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Dynamic Linkages Between Profitability and Its Determinants: Empirical Evidence from Jordanian Commercial Banks

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Abstract

This paper employed the panel Unit root tests, co-integration, and panel Autoregressive Distributed Lag (ARDL) model to examine the link between banks' profitability and its determinants for 13 Jordanian commercial banks between 2000 and 2018. Pooled mean group (PMG) and dynamic fixed effect (DFE) models were applied. Hausman test result confirmed that DFE was preferred to PMG. The results confirmed the existence of a long-run equilibrium relationship between commercial banks' profitability and their determinants. In the short-run, banks' profitability in Jordan is positively related to return volatility. However, this is negatively related to credit risk and market concentration. In the long run, profitability is positively related to credit risk and negatively related to operational risk, bank size, stock market volatility, and market concentration. Credit risk and capital have bi-direction causality with banks' profitability, while GDP and market concentration have uni-direction causality. At present, the Jordanian economy during the Covid-19 pandemic triggered the banking sector's impact on the economy as the sector contributed to 20.8% GDP in 2019. The findings can help stakeholders such as bank managers, investors, shareholders, and policymakers make better decisions on banks' performance, thereby contributing to their economies.

Keywords: Profitability, Commercial Banks, Pooled Mean Group, Dynamic Fixed Effect, Jordan

JEL Classification Code: G14, G32, G21, C58, C23

1. Introduction

Over the past decades, bank profitability determinants have attracted different stakeholders, such as scholars, policymakers, and governments. Several studies (Garcia & Guerreiro, 2016; Dietrich & Wanzenried, 2014) confirmed that banks' profitability is vital to the banking industry's stability and competitiveness. In 2008, the Lehman Brothers' bankruptcy increased stakeholder interest in profitability because low profitability was the main reason for prominent institutions' failure (Bolarinwa et al., 2019; Garcia & Guerreiro, 2016). Disruptive bank collapse led to the advancement of economies, particularly The European Union and the United States of America, are reducing the reliance on banks' profitability as a significant indicator of the competitiveness of the banking industry and the financial sector's stability (Garcia & Guerreiro, 2016). An investigation of the determinant of a bank's profitability is critical to the financial sector's stability and the economy.

Previous studies have argued that past values of a bank's profitability (the role of profit persistence) can influence a bank's profitability. Nevertheless, recent studies from developed countries (Garcia & Guerreiro, 2016; Ariyadasa et al., 2017) considered that profit is dynamic. These studies have argued that ignorance of this issue (profit dynamicity) in commercial bank profit modeling may lead to spurious and inconsistent results. Consequently, many studies in emerging economies have neglected the role of profit persistence (Bolarinwa et al., 2019). The studies in the Jordanian context neglected the profit persistence issue while constructing the bank profitability determinants model.

Jadah et al. (2020) stated that in most MENA countries, including Iraq, money, and stock markets are currently underdeveloped. Consequently, commercial banks play

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a significant and essential role in regional economies. Therefore, a fragile banking system, which can be exacerbated by low profitability, can damage the entire financial system of the affected country or even spill over to other countries, especially in the case of international banking operation

In this study, many reasons influence the choice of the Jordanian banking sector. First, there are only a few studies on the profitability of the Jordanian banking sector. Second, Jordan is a small country with limited resources that suffers from high government debt and slow economic growth and relies heavily on the banking sector (Bekhet & Al-Smadi, 2017; Bekhet et al., 2020). In 2019, Jordan's GDP growth reached 2.0%, and public debt reached 99.1% of its GDP (World Bank, 2020a). Third, the banking sector is relatively large, and licensed banks' assets reached 161.9% of the state's GDP at the end of the fiscal year 2018. The assets of the banking sector accounted for 93.3% of the state's financial system. This banking sector contributes 20.8% of the GDP to the Jordanian economy and the real estate and insurance sectors (CBJ, 2020a). Fourth, in the past two decades, the Jordanian banking sector recorded the highest profit value, reaching 2.0% at the end of 2005. However, this value decreased to 1.2% in 2018 (CBJ, 2020b). Thus, management and policymakers need to understand the factors affecting low profitability to stimulate the financial sector, thus, contributing to Jordan's GDP.

This paper focuses on the dynamic links between bank profitability and its determinants in formulating the best policy for stimulating the sector through casualty analysis. It also aims to define the short and long dynamic relationships between commercial bank profitability and its determinants using a set of panel data spanning from 2000 to 2018 (for more details, see Section 4).

This study makes several contributions: (a) we use the Panel Autoregressive Distributed Regression (PARDL) model to study the fundamental dynamic relationship between commercial bank profitability and its determinants. This model has rarely focused on Jordan. The study highlights the inherent homogeneity problems arising from the persistence of profit in a modeling bank's profitability that previous studies ignored. PARDL is worth studying if the variables contain mixed $I(1)$ and $I(0)$ as well as $I(1)$ or $I(0)$. Besides, PARDL allows for the use of a large number of lagged periods. It also helps avoid problems of smoothing and chain linking bias. (b) This paper examines the long-term and short-term relationships between internal and external factors and bank profitability. (c) This study attempts to discover the impact of yield fluctuations for the first time in the Jordanian context. (d) It examines the suitability of structural conduct performance (SCP) in the Jordanian banking sector. (e) It also sheds light on the causal trend between banks' profitability and their determinants, which is essential for improving decision efficiency. Finally, we compared the results to previous studies to fill the void in the literature. This study used data from 13 commercial banks in Jordan from 2000 to 2018.

The remainder of this paper is organized as follows. The second section provides an overview of the Jordanian banking sector. Section 3 discusses the theoretical background and previous studies. Section 4 describes data sources, variables definitions, and methodology procedures. Section 5 provides reports on the experimental results and a discussion. Section 6 presents the conclusion and policy implications.

