarding the role of financial depth. The relation is not linear. Higher financial depth is linked to more volatility as the measurement of financial depth reaches 96-124 percent of GDP. More importantly, the study demonstrated that more robust financial depth dynamics, measured by private credit, in the last 45 years have increased the GDP volatility within a large group of countries.

W. Xue (2020) found the consequences of the expansion of the financial sector on the volatility of growth with data from 50 nations. Empirical findings demonstrate that overall volatility in growth decreased globally from 1997 to 2014, with developed economies showing significantly less volatility in growth than emerging ones.

The study results revealed that the expansion of the financial sector considerably decreases the volatility of growth which is defined as (Standard deviation of monthly real industrial production growth), particularly in the lower regime, using a dynamic panel threshold model and a cross-sectional threshold.

Moreover, the development of the financial sector intensifies the inflation volatility shock towards its greater regime of volatility. In particular, in groups of nations under the lower regime, the bank credit indicators adversely influence growth volatility.

Private credit and credit allocation perform well in developed countries, whereas credit allocation and domestic credit in emerging countries are essential. Compared to developing markets, developments in the financial sector in developed economies considerably minimize the volatility of growth when private credit measures the development of the financial sector.

E. Smolo et al. (2021) examined the influence of bank concentration and financial development on economic volatility, measured as the 3-year rolling standard deviation of the annual growth rate of real GDP per capita for the Organization of Islamic Cooperation (OIC) member countries. Utilizing the panel model to evaluate the implications of bank market concentration and financial development on growth volatility through a sample that includes 49 out of 57 (OIC) member countries from 2000 to 2017.

Smolo et al. (2021) study results revealed no significant relationship between bank concentration and economic volatility when entered autonomously into the models. In the meantime, financial development mitigates economic volatility. More specifically, the volatility-increasing effect of bank concentration tends to be moderated by financial development.

1.3 Implications of public debt and financial development for economic growth volatility

The association between financial development and the growth of the economy could be explained by (Schumpeter, 1911). Financial development holds augmentations in the (a) creating of ex-ante information about expected investments, (b) monitoring of investments and using of corporate governance, (c) exchange, variation, and risk management, (d) enlistment and amalgamation of savings, and (e) conversation of goods and services. These financial parts may distress savings and investment decisions and, accordingly, the economy's growth. Meanwhile, numerous market frictions occur. While, subsequently, laws, regulations, and policies disparity crosswise economies, enhancements lengthways any single amount may have dissimilar penalties for resource allocation and welfare depending on the other frictions at play in the economy.

On the other hand, the critical policy consequence of the school of McKinnon/Shaw is that government limitations on the banking system (for example, interest rate ceilings, more reserve options, and absorbed credit programs) postponement the process of financial development and, henceforth, diminish economic growth (Demetriades and Hussein, 1996).

Similar conclusions are also gained by the endogenous growth line of literature, in which the services provided by financial mediators were established. Besides, the positive connotation between the financial system's evolution and the natural economic development, predictable by the McKinnon/Shaw technique and the endogenic growth line of literature, has documented many empirical establishments from cross-country studies (King and Levine, 1993).

The uncovered level and direction of the association between economic growth and financial development is essential as it delivers the path for the execution of policies that can have a broader influence on the growth and, therefore, on the standard of living of the populations of an economy. M. Ibrahim and P. Alagidede (2017) show that the developed financial sector lowers the influence of trade shock conditions on the business cycle and the continuation of volatility in more open countries while trade openness increases macroeconomic fluctuations.

Nonetheless, based on latest (Ma and Song, 2018, Xue, 2020, Smolo et al., 2021) studies the positive relationships between per capita income growth and financial development is far from clear. J. Acedański and J. Pietrucha (2019) found evidence to the opposite direction. A significant link was found between the degree of financial deepening growth and output volatility. Moreover, after going through the whole history (i.e. the past 45 years), they proved that financial systems were more robust and that could

be quantified by credit growth what, in the end, led to output volatility.

The existence of the state responsibility in the economic theory is actively discussed today not only for those countries that have reached the level of the developed state but for those ones that are developing as well. Essentially from the theoretical perspective, there is multitude zero the same answer. Here (Reinhart and Rogoff (2010)) can be mentioned, who studied the economies of 44 countries, and found that the growth begins to slow when public debt exceeds 90%, which is coincident with results of (León et al., 2019), who found that the increase in the debt-quarterly output ratio with the value of 75% decelerates. As it follows, public debt is a factor of systemic instability. The level of a country's public debt has served as a major driver of economic growth after the financial crisis. On one hand, A. Pescatori et al. (2014) claim that debt is positively correlated with the condition of growth, i.e. debt can make growth both more pronounced and more volatile. Also unpredictable growth fluctuations can endanger not only economy welfare but also people who are working. The high public debt, working in a mode contrary to that of countercyclical fiscal policies, increases the level of the economic volatility and long-term economic growth.

2. THE EMPIRICAL MODEL

This study uses the below model to explain the impact of public debt and financial development on the volatility of economic growth as there is a limited number of studies that introduced this relationship in one of the developing countries like Jordan. To examine that effect, this study specifies the following model:

$$RGDP_t = \alpha + \beta_1 FinDiv_{t-1} + \beta_2 INTR_{t-1} + \beta_3 TRDO_{t-1} + \beta_4 RM_{t-1} + \beta_5 DTGDP_{t-1} + \varepsilon_t \dots (1)$$

$t = 1, \dots, T$

where $RGDP_t$ is the log of real GDP per capita (Levine and Zervos, 1998). $DTGDP$ is the lagged ratio of the gross public debt to GDP (Panizza and Presbitero, 2014). $FinDiv_{t-1}$ and $CRDT_{t-1}$ represent proxies for financial development entered individually in each regression. Since there is no widely recognized empirical definition of financial development, some researchers like (Levine, 2002) classified overall financial sector development based on indicators of activity, size, and efficiency. As suggested by (Levine and Zervos, 1998 and Levine et al. 2000; and Levine, 2002), in this paper, the measures of financial development is $CRDT_{t-1}$: defined as the lagged value of credits by financial intermediaries to the private sector divided by GDP, which is commonly used as a measure of financial activity (Levine et al. 2000; Levine, 2002; Beck and Levine, 2002; and Cihák et al. 2013 and Sanfilippo-Azofra et al. 2018). The private credit to GDP has a strong statistical relation to long-term economic growth (Demirgüç-Kunt and Levine, 2008). Previous work shows that Private Credit (Levine et al. 2000; Beck et al. 2000) employ large effects on economic growth.

RM : is market return calculated as $RM_t = \log(P_{m,t} / P_{m,t-1})$. $R_{m,t}$ is the return on the market value-weighted index of the Amman Stock Exchange (ASE). $P_{m,t}$ is the market price index of Jordan at the end of period t . The market price indices are extracted from the ASE. (Cole et al. 2008) Used the lagged market excess return measure, and for the study purposes, the total market return will be used to control market performance as the above equation. Alternatively, the banking index return will be used instead of the return on the market index as used by (Cole et al.). $TRDO$ measures the trade openness ratio (Exports plus Imports) for the time $t-1$ Divided by GDP. This indicator is usually described as an indicator of a country's participation in the global trading system. $INTR$ is the lagged rediscount interest rate.

2.1 GDP volatility Process using GARCH Model

Why is GARCH a more popular and commonly used model than ARCH? The previous is extra stingy and avoids overfitting, rendering to the response. Thus, the model is less likely to violate non-negativity limitations.

By including lagged conditional variance terms in the equation, the concept of GARCH was created. (Bollerslev, 1986) developed the concept and published it in a paper titled "Generalized Autoregressive Conditional Heteroskedasticity.", The GARCH (1,1) model is the most basic type of GARCH.