2. Overview of the Jordanian Economy and Banking Sector

Jordan is characterized by a high unemployment rate, inflation, poverty, and a high budget deficit. The country is heavily dependent on foreign aids. The GDP slowed down by one percentage point in 2013, and inflation accelerated to 4.6% in 2014. The increase in rental prices is the primary cause for the increase in inflation despite the slower economic growth, reflected by the increase in demand owing to a large refugee influx. Jordan's property market is facing an uphill struggle as citizens deal with lower finances and higher interest loans from banks. Significant investment from non-Jordanians in the market has also contributed to increased prices of apartments and houses, which are now out of reach for many Jordanians. The inflation and GDP growth rates were 4.3% and 4.2% between 1978 and 2020, respectively. World Bank (2020b) highlighted that crises in Syria and Iraq caused a flood of refugees, increased the cost of health and education, and cut out its commerce routes. Besides, a decline in external aids has put a burden on Jordan in the short- and medium-term. In 2019, the government debt reached 99.1% of its GDP (World Bank, 2020b). The global economic growth decreased slightly in 2019 compared to its growth in 2018; the global real GDP growth rate reached 2.9% in 2019 compared to 3.6% in 2018. So, the unemployment rate edged up to 19.2 percent, 18.6 percent in the same period in 2018 (Department of Statistics, 2020). Moreover, in the last two decades, the Jordanian economy has been affected by regional political conflict. And the inflation accelerated owing to the political instability in Syria and Iraq.

However, the financial sector played a vital role in improving economic development in the past years. As mentioned previously, the banking sector is the most significant financial sector component, with about 93.5% financial assets, reaching JD 54.7 billion at the end of the 2019 fiscal year (CBJ, 2020b). The banking system played a crucial role in motivating economic growth, contributing to 20.8% of its GDP and the insurance and real estate sectors (CBJ, 2020a). However, a healthy banking sector drives economic growth and facilitates economic activity. The monetary and banking policy implemented

by the CBJ during 2019, was characterized by flexibility, and responsivity to domestic, regional, and international economic developments, in line with its mandate of maintaining monetary and financial stability represented in sustaining the stability of appropriate inflation rate, and the exchange rate of the Jordanian Dinar (JD). The performance of the licensed banks improved during 2019, as their total assets grew by 5.4 percent to reach JD 53.6 billion. Deposits increased by JD 1.5 billion, with a growth rate of 4.3 percent, most of which were in JD. Furthermore, credit facilities extended by licensed banks grew by 3.7 percent, most of which were extended to the private sector. As for the market interest rates, the interest rate margin decreased by 31 basis points, compared to the end of 2018, to reach 3.65 percent. Theoretically, this ratio demonstrates the bank's capital strength. CBJ pegs the compulsory ratio to 12.0%; whereas, the Basel committee ratio is 8.0%. The ratio shows whether the capital is sufficient to withstand shocks (Ahmad et al., 2016).

In 2019, the concentration ratios of the banking sector in Jordan continued to follow a downward trend, while the competitiveness levels kept their upward trend. The assets of the largest five banks out of 24 banks accounted for 53.6% of licensed banks' total assets at the end of 2019, compared to 60% ten years ago. The improvement in the competitiveness is due to banks' continuous enhancement and continuously seeking to upgrade their businesses and products to increase their competitive capabilities, in addition to the increase in the number of banks after licensing three new banks in 2009 (CBJ, 2020b). The determinants of bank profitability in general, and of the impact of market structure and efficiency on bank performance in particular, remain a much-researched topic in bank performance analysis. The validity of the SCP hypothesis is examined by using the Herfindahl-Hirschman Index (HHI), which is one of the most commonly used measurements of industry concentration. The HHI is calculated as the sum of the squared market shares of each firm in the industry (Bucevska & Misheva, 2017). However, the time trend of the HHI for the Jordanian banking sector for 2000 to 2018 periods showed a downward trend since 2000 with a value of 4,687 points in 2000, reaching 2,315.8 points in 2018, reflecting a significant increase in the industry competition. However, the Jordanian banking system enjoys a sufficient and safe liquidity level as indicated by liquidity ratios registered at the end of 2019. The total high-liquid assets accounted for 45.6% of total assets at the end of 2019 compared to 44.9% at the end of 2018. This increase in the liquidity ratio is due to the larger growth in deposits than the growth of credit facilities. Legal liquidity increased to 133.8% at the end of 2019, compared to 131% at the end of 2018; the minimum requirement of legal liquidity is 100% (CBJ, 2020b).

Bekhet and Eletter (2014) stressed that credit risk is one of the most critical banking environment issues, and its risk-taking affects banks' profits and behavior. In 2003, the ratio of non-performing loans was 15.5%. Then, it declined significantly, reaching its lowest point in 2007 at 4.1%. This decrease is enhanced by economic activities, improvement in banks' management efficiency, and banks' write-offs of non-performing loans with full collaterals. However, the ratio increased again after the global financial crisis of 2008, reaching 8.5% in 2011 (Rajha, 2016). It fluctuated again, reaching 5 % in 2019 (CBJ, 2020b).

After reviewing the Jordanian economy, we examine the factors responsible for the bank's profitability. Besides, we highlight the favorable and unfavorable factors influencing bank profitability, allowing bank management policymakers to control and boost the variables associated with profit growth in banks. These factors help grant more credit to the economy, guarantee more flexible capital ratios, and offer shareholders fair returns.

3. Theoretical Background and Literature Review

3.1. Theoretical Background

Existing literature has confirmed two theories explaining bank profitability. These are the Structure-Conduct-Performance (SCP) paradigm and the efficiency theory (ET) (Athanasoglou et al., 2008; Dietrich & Wanzenried, 2014). Mason (1939) and Bain (1951) proposed the SCP (the Harvard school theory). According to this theory, monopoly profit is developed through the ascending market share or power (Athanasoglou et al., 2008). However, the hypothesis of SCP is based on the assumption that market concentration is the ideal market power measure (Ahmad et al., 2016). Prior research focuses mainly on the structure-conduct-performance (SCP) hypothesis or market-power. SCP suggests that banks in more concentrated markets are subject to less competition and typically set prices that are less favorable to consumers, e.g., lower deposit rates and higher loan rates. Conversely, the efficient structure hypothesis suggests that more efficient banks incur lower costs and therefore, earn higher profits. The more efficient banks increase their market share and hence, the industry becomes more concentrated. Many banking studies find positive relationships between profitability and concentration.