The GARCH model equation is as follows:

$$GDP_t = \alpha + \beta_1 GDP_{t-1} \dots\dots\dots (2)$$

$$h_t^2 = \alpha + \beta \mu_{t-1}^2 + \gamma \sigma_{t-1}^2 \dots\dots\dots (3)$$

α = Constant

β, γ = Coefficients

μ_{t-1} = Return of previous period GDP volatility

σ_{t-1} = volatility of previous period GDP volatility

Eq. (2), according to this paper, is the mean equation that represents the relation between GDP and its lag. Eq. (3) is the variance equation that describes the volatility relation (GDP volatility).

GARCH (1,1) model may be generalized to additional lag terms. For example, In the GARCH (p,q) model, where p is the order of GARCH term σ^2 , also "q" is the order of ARCH, the term μ^2 is given by:

$$\sigma_t^2 = \alpha + \alpha_1 \mu_{t-1}^2 + \dots + \alpha_q \mu_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + \dots + \beta_p \sigma_{t-p}^2$$

In summary, the above equation might be expressed as: (4)

$$h_t = \alpha + \sum_{i=1}^q \alpha_i \mu_{t-i}^2 + \sum_{i=1}^p \beta_i \sigma_{t-i}^2 \dots\dots\dots (5)$$

σ_t^2 = Conditional variance at time t.

μ_t = Disturbance term.

$\mu_t = \sigma_t \eta_t$

where η_t is an independent and identically distributed (iid) random variable with mean zero and variance 1. In addition, σ_t^2 equals the conditional variance of the growth rate, given the information available at time t - 1. The conditions that $\alpha_i \geq 0$, $\beta_i \geq 0$, and $\alpha_1 + \beta_1 < 1$ ensure positive and stable conditional variances of μ_t . The sum, $\alpha_1 + \beta_1$, measure shocks' persistence to the conditional variances. If β_1 equals zero, the process reduces to an ARCH (1). When α_1 and β_1 both equal zero, the variance equals a constant. Estimate the model by employing (Bollerslev and Wooldridge's, 1992) quasi-maximum likelihood estimation (QMLE) technique, assuming normally distributed errors and using the (Berndt et al., 1974) (BHHH) algorithm.

A. Lunde and P. Hansen (2001) argue that GARCH (1,1) provides the best forecasting volatility results. Here GARCH (1,1) is used because (Lunde and Hansen, 2001) also argue that GARCH (p,q) will be used where daily data of several decades is used or hourly data of several years.

The estimation equations of the GARCH model:

$$GDP_t = \alpha + \beta_1 GDP_{t-1} + \gamma \sigma_{t-1}^2 + \varepsilon_t \dots\dots\dots (6)$$

$$h_t^2 = \alpha + \beta \mu_{t-1}^2 + \gamma \sigma_{t-1}^2 + \lambda DTGDP_{t-1} + U_t \dots\dots (7)$$

$$h_t^2 = \alpha + \beta \mu_{t-1}^2 + \gamma \sigma_{t-1}^2 + \lambda FINDIV_{t-1} + U_t \dots\dots (8)$$

α = Constant β, γ, λ = Coefficients, ε, U = Error terms indicators

μ_{t-1} = Return of previous period GDP volatility

σ_{t-1} = volatility of previous period GDP volatility

2.2 Data and Sample

To calculate and collect the variables such as (real GDP per capita, credits by financial intermediaries to the private sector, stock market capitalization, stock market turnover ratio, inflation, trade openness, and rediscount interest rate), this study used data from the Department of Statistics, Central Bank of Jordan, and Amman stock exchange over the period from 1990 to 2018. Noting that the years 2020 and 2019 are not included in the sample period to avoid the effect of COVID-19 and to the recent change in the methodology of calculating GDP using ISIC 4 instead of ISIC 3, which affects the availability of data to use for a long time series. In addition, this paper also used quarterly data for two variables (real GDP per capita and gross public debt) from 2000 to 2018 and used it as a robustness check for the results of the study models used in this paper.

3. RESULTS AND DISCUSSIONS

$RGDP_t$ is the log of real GDP per capita. $DTGDP$ is the lagged ratio of the gross public debt to GDP. $CRDT_{t-1}$ is the lagged value of credits by financial intermediaries to the private sector divided by GDP. RM is market return calculated as $RM_t = \log(P_{m,t} / P_{m,t-1})$. RM_t is the return on the market value-weighted index of the Amman Stock Exchange (ASE). $P_{m,t}$ is the market price index of Jordan at the end of period t . The market price indices are extracted from the ASE. $TRDO$ measures the trade openness ratio (Exports plus Imports) for the time $t-1$ Divided by GDP. $INTR$ is the lagged rediscount interest rate.

Table 1. Descriptive Statistics

Stats	Mean	Median	Std. Dev.	Minimum	Maximum
RGDP	7.089	7.076	0.131	6.845	7.316
DTGDP	0.986	0.944	0.267	0.602	1.834
CRDT	0.914	0.908	0.043	0.845	0.999
RM	0.031	0.005	0.115	-0.198	0.368
TRDO	0.866	0.854	0.141	0.665	1.176
INTR	6.181	6.250	1.960	2.500	9.000

Source: Author calculations based on the Department of Statistics, Central Bank of Jordan, and Amman stock exchange publications.

Table 2. The Unit Root Test Results

Variables	Value at Level $I(0)$		
	Intercept	Intercept and Trend	None
RGDP	-2.411	-0.760	0.835
DTGDP	-4.609***	-3.060	-2.605**
CRDT	-1.376	-1.330	-0.307
RM	-5.228***	-5.376***	-4.905***
TRDO	-1.285	-1.204	-0.669
INTR	-2.309	-3.288*	-0.975
Variables	Value at First Difference $I(1)$		
	Intercept	Intercept and Trend	None
RGDP	-3.425**	-4.432***	-3.335***
DTGDP	-3.3129**	-3.470*	-3.291***
CRDT	-4.699***	-4.595***	-4.768***
RM	-10.720***	-10.528***	-10.933***
TRDO	-4.081***	-4.112**	-4.143***
INTR	-3.450**	-3.436*	-3.502***

Source: Author calculations

*, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

As shown in table (2), the ADF results demonstrate that the null hypothesis of a unit root cannot be rejected for the given variables at 5% significance, and hereafter, all variables are non-stationary at their levels except DTGDP and RM.

In addition, the results show that, for all variables in the first differentiation data, the ADF values are greater than the critical t-value at the 90% significance level. Based on these results, reject the null hypothesis that the series has a root of unity in its first differences, and that all variables integrate to first order I (1).

3.1 Cointegration Results

The time series variables are integrated of order one, I (1), according to the results of the unit root test shown in table 2. The next test is to determine whether there is at least one linear combination of the variables integrated of order zero, I(0), and whether or not there is a stable and non-spurious cointegrated relationship between time series variables over the long run.

Table 3. Results of Optimal Lag Length Selection Using AIC HQ, and SC

<i>Lag</i>	<i>AIC</i>	<i>HQ</i>	<i>SC</i>
0	-8.404	-8.323	-8.111
1	-16.011	-15.443	-13.963
2	-15.690	-14.636	-11.887
3	-20.778	-19.236	-15.220
4	-284.620*	-280.799*	-277.306*

* Indicates lag order selected by the criterion

AIC: Akaike information criterion, HQ: Hannan-Quinn information criterion, SC: Schwarz information criterion

Source: Author calculations

The lag of the Cointegration test, VAR Model, and VECM must be chosen optimally. The study made use of “VAR Lag Order Selection Criteria” to identify the suitable lag length which should be used in the analysis. Regarding maximizing the lag length, table (3) reveals four lags of the optimal number across three models showing the Akaike information criterion, Hannan-Quinn criterion, and Schwarz information criterion. Such a result was considered in the bow of creating the most accurate models for the analysis. It is also worth mentioning that the delays in choosing the best drop length were dependent on the frequency of the used data. In general, the lead/lag time is small for annual cycles. However, the more the data frequency, the bigger the number of lag periods.