This theory states that market structure affects firm conduct and performance, showing that variables like size, concentration, diversification, cost structure, and product differentiation have a direct and positive impact on variables like merger and acquisition, legal strategies, pricing strategies. Therefore, the theory states that bank profitability is determined by internal factors such as size, liquidity, operational efficiency, and external factors such as market concentration (Mason, 1939; Bain, 1951). Besides, ET

(the Chicago school theory) stated that product differentiation and management efficiency determine profitability and market power rather than market concentration. This theory postulates that firm power and dominance as a result of efficiency. Demsetz (1973) challenged the SCP theory by arguing that competitive behavior leads to efficiency. Besides, better customer satisfaction policies and the latest technology are ways to gain market power.

3.2. Review of Empirical Literature

The empirical literature provided substantial evidence about bank profitability determinants. Table 1 summarized these studies published within the last six years. These parameters are rated. (i) Bank-specific factors (operating risk, bank size, liquidity, capital risk, credit risk, financial leverage, and diversification). These elements are vital in determining bank profitability. (ii) Industry-specific factors and market concentration measured by the HHI have been found to impact bank profitability significantly. (iii) Empirical studies have also examined several macroeconomic determinants (GDP, per capita GDP, inflation, and financial crisis) that significantly affected banks' profitability. Many studies focused on a panel of countries and a specific country. However, some studies made distinctions between developed and developing economies. In this study, we classify countries into developed and developing countries. Then, we focus on the Jordanian economy.

a. In developed countries, the concept of bank profitability has received considerable attention of many scholars: Greece (Vogiazas & Alexiou, 2015); Croatia (Pervan et al., 2015); Portugal (Garcia & Guerreiro, 2016); France (Bouzgarrou et al., 2018); New Zealand (Kumar et al., 2020). Other studies used samples from a panel of countries: Netherlands, Spain, United Kingdom, France, Germany, Switzerland, Denmark, Austria, Italy, and Belgium (Ercegovac et al., 2020); Estonia, Bulgaria, Croatia, Cyprus, Czech Republic, Malta, Hungary, Latvia, Lithuania, Romania, Poland, Slovenia, and the Slovak Republic (Nina & Socol, 2020). Besides, for panel study.
b. Bank profitability in developing countries has received the interest of many scholars: Tunisia (Bougatef, 2017); Selected Balkan countries (Bucevska & Misheva, 2017); Vietnam (Phan et al., 2020; Dao & Nguyen 2020); Indonesia (Prasanto et al., 2020); Thailand (Hasan et al., 2020); India (Almaqtari et al., 2019; Ariyadasa et al., 2017); Sri Lanka (Pisedtasalasai & Edirisuriya, 2020).
c. Many scholars explored bank profitability in Jordan in the last ten years (Alshatti, 2016; Shamki et al., 2016; Omet, 2019; Saleh & Afifa, 2020).

All these studies confirmed that many variables influenced bank profitability. However, some of these studies confirmed that bank capital, credit risk, operational risk, and bank size are crucial internal determinants of bank profitability. In contrast, market concentration, GDP, and inflation are critical external determinants.

Based on Table 1 majority of the studies used GMM and FEM models. This paper uses PMG to achieve the objectives of the paper, as mentioned earlier. Also, a review of this literature assists in achieving the study aims and formulating the following hypotheses:

H1: *The Jordanian commercial banks' profitability and its determinants are significantly integrated with I(1), I(0), or purely I(1), I(0) mixed.*

H2: *There is a significant dynamic equilibrium relationship between Jordanian commercial banks' profitability and their determinants.*

H3: *There are significant dynamic long-run and short-run impacts of credit risk, capital risk, operational risk, and bank size variables on commercial bank profitability in Jordan.*

H4: *There is a significant dynamic long-run and short-run impact of market concentration, return volatility, inflation, GDP variables on commercial bank profitability in Jordan.*

H5: *Casualty direction between commercial banks' profitability and their determinants exists.*

4. Data and Methodology

4.1. Sample, Data Sources, and Variables Definitions

We sample all commercial banks operating in Jordan for more than 19 years spanning from 2000 to 2018. Foreign banks are not included in the sample owing to their financial statement unavailability. Islamic banks are also excluded as they operate under different principles (Murabaha). The credit risk, capital risk, operational risk, and bank size variables are calculated directly from banks' financial statements, collected from the Amman Stock Exchange database (http://www.ase.com.jo). Besides, we collected the market concentration, return volatility, inflation, and GDP variables from the World Bank database and banks' financial statements (http://www.worldbank.org).

Bank profitability determinants (Return on Asset, RA) are classified into two groups. First, factors within the bank scope (internal determinants) are credit risk I, capital risk (K), operational risk (O), and bank size (Z). Second, factors beyond the control of bank managers (external determinants), which are market concentration (M), return volatility I, inflation (I), and GDP (G). We use annual balanced panel

Table 1: Summary of Selected Empirical Studies

Country	Author(s)	Sample (banks)	Data Period	Methodology	Influence on Profitability	
					Positive	Negative
A. Developed Countries						
Greek	Vogiazas & Alexiou (2015)	17	2004–2010	GMM	K; HP; PC; G	PD; O
Croatia	Pervan et al. (2015)	46	2002–2010	GMM	M; LP; ID; Z; K; G; MG	O; C; I
Portugal	Garcia and Guerreiro (2016)	27	2002–2011	OLS/FEM	MG; HDI; (K; C; IR; GD) during the financial crises period	OE; G; (K; C; IR; GD) before the financial crises
France	Bouzgarrou et al. (2018)	170	2000–2012	GMM	LP on foreign banks; LR; D; I	LP on domestic banks; C; K; G
New Zealand	Kumar et al. (2020)	19	2006–2018	GMM	K; short term IR	Long term IR; C; OE
10 European Countries	Ercegovac et al. (2020)	22	2007–2019	GMM	OE; C	–
12 European Countries	Nina and Socol (2020)	13	2000–2017	Robust OLS	K; I; G	LDR
B. Developing Countries						
Tunisia	Bougatef (2017)	11	2003–2011	GMM	CO; LR; K; Z; O	C
Balkan Countries	Bucevska and Misheva (2017)	127	2005–2009	GMM	O; K; IM; LP	C; M
Indonesia	Prasanto et al. (2020)	4	2007–2017	VECM	LDR; O; C; G; EX	–
	Hasan et al. (2020)	26	2007–2018	FEM	LDR; NIM; COC; FED	O; K
Veitnam, Malaysia, Thailand	Dao and Nguyen (2020)	27	2012–2016	FEM	C	O; Z; K
Vietnam	Phan et al. (2020)	10	2008–2018	OLS/2SLS	O; L; OS; I; G	–
India	Almaqtari et al. (2019)	69	2008–2017	REM/GMM	Z; AM; I; the number of branches	IR; G; EX
Sri Lanka	Ariyadasa et al. (2017)	10	Q42006–Q42014	Panel ARDL	In S-R: K; LR; NIM In L-R: IR; NIM; LR	In S-R: IR; Armed conflict. In L-R: K; Armed conflict
	Pisedtasalasai and Edirisuriya (2020)	17	2001–2016	2SLS	D; K;	O; C; I; WAR; UGB

Table 1: (Continued)

Country	Author(s)	Sample (banks)	Data Period	Methodology	Influence on Profitability	
					Positive	Negative
C. Jordanian literature						
Jordan	Alshatti (2016)	13	2005–2014	MR	K; MK; V	C
	Shamki et al. (2016)	13	2005–2013	MR	LDR	K
	Omet (2019)	13	2009–2017	SUR	D	–
	Saleh & Afifa (2020)	13	2010–2018	FEM	C; LR; Z; O	K; G

Notes: Growth of total loan: GL; Operational risk: O; interest income to total income: IM; Funding cost: FC; Ownership: OS; Growth of deposit: GD; bank size: Z; capital: K; Inflation: I; Credit risk: C; Public debt to GDP: PD; Housing prices: HP; Private consumption: PC; Market concentration: M; Lagged Profitability: LP; Intermediation: ID; Market growth: MG; Household disposable income: HDI; Diversification: D; Personal income growth: PIG; Housing index: HI; Liquidity risk: LR; Unemployment rate: UNEMP; Interest rate: IR; Loan to deposit ratio: LDR; Deposits: DEP; Loan: L; Asset Growth: AG; Merger and acquisitions: MA; Loan to asset ratio: LA; Burden to asset ratio: BA; Net interest margin: NIM; Corruption: CO; asset management: AM; Exchange rate: EX; Consumption of cement: COC; Federal rate: FED; Debt ratio: DR; market capitalization: MK; Leverage: V; Growth domestic product: G; Multiple regression: MR; Unlisted Government banks: UGB; Seemingly unrelated regression: SUR; Fixed effect model: FEM; Random effect model: REM; Generalized method of moment: GMM; autoregressive distributed lag: ARDL; Two stage least square: 2SLS. S-R: Short-Run; L-R: Long-Run.

Table 2: Variables Description, References

Variables	Definition	References
RA	Profit before interest and tax divided by total assets (%)	(Ariyadasa et al., 2017; Bucevska & Misheva, 2017; Knezevic & Dobromirov, 2016; Paolucci & Menicucci, 2016)
C	Loan loss provision divided by total loans	(Paolucci & Menicucci, 2016; Bucevska & Misheva, 2017)
K	Total equity to total asset ratio	(Alshatti, 2016; Sun et al., 2017)
O	Operating expenses divided by total income	(Garcia & Guerreiro, 2016; Zarrouk et al., 2016; Ariyadasa et al., 2017)
Z	Natural logarithm of total asset	(Dao & Nguyen, 2020; Saleh & Afifa, 2020)
M	HHI index	(Pervan et al., 2015; Knezevic & Dobromirov, 2016; Bucevska & Misheva, 2017)
R	Annualized Standard Deviation of daily stock return	Agusman et al., (2008)
I	Δ in a consumer price index	(Pervan et al., 2015; Zarrouk et al., 2016; Bucevska & Misheva, 2017)
G	GDP growth rate	(Pervan et al., 2015; Zarrouk et al., 2016)

data for these determinants within (2000–2018) for all thirteen commercial banks working in Jordan. Data with the dimensions of time series for the (2000–2018) (i.e. $t = 1, \ldots, T$) and cross-sections (i.e., $i = 1, \ldots., N$) are panel data set. Then, the observation number is ($I \times t = 247$). Table 2 summarizes these determinants and previous studies that use these determinants.

4.2. Model Construction

In empirical research, the panel data model examining the relationship between financial performance and its determinants has many advantages. For example, panel data compares countries' cross-sectional characteristics to capture the RA's dynamic interaction and determinants.

Besides, as many observations increase the degree of freedom, the estimation would become more efficient. Based on the theoretical background, past studies, and the model of Ariyadasa et al. (2017), we develop Equation (1) to present the relation between the dependent variable (RA) and its regressors for Jordanian commercial banks.

$$RA_{it} = \alpha_{i0} + \beta_1 C_{it} + \beta_2 K_{it} + \beta_3 O_{it} + \beta_4 Z_{it} + \beta_5 M_{it} + \beta_6 R_{it} + \beta_7 G_{it} + \beta_8 I_{it} + \varepsilon_{it} \quad (1)$$

where, i = 1, 2, …, 13 denote the banks; t = 2000, 2001, …, 2018 denote period; ε_{it} is the error term.