Johansen approach can be used to identify the number of cointegrated equations concerning any series of non-stationary variables of the same order. The Johansen maximum likelihood test based on the leading eigenvalue of the stochastic matrix and the trace of the stochastic matrix is presented in Table (4). These tests provide a direct proof that the variables are indeed associated with each other in the long-term equilibrium.

Table 4. Cointegration Test Based on Trace and Maximal Eigenvalue

<i>Cointegration test based on Trace</i>				
<i>Hypothesized No. of CE(s)</i>	<i>Eigenvalue</i>	<i>Trace Statistic</i>	<i>0.05 Critical Value</i>	<i>Prob.**</i>
None *	0.947	163.793	95.754	0.000
At most 1 *	0.710	84.420	69.819	0.002
At most 2 *	0.565	51.011	47.856	0.025
At most 3	0.400	28.516	29.797	0.070
At most 4	0.310	14.711	15.495	0.065
At most 5 *	0.160	4.701	3.841	0.030

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values				
<i>Cointegration test based on Maximal Eigenvalue</i>				
<i>Hypothesized No. of CE(s)</i>	<i>Eigenvalue</i>	<i>Trace Statistic</i>	<i>0.05 Critical Value</i>	<i>Prob.**</i>
None *	0.947	79.372	40.078	0.000
At most 1	0.710	33.409	33.877	0.057
At most 2	0.565	22.494	27.584	0.196
At most 3	0.400	13.805	21.132	0.381
At most 4	0.310	10.011	14.265	0.211
At most 5 *	0.160	4.701	3.841	0.030

Max-eigenvalue test indicated 1 cointegrating eqn(s) at the 0,05 level.

* denotes rejection of the hypothesis at the 0,05 level.

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

Source: Author calculations

Table (4) shows the trace test statistics for the null hypothesis without cointegration vectors and the alternative hypothesis with cointegration vectors. The trace test statistic suggests that there are three cointegration equations. Similarly, we can derive the number of cointegration vectors based on the eigenvalue test statistic. As can be seen from table (4), we show that there is a cointegration equation.

3.2 Vector Error Correction Model (VECM) Results

The study used the Vector Error Correction Model (VECM) to examine the short-term dynamics of the long-run relationship based on the cointegration test. This was done in accordance with stationary tests ADF and cointegration tests (Trace and maximum Eigenvalue), which demonstrated that the study variable was stable at the first difference and had cointegration equations.

The VAR can be constructed in terms of the levels of data or their differences with an error correction term (ECT) as an addition to capture the long-run dynamics. According to the proposed approach, the resulting model is a VECM, sometimes called a vector equilibrium correction model (Maddala, 1992; Lutkepohl and Kratzig, 2004). As a starting point, we can set a VECM for the macroeconomic variables that affect the GDP. Since the data are on an annual basis, therefore the model will be constructed as follows:

$$\Delta RGDP_t = \beta_0 + \sum_{i=0}^n \beta_1 \Delta RGDP_{t-1} + \sum_{i=0}^n \beta_2 \Delta DTGDP_{t-1} + \sum_{i=0}^n \beta_3 \Delta CRDT_{t-1} + \sum_{i=0}^n \beta_4 \Delta RM_{t-1} + \sum_{i=0}^n \beta_5 \Delta TRDO_{t-1} + \sum_{i=0}^n \beta_6 \Delta INTR_{t-1} + \sum_{i=0}^n \beta_7 ECT_{t-1} + \varepsilon_t \quad (9)$$

Where Δ is the first difference t , time, ECT_{t-1} is the error correction term lagged one period derived from the long-run cointegration relationship and measures the magnitude of the past disequilibrium, β_8 is the long-run coefficient, ε_t is serially uncorrelated error terms. $\Delta RGDP$ the differences in the $RGDP$ that capture the short-run dynamics, β_0 , intercept (constant), and $(\beta_1- \beta_7)$: Coefficients.

Table 5. Short-Run Dynamics of Macroeconomic Determinants of Economic Growth

<i>Explanatory Variables</i>	<i>Coefficient</i>	<i>t-statistic</i>
$\Delta RGDP_{t-1}$	0.407	2.252
$\Delta DTGDP_{t-1}$	-0.005	-0.065
$\Delta CRDT_{t-1}$	0.382	1.681
ΔRM_{t-1}	0.080	1.859
$\Delta TRDO_{t-1}$	-0.021	-0.308
$\Delta INTR_{t-1}$	0.009	1.549
ECT_{t-1}	-0.092	-3.201
C	0.007	1.228

<i>Explanatory Variables</i>	<i>Coefficient</i>	<i>t-statistic</i>
<i>R-squared</i>	0.594	
<i>Adj. R-squared</i>	0.444	
<i>S.E. equation</i>	0.026	
<i>F-statistic</i>	3.965	
<i>Log likelihood</i>	64.850	
<i>Akaike AIC</i>	-4.211	
<i>Schwarz SC</i>	-3.827	
<i>Diagnostic Tests:</i>		
<i>Autocorrelation, LM test</i>	30.899	[0.710]
<i>Normality Test, JB-test</i>	14.354	0.279]
<i>Heteroskedasticity, White test,</i>	298.751	[0.412]

Numbers in square brackets are P- values.

Source: Author calculations

Table (5) shows the short-run dynamics of macroeconomic determinants of economic growth using the VECM test. The dependent variable in all specifications is $\Delta RGDP$. All other variables are as defined earlier.

The error correction term (ECT) has a coefficient of -0.092, which is clearly negative. Also known as the adjustment factor or convergence rate, this factor means that the error correction term has an opposite adjustment effect when RGDP deviates from long-run equilibrium. This also means that the resulting convergence terms are relatively slow. Apply a battery of diagnostic tests to the rest of his VECM. They are shown at the bottom of Table (5). First, the LM test does not erroneously suggest serial correlation problems. Additionally, normality tests suggest evidence of nonnormality. Finally, the White test shows that the model has no heteroscedasticity problem. Therefore, we can conclude that the vector error correction model used in our analysis passed the required diagnostic tests.

From Table (6), C (1) is that of the cointegration equations and stands for the error correction term coefficient. In the model solution we need the negative signal to the coefficient and the coefficient to be statistically significant which means that there is the long-run causality from the independent variable to (RGDP). As indicated in Table (6) the sign of C (1) is negative and highly significant since the probability is 1%. This implies that a long-term causality exists from the independent variables that are the (RGDP). We also check with Wald's test because the chi-square test statistic is (10.244) and its probability is 1%. This means that there is long-term independent variable cause and effect (RGDP). The cointegration coefficient (ECM (-1)) is -0.092; the probability value is 1%. It implies that the country addresses rapidly short-term imbalances with a correction rate of 9.2%. It is similar to the above - meaning that the current year's deviation from long-run equilibrium will be corrected at a rate of 9.2%.