We use many steps to achieve the study objectives. **First**, we use descriptive statistics and an interrelationship matrix to check the data quality. **Second**, we check panel data stationary through various panel unit root tests, which are prerequisites because simple OLS techniques lead to spurious results (Bekhet & Othman, 2017). Then, we use panel unit root tests of Augmented Dicky Fuller (ADF), Im-Persan-Shin (IPS), Phillips-Perron (*P-P*), and Levin-Lin-Chu (LLC) methods. **Third**, we use Pesaran et al. (1998) estimators (MG & PMG) under the ARDL approach to estimate the long-run and short-run relationship among the variables. Their difference is that the MG estimator seems to be more consistent with the assumption that both the slope and intercepts vary across sections (Banks). In comparison, the PMG estimator is consistent with the assumption of long-run slope homogeneity. An alternative estimator assumes that the homogeneous slope is dynamic fixed effects (DFE); whereas, the slopes are fixed, and the intercepts vary across sections (Banks).

For the panel ARDL, the MG estimator estimates the long-run parameters from ARDL models for individual banks. However, the MG estimator is sensitive to the size of the time-series dimension. Therefore, this paper compares the PMG and DFE estimation results as our data for both *N* and *T* are small. Using a Hausman test, we test the PMG estimator's suitability relative to the DFE estimator based on the two estimators' consistency and efficiency properties. The Hausman statistic (HS) is a chi-squared distribution. For the null hypothesis, PMG is preferred. If the HS is higher than the critical value, the hypothesis is rejected. Thus, we prefer PMG to DFE.

The advantages of the ARDL approach are that regardless of regressors being *I*(0) or *I*(1), it is applied if the variables have mixed *I*(1) and *I*(0) and purely *I*(1) or *I*(0). Besides, it permits many lags. Also, it helps to avoid the problem of hypotheses test failing caused by endogeneity. Moreover, both short-run and long-run estimates can be run simultaneously, while the error correction model (ECM) can integrate short-run adjustment and long-run equilibrium. Moreover, initiating the Δ cancels and eliminates the serial correlation. Equation 2 explains the ARDL model.

$$\begin{aligned}\Delta RA_{it} = {} & \beta_{i0} + \varphi_i (RA_{it-1} + \beta_{2i} C_{it-1} + \beta_{3i} K_{it-1} \\ & + \beta_{4i} O_{it-1} + \beta_{5i} Z_{it-1} + \beta_{6i} M_{it-1} \\ & + \beta_{7i} R_{it-1} + \beta_{8i} G_{it-1} + \beta_{9i} I_{it-1}) \\ & + \sum_{p=1}^{m} r_{1ip} \Delta RA_{it-p} + \sum_{q=1}^{n} r_{3iq} \Delta C_{it-q} \\ & + \sum_{q=1}^{n} r_{2iq} \Delta K_{it-q} + \sum_{q=1}^{m} r_{4ip} \Delta O_{it-q} \\ & + \sum_{q=1}^{n} r_{5ip} \Delta Z_{it-q} + \sum_{q=1}^{n} r_{6ip} \Delta M_{it-q} \\ & + \sum_{q=1}^{n} r_{7ip} \Delta R_{it-q} + \sum_{q=1}^{n} r_{8ip} \Delta G_{it-q} \\ & + \sum_{q=1}^{n} r_{9ip} \Delta I_{it-q} + \varepsilon_{it}\end{aligned} \quad (2)$$

Where, Δ is the first difference; Φ_i is the speed of adjustment which needs to be significant and negative; ε_{it} is the error correction term; $\beta_1, \beta_2, \ldots, \beta_9$ represent long-run coefficients; $r_1, r_2, \ldots, r_9$ represent the short-run coefficients, and other variables are as defined earlier. The lag selection is based on the Schwarz criterion.

Fourth, we use Kao co-integration test to check the existence of long-run relationships among the variables. The null hypothesis of no co-integration, H0*: $\beta_1 = \beta_2 = \beta_3, \ldots, \beta_9 = 0$,* is tested against the alternative hypothesis, H1*: $\beta_1 \neq \beta_2 \neq \beta_3, \ldots, \beta_9 \neq 0$*. The variables are co-integrated if the null hypothesis is rejected. Besides, if the null hypothesis (H0) is rejected, in that case, the long-run relationship's existence is confirmed, while the rejection of the hypothesis (i.e., H1 = there is co-integration among the variables) means the opposite. However, when the long-run relationship is confirmed among the variables, ECM is employed. An ECM is built as Equation (3):

$$\begin{aligned}RA_{it} = {} & \alpha_{i0} + \sum_{q=1}^{n} \alpha_{1ip} \Delta RA_{it-p} + \sum_{q=1}^{n} \alpha_{2ip} \Delta C_{it-q} \\ & + \sum_{q=1}^{n} \alpha_{3ip} \Delta K_{it-q} + \sum_{q=1}^{n} \alpha_{4ip} \Delta O_{it-q} \\ & + \sum_{q=1}^{n} \alpha_{5ip} \Delta Z_{it-q} + \sum_{q=1}^{n} \alpha_{6ip} \Delta M_{it-q} \\ & + \sum_{q=1}^{n} \alpha_{7ip} \Delta R_{it-q} + \sum_{q=1}^{n} \alpha_{8ip} \Delta G_{it-q} \\ & + \sum_{q=1}^{n} \alpha_{9ip} \Delta I_{it-q} + \varphi_{1i} ECT_{1it-1} + \mu_{it}\end{aligned} \quad (3)$$

Where $\alpha_{1i}, \alpha_{2i}, \alpha_{3i}, \ldots, \alpha_{9i}$ represents the short-run dynamics coefficients used to highlight the causalities between RA and its determinants. ECT_{t-1} is the speed of adjustment at which a dependent variable reaches equilibrium after short-run shock, and μ_{it} is error terms.