Table 6. VECM Estimation Results of Equation (10)

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Prob.</i>
C(1)	-0.092	0.029	-3.201	0.002
C(2)	0.407	0.181	2.252	0.026
C(3)	-0.005	0.071	-0.065	0.949
C(4)	0.382	0.227	1.681	0.095
C(5)	0.009	0.006	1.549	0.124
C(6)	0.080	0.043	1.859	0.066
C(7)	-0.021	0.068	-0.308	0.759
C(8)	0.007	0.005	1.228	0.222
R-Squared	0.716			
Adjusted R-squared	0.611			

Moreover, a percentage change in *DTGDP* is associated with a -0.005 decrease on average *ceteris paribus* in the short run, and also a percentage change in *CRDT* is associated with a 0.382 increase on average *ceteris paribus* in the short run. Denote that the VECM estimated with (3) cointegration equations for model are presented in the appendix.

3.3 GDP Volatility persistence

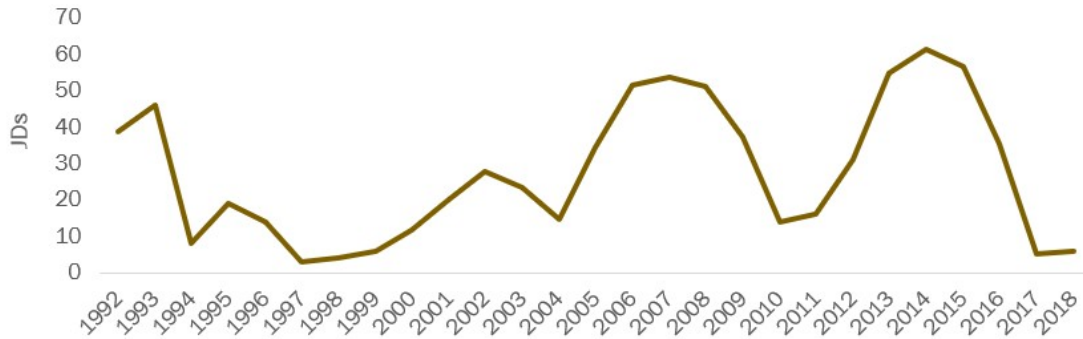


Figure 1. Three Years Standard Deviation of Real GDP Per Capita

Source: Department of Statistics and Author calculations

Using the Department of Statistics data from 1990 to 2018, this study calculates the moving standard deviation (SD) of Real GDP Per Capita every 3 years as an indicator of volatility, as revealed in figure (1). Figure (1) shows that there has been no stabilization in the volatility over the years. From 2004 till 2008, the 3-year SD seems to increase volatility, indicating some kind of volatility process. 2008 is a milestone because of the financial crisis and its effect on the economy. In addition, the period from 2010 to 2017 is affected by the Syrian crisis.

In sum, the previous milestone and events that affected the Jordan Economy and reflected the volatility of real GDP per capita were the motivation to measure GDP Volatility persistence.

Persistence of volatility refers to which volatility type and what portion of the current volatility is influenced by the volatility of the previous periods. It is, nevertheless, the GARCH(1, 1) specification that is usually used to estimate how volatility persists. Prior studies propose that ARCH and GARCH effects are used to estimate the tendency of variation to re-occur. This is indicative that the aftermaths of earthquakes are more or less long term and will not fade away. As can be seen from the analysis, the lower the GARCH and ARCH effect values are, the sooner the effects start to wear out.

ARCH alpha coefficient is commonly set anywhere in the range of 0.05 for a fairly stable market to about 0.1 for an unreliable one. The α factor quantifies how much the returns for today impact volatility of the next period while the sum of the α and β measures the speed at which this effect diminishes. Substituting the equations (6&7) in the table gives the persistence of volatility for GDP.

Table 7. Volatility Persistence Results for GDP

	Coefficient
AR(1)	
(α)	0.0003 [0.096]
(β_1)	0.711 [0.205]
(γ)	-0.110 [0.742]
$\gamma + \beta_1 < 1$	0.610
AIC	-4.091
SIC	-3.853
HQ	-4.018
Adjusted R-squared	0.924

	Coefficient
AIC: Akaike information criterion, HQ: Hannan-Quinn information criterion, and SIC: Schwarz information criterion	

Numbers in square brackets are P-values.

Source: Author calculations

The result form for the level model (GARCH 1.1). Objective evaluations of the model show that the coefficients of the three parameters of the conditional variance equation (constant, α , and β) are not significant at the 95% confidence level, as measured by their z-statistics and their marginal significance level. The sum of $\alpha + \beta$ (0.610) shows that there is no persistence of past volatility to explain current GDP volatility¹.

Table 8. Estimation Results for the effect of Debt on GDP Volatility

	Coefficient
AR(1)	
(α)	0.001 [0.124]
(β)	0.678 [0.021]
(γ)	-0.053 [0.304]
(λ)	-0.001 [0.235]
$\gamma + \beta < 1$	0.625
AIC	-4.034
SIC	-3.748
HQ	-3.947
Adjusted R-squared	0.924

AIC: Akaike information criterion, HQ: Hannan-Quinn information criterion, and SIC: Schwarz information criterion

Numbers in square brackets are P-values.

Source: Author calculations

The sign of the indicator λ defines the relationship between volatility and debt, as it is clear from the results shown in table (8), λ is negative and not significant, suggesting that there is no association between the volatility of GDP and debt².

Table 9. Estimation Results for the effect of Financial Development on GDP Volatility

	Coefficient
AR(1)	
(α)	-0.002 [0.675]
(β)	0.746 [0.215]
(γ)	-0.072 [0.689]
(λ)	0.002 [0.630]
$\gamma + \beta < 1$	0.674
AIC	-3.971
SIC	-3.685
HQ	-3.883
Adjusted R-squared	0.919

AIC: Akaike information criterion, HQ: Hannan-Quinn information criterion, and SIC: Schwarz information criterion

Numbers in square brackets are P-values.

Source: Author calculations

¹ This result has been tested by using quarterly data for real GDP per capita from 2000 to 2018 and it gives the same results as the annual data.

² This result has been tested by using quarterly data for real GDP per capita and gross public debt from 2000 to 2018, and it gives the same results of the relationship between real GDP per capita and debt as used in the annual data.

The sign of the indicator λ defines the relationship between volatility and debt, as it is clear from the results shown in table (9), λ is positive and not significant, suggesting that there is no association between the volatility of GDP and financial development measured by CRDT.

CONCLUSIONS

In this research, we examine the impact of both government debt and financial development on the volatility of (macro-level) economic growth in Jordan by implementing estimation methods for time series analysis involving VECM and GARCH models for sample data. It employs data collected by the Bureau of Statistics, the Central Bank of Jordan and the Amman Stock Exchange from 1990 to 2018 on the Jordanian market, one of the emerging economies.

Based on the results of stationary ADF tests and cointegration tests (trace and maximum eigenvalue) performed to determine the appropriate method to analyze the time series data, it was found that the test variable was stable at the first difference and had cointegration equations in the study the short-run dynamics of the long-run relationship based on the cointegration test, a vector error correction model (VECM) analysis was performed and it was shown that "there is a long-run causality from the variables to (RGDP) In addition, this document implements the ARCH and GARCH estimation methods , to measure the persistence of volatility. According to the results of the analysis, it was found that there is no correlation between government debt and financial development on the growth economy volatility, and there is no persistent volatility to explain the current GDP volatility (on macro level) in Jordan.

Thus, the findings show that this study failed to determine the drivers of GDP growth volatility. Therefore, future research is invited to investigate the determinants of GDP volatility. Moreover, Jordan's sustainability risks reflected by the new consolidated debt concept for public debt sustainability analysis would be a good subject for future research. Nevertheless, the efficiency of the consolidation process for the Social Security Corporation operations, which could help to reflect the underlying debt sustainability risks and liquidity pressures over the near- and medium-term, would be also an interesting subject to analyse.

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