Fifth, since the PMG finding doesn't give the causality between the variable and considering the need of policymakers

for causality to build effective policies, this study employs Dumitrescu-Hurlin's causality test. This test can be used in both balanced and unbalanced panels and both short and long panels. Further, this test overcomes the disadvantages of the standard causality test and eliminates the problems of non-heterogeneity (Assi et al., 2021). The following heterogeneous linear model is considered for the sake of this test:

$$RA_{i,t} = \alpha_i + \sum_{p=1}^{p} \delta_i^{(p)} RA_{i,t-p} + \sum_{q=1}^{q} \psi_i^{(q)} X_{i,t-p} + \varepsilon_{i,t} \quad (4)$$

Where α_i is the individual effect and supposed to be fixed in the time dimension, $\delta^{(p)}$ and $\psi^{(k)}$ represents the coefficients used to highlight the causalities between RA and its determinants. X_i is the independent variable, p and q are the lag parameters, while the $\varepsilon_{i,t}$ is the error term. The null hypothesis represents the lack of causality between the variables. The alternative hypothesis represents the existence of the causality between the variables. Null and alternative hypotheses are as follow:

$$\text{H0: } \psi_i = 0, \text{ and H1: } \begin{cases} \psi_i = 0 \forall_i = 1, 2, \ldots, N_1 \\ \psi_i \neq 0 \forall_i = N_{1+1}, N_{1+2} \ldots, N \end{cases}$$

5. Results and Findings

5.1. Descriptive Results and Interrelations Matrix

Checking the variables' descriptive statistics (the mean, minimum, maximum, and standard deviation) is crucial for cross-section and time series analysis. The highest and lowest value of RA is 0.05 and −0.05, respectively. The mean value of bank size is 9.13 with a standard deviation of 0.52. The ratios of credit risk, capital risk, operational risk are 7%, 13%, 61%, and 9.13%, with a standard deviation of 8%, 4%, and 17%. As for as the external variables, the mean values of market concentration, return volatility, inflation, and GDP are 34%, 24%, 3%, and 5% with standard deviation of 8%, 1.4%, 3%, and 2%, respectively.

Furthermore, we checked the interrelationship among the variables, which shows a significant negative correlation between RA and credit risk ($r = -0.34$) and operational risk ($r = -0.67$) at a 1% significance level. These results are consistent with earlier findings (Batten & Vo, 2019; Petria et al., 2015). Moreover, capital risk showed a positive correlation with RA ($r = 0.19$) at a 1% significance level, consistent with Petria et al. (2015). Regarding the external variables, market concentration showed a significant negative correlation with RA ($r = -0.11$) at a 10% significance level; whereas, inflation and GDP showed a positive correlation with value ($r = 0.19$, $r = 0.25$) at a 1% significance level; this supported the finding of Knezevic and Dobromirov (2016). The results show that past studies support interrelationships between the variables.

5.2. Unit Root and Co-integration Results

Unit root test is an essential step in an econometrics analysis. If the data has a unit root or nonstationary, the regression analysis would not be real or spurious (Bekhet & Al-Smadi, 2015). Table 3 reports the results of four-unit root tests. The decision of the results shows that the internal variables (*C* and *O*) are stationary at a level I(0); whereas, (*K* and *Z*) are stationary at the first difference, I(1). For external variables, all variables are stationary at the level I(0) except (*M*), which is stationary only at the first difference I(1).

Thus, the individual series are either I(0) or I(1), while none of the variables are integrated at I(2). We proceed to apply the panel ARDL model developed by Pesaran et al.

Table 3: Stationary Tests Results

Variables	ADF		IPS		PP		LLC		Decision
	I(0)	*I*(1)	*I*(0)	*I*(1)	*I*(0)	*I*(1)	*I*(0)	*I*(1)	
RA	77.62[a]	177.65[a]	–5.53[a]	–13.14[a]	90.21[a]	280.54[a]	–5.42[a]	–15.33[a]	*I*(0)
C	55.51[a]	84.71[a]	–3.49[a]	–6.21[a]	19.44[a]	60.41[a]	–2.39[a]	–7.16a	*I*(0)
K	19.18	116.24[a]	0.93	–12.17[a]	23.62	140.82[c]	–1.52[a]	–20.38[a]	*I*(1)
O	62.26[a]	121.83[a]	–6.27[a]	–9.69[a]	42.71[a]	150.49[a]	–12.69[a]	–9.01[a]	*I*(0)
Z	27.06	95.85[a]	0.52	–7.60a	15.16	88.18[a]	0.00	–9.44[a]	*I*(1)
M	6.25	114.93[a]	2.62	–9.28[a]	9.35	62.18[a]	1.70	–14.36[a]	*I*(1)
R	38.51[c]	95.99[a]	–2.03[b]	–7.55[a]	25.07	130.84[a]	–4.18[a]	–11.11[a]	*I*(0)
I	92.44[a]	242.99[a]	–7.37[a]	–20.79[a]	92.34[a]	308.94[a]	–6.46[a]	–20.40[a]	*I*(0)
G	134.74[a]	137.50[a]	–10.15[a]	–11.24[a]	30.37	137.80[a]	–12.71[a]	–15.82[a]	*I*(0)

Notes: [a, b,] and [c] denote statistical significance at 1%, 5%, and 10% levels, respectively.

(1999). The optimal lag length of the ARDL model is chosen by the Schwarz information criterion (SIC).

Kao test is employed to examine the co-integration among the variables. The results confirmed the rejection of the null hypothesis (i.e., H0 = no co-integration) and the acceptance of the alternative hypothesis (H1 = there is co-integration among the variables). It confirms a long-run relationship between the variables in the Jordanian commercial banks. Based on these findings, there is a dynamic relationship between the internal and external determinants of profitability in Jordanian commercial banks. This study applies the two most common estimation methods, the Pooled Mean Group (PMG) and dynamic fixed effect (DFE) (see section 5.3).

5.3. Dynamic Model Estimation

PMG and DFE methods are applied to estimate the nonstationary heterogeneous panels. Then, the Hausman test is applied to confirm which model is more significant. The null hypothesis is that all long-run coefficients are equal across all panels. We check the assumption that long-run slope homogeneity exists. The PMG estimator constrains the long-run coefficients to be equal across all panels. This 'pooling' across banks in the sample is efficient and is a consistent estimator when the restrictions are valid. Based on past studies, the Hausman test was performed to identify slope homogeneity (or heterogeneity). The computed Hausman statistic is 82.8, and the *p*-value is 0.000. The results provide sufficient evidence to conclude that the DFE estimator is suitable for this test. From the results, the null hypothesis is rejected, and we prefer DFE to PMG. Table 4 shows the results of the DFE estimation model for Jordanian commercial banks.

Furthermore, we follow Samargandi et al. (2015) and Blackburne and Frank (2007), who confirmed that the DFE has a cluster option to deal with possible heteroscedasticity and serial correlation problems. Table 5 shows the results of the clustered DFE estimation model.

Table 5 shows that the error correction term (speed of adjustment, 95%) is significantly negative at the 1% level and less than 1 in its absolute value. The results reveal a long-run dynamic relationship between bank profitability and independent variables. In general, the disequilibrium of the commercial banks' profitability and its determinants would be toward an equilibrium of 95% annually.

Credit risk, market concentration, and return volatility significantly affect commercial bank profitability in the short run. Consequently, a 1% increase in credit risk and market concentration will decrease bank profitability by 0.06% and 0.10 %, respectively. Besides, a 1% increase in return volatility will increase bank profitability by 0.0003%. In the long run, credit risk, operational risk, bank size, market concentration, and return volatility significantly affect bank profitability. Thus, a 1% increase in credit risk will increase bank profitability by 0.01%. A 1% increase in operational risk, bank size, market concentration, and return volatility will decrease bank profitability by 0.03%, 0.01%, 0.01%, and 0.0004%, respectively.

In the short run, the credit risk harms bank profitability, compiled by the previous studies (Bucevska & Misheva, 2017; Kumar et al., 2020). However, in the long run, credit risk expressed a positive impact, which followed the results of Sun et al. (2017). However, insignificant capital risk result is consistent with previous studies (Alshatti, 2016; Sun et al., 2017). This finding showed that Jordanian commercial banks benefit from a high percentage of the equity to total asset, more than other banks that depend on debt as the primary financing source.

Table 4: DFE Estimation of ARDL

Long Run				Short Run			
Variables	**Std. Err.**	***Z*-value**	**(DFE)**	**Variables**	**Std. Err.**	***Z*-value**	**Robust (DFE)**
C_{it-1}	0.0066	2.06	0.0137***	ΔC_{it-1}	0.0075	–7.37	–0.0554***
K_{it-1}	0.0160	–0.57	0.0091	ΔK_{it-1}	0.0194	1.39	0.0270
O_{it-1}	0.0030	–9.28	–0.0281***	ΔO_{it-1}	0.0026	0.90	–0.0023
Z_{it-1}	0.0037	–3.22	–0.0117***	ΔZ_{it-1}	0.0094	–0.56	–0.0053
M_{it-1}	0.0138	–0.97	–0.0133*	ΔM_{it-1}	0.0310	–3.22	–0.0999**
R_{it-1}	0.0003	–1.29	–0.0004***	ΔR_{it-1}	0.0003	1.03	0.0003***
G_{it-1}	0.0200	–1.70	–0.0558	ΔG_{it-1}	0.0235	–0.68	–0.0160
I_{it-1}	0.0272	2.01	0.0402	ΔI_{it-1}	0.0105	–0.58	–0.0061
				ECM	**0.0621**	**–15.26**	–0.95***

Notes: ***, **, *Indicates significant at 1%, 5% and 10% levels respectively.

Table 5: Results of Clustered DFE

Long Run				Short Run			
Variables	**Std. Err.**	***Z*-value**	**Robust (DFE)**	**Variables**	**Std. Err.**	***Z*-value**	**Robust (DFE)**
C_{it-1}	0.0040	3.42	0.0137***	ΔC_{it-1}	0.0073	–7.56	–0.0554***
K_{it-1}	0.0128	–0.71	0.0091	ΔK_{it-1}	0.0166	1.62	0.0270
O_{it-1}	0.0068	–4.13	–0.0281***	ΔO_{it-1}	0.0024	0.97	–0.0023
Z_{it-1}	0.0028	–4.24	–0.0117***	ΔZ_{it-1}	0.0094	–0.57	–0.0053
M_{it-1}	0.0077	–1.73	–0.0133*	ΔM_{it-1}	0.0503	–1.99	–0.0999**
R_{it-1}	0.0001	–2.72	–0.0004***	ΔR_{it-1}	0.0001	3.68	0.0003***
G_{it-1}	0.0455	–1.23	–0.0558	ΔG_{it-1}	0.0319	–0.50	–0.0160
I_{it-1}	0.0272	1.48	0.0402	ΔI_{it-1}	0.0110	–0.58	–0.0061
				ECM	**0.0925**	**–10.24**	–0.95***

Notes: ***, **, *Indicates significant at 1%, 5% and 10% levels respectively.

Table 6: Dumitrescu-Hurlin Granger Causality Test Results

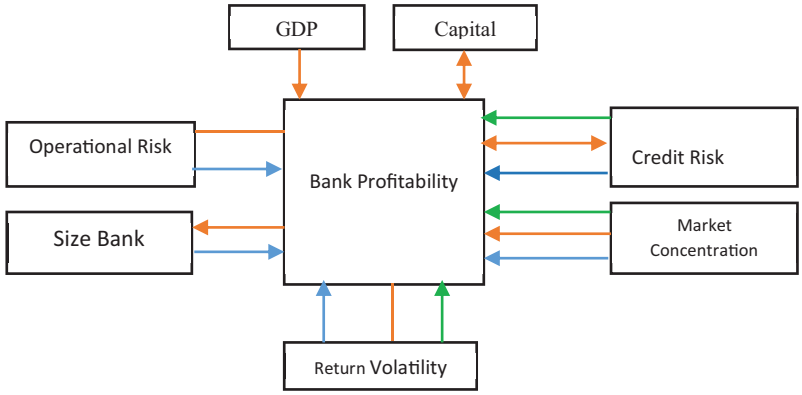
Hypotheses	***W*-statistic**	***Z*-statistic**	***P*-value**	**Result**	**Conclusion**
C ↔ RA	3.7236	5.1494	0.000	Reject [H1]	Bi-directional causality
K ↔ RA	2.0218	1.7538	0.009	Reject [H1]	Bi-directional causality
O – RA	1.8771	1.4649	0.143	Accept [H0]	Neutral
Z → RA	3.3143	4.3328	0.000	Reject [H1]	Uni-directional causality
M → RA	1.9162	2.3358	0.020	Reject [H1]	Uni-directional causality
R – RA	1.4569	0.6266	0.531	Accept [H0]	Neutral
G → RA	3.8595	5.4206	0.000	Reject [H1]	Uni-directional causality
I – RA	1.3447	0.4026	0.687	Accept [H0]	Neutral

In the long run, the result of operational risk (a significant negative impact on bank profitability) means that Jordanian banks are inefficient in managing their operating cost. This result is consistent with earlier studies (Garcia & Guerreiro, 2016; Zarrouk et al., 2016; Ariyadasa et al., 2017). Besides, the bank size (a significant negative impact on profitability) concludes that banks in Jordan are not benefiting from their economies of scale. This outcome supports the findings of Dao and Nguyen (2020).

In the short and long run, the market concentration has a significant negative impact on Jordan's commercial banks. This finding means that Structure-Conduct-Performance (SCP) was not valid in Jordanian commercial banks. The result indicates that banks in Jordan depend more on product differentiation and management efficiency. The result is in line with García-Herrero et al. (2009) and Bucevska and Misheva (2017). Besides, return volatility positively influences bank profitability in the short run, showing a negative impact in the long run and a more volatile return, and lowering bank profitability. Rahman et al. (2018) revealed that stock market volatility has a significant negative impact on return, equity, and the assets of banks; and, the bank-size has a significant negative impact on the volatility-performance relationship. Specifically, the results suggested that during the time of high volatility, banks' profitability starts to decline but this profitability decline is not the same, for all sizes of banks. The negative impact of volatility for larger banks is high. Finally, none of the remaining external factors (GDP and inflation) had a significant effect on Jordan's bank profitability in both the short and long run.

5.4. Granger Causality Results

Table 6 shows the Dumitrescu-Hurlin Granger causality test results, and it indicates the presence of two-bi-directional relationships, three uni-directional relationships, and three neutral relationships. Profitability has a bi-directional relationship with credit risk and capital risk. In contrast,



Notes: 1) and represent long-run and short-run coefficients, respectively.
2), , represent bi-directional, uni-directional, and Neutral casualty, respectively.

Figure 1: Long-run and Short-Run Relationships Between RA and its Determinants

uni-directional relationships were found between profitability on the one hand and bank size, market concentration, GDP on the other. Also, operational risk, return volatility, and inflation were found neutral to profitability. However, these findings are consistent with the findings of Katırcıoglu et al. (2018) and Raza and Jawaid (2013). Furthermore, it is essential to mention that the causality test results support this study's earlier results.

Figure 1 summarizes the long-run and short-run impact on bank profitability and causality directions for the determinants. Referring to the above discussion, increases in operational risk, bank size, return volatility, and market concentration will decrease bank profitability in the long run. In the short-run, increases in credit risk and market concentration will decrease bank profitability, whereas credit risk increases will improve the bank performance in the long-run. However, an increase in return volatility will increase bank performance in the short-run. These results show that an upgrade of the above variables would help manage Jordan's banking sector and improve its GDP contribution. Finally, we can highlight the decision of this paper's hypotheses as listed earlier are accepted.

6. Conclusion

This paper aims to highlight the determinants that influence Jordanian commercial banks' profitability in the long and short-run. Many studies used different variables to present results. This paper is a supplement to the previous studies. To achieve the above objective, we investigate the dynamic relationships among banks' profitability and their determinants using PMG. A set of panels consisted of 13 commercial banks from 2000 to 2018. The credit risk, capital risk, operational risk, bank size (internal variables), market concentration, return volatility, GDP, and inflation (external variables) are used. This procedure can help policymakers to design suitable financial policies. Besides, the outcome of the study will help economists to determine bank profitability.

The main findings are summarised as follows: (i) Credit risk and market concentration negatively affect bank profitability in the short run. Besides, return volatility has a positive relationship with bank profitability. (ii) In the long run, operational risks, bank size, return volatility, and market concentration negatively impacts commercial bank profitability. Meanwhile, credit risk had a positive relationship with bank profitability. This study fills a knowledge gap by empirically investigating the short-run and long-run relationships between commercial banks' profitability and determinants.

At present, the pandemic of Covid-19 has imposed many challenges on the Jordanian economy. According to The Euro-Mediterranean Study Commission (2020) some of the short term effects caused by the lockdown lead to a loss of $116 million per day, a drop by USD 532.48 million of monthly tax revenue, a decrease in export by USD 1.1 billion, a loss of USD 353 million in the tourism sector between April and May 2020. However, the policymakers have taken various measures to mitigate the effect of the Covid-19. First, they pumped JD150M liquidity to the private sector to revitalize the economy. Second, the government allocated JD30M to the tourism sector and JD5M to recover and support activities after the crisis. Third, JEDCO disbursed JD0.68mn to fund two programs to boost SMEs. Fourth, they granted a JD10M interest-free loan with five years graces period to farmers, and JD500mn facilities were granted to SMEs (and expanded later to include larger companies). Fifth, they allocated JD16M for maternity insurance and insurance to the elders and the sick.

Sixth, they reduced the banks' compulsory reserves from 7% to 5% and injected JD500M liquidity into the market. Seventh, they postponed the credit facilities instalments for companies and individuals (CBJ, 2020c).

The study's outcome is a signal to policy makers to concentrate on other sectors to help the economy withstand such shock. The current study results will help different economic parties and bank managements concentrate more on the crediting policies and their operating costs and expenses. Credit and operational risks negatively affect the bank's profit in the short and long run. An increase in equity financing is crucial as it positively impacts the bank's profit in the short and long run. Finally, variables such as taxation, interest rate, and ownership structure were omitted in this study. Therefore, further studies should consider them.

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