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Dynamic Elasticities Between Financial Performance and Determinants of Mining and Extractive Companies in Jordan

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Abstract

This study aims to identify the elasticities and casualties of financial performance and determinants of the mining and extractive companies listed in Jordan's stock market over the 2005–2018 period. The conceptual framework is based on the Resource-Based View theory and Arbitrage Pricing theory is used to describe the relationship between the external environment and the financial performance of the companies. Profitability ratio (return on assets) is utilized as a proxy of financial performance measurement. Meantime, the company's characteristics, macroeconomic variables, and non-economic factors are utilized as independent factors. Data sources are panel data set for mining and extractive companies over the above period. Fully Modified Ordinary Least Square (FMOLS), Dynamic Ordinary Least Squares (DOLS), and Pooled Mean Group (PMG) methods are applied. The empirical findings indicated that company size, sales growth, financial leverage, liquidity, and GDP growth were the critical determinants of mining and extractive companies' financial performance in the Amman Stock Exchange. Thus, the findings conclude that company characteristics and GDP growth mainly drive financial performance. Moreover, the findings reveal that a bidirectional causal elasticity exists between GDP and financial leverage and return on assets (ROA). Sound financial performance can be obtained by paying more attention to GDP growth and firms' characteristics.

Keywords: Financial Performance, Amman Stock Exchange, Panel Autoregressive Distributed Lag, Granger Causality, Jordan

JEL Classification Code: G14, G32, C58, O2

1. Introduction

The mining and extractive industry is considered as one of the oldest known industrial operations. Mining was crucial for major countries' growth, such as Canada, the USA, and Australia. Meanwhile, the whole western hemisphere is rich in an extensive range of mining deposits. Russia is the leading country in Europe for mining companies, Africa is rich in minerals. Hence, for decades, many key mining companies have developed mining operations (Maverick, 2020). In general, the mining and extractive industry sector plays a critical political and social-economic role in the lives of 81 countries that encompass 3.5 billion people. Fifty-one of these are complemented with extractive industries' transparency initiatives, whereas many of these countries still encounter numerous challenges such as weak governance and resource dependency (World Bank, 2020). Therefore, the industrial sector is considered one of the biggest contributors to the economy and plays a significant role in any country's economic development locally and internationally (Matar & Eneizan, 2018).

In Jordan, the industrial sector ranked second as a trading value distribution after the financial sector in 2017, with a percentage of 22.4%. Moreover, in 2018, 24.77% of the total workforce in Jordan was active in the industrial sectors (ASE Annual Report, 2019). Besides, mining and extractive sub-sector plays a crucial role in the growth of the most significant economic sectors, apart from being considered a cornerstone of Jordan's economy. For instance, Jordan ranked as the second-largest exporter and the fourth-largest producer of potash, the second-largest exporter, and the sixth-largest producer of phosphate. The reserves of oil-shale

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are the fifth biggest in the world. Also, Jordan has around 3% of sustainable uranium world resources (Al Tarawneh, 2016). However, according to Amman Stock Exchange (ASE) (2018), "the performance of price index weighted by full market capitalization had a decrease of 1.5% in 2017 compared with the year 2016". At the sector level, the industrial sector increased by 6.5% in 2017, resulting from the increase in the indices of printing and packing and tobacco and cigarette industries sub-sectors. Meanwhile, the subsectors of the mining and extraction industry had decreased by 2.8% in 2017. It is worth mentioning that tobacco and cigarettes, and mining and extraction sub-sectors impact the industrial sector's index by almost 72%.

In addition to that, one of the most important indicators to measure financial performance is the return on assets (ROA). This indicator is a crucial gauge used to measure a general sense of companies' health and financial performance stability (Robin et al., 2018). The cumulative ROA behavior for mining and extractive companies has fluctuated from 2005 to 2018. The ROA percentage increased from 9.4% in 2005 to 28.1% in 2008, then dropped in 2009 to 12.8%. The cumulative ROA in the mining and extractive companies decreased from 20.1% in 2011 to 0.5% in 2017. Besides, firms target ROA to be as high as possible as it reflects firms' capability to generate profits by using their assets. Thus, the higher ROA, the more profitable, efficient, and productive the firm is (Gallo, 2016). Nevertheless, firms' characteristics (e.g., size, leverage, and liquidity) are positively associated with the total income level is received by Jordanian firms (Samhan & Al-khatib, 2015).

Meanwhile, GDP growth plays a crucial role in determining Jordanian companies' financial performance (Kharawish et al., 2011). Therefore, the interaction between macro and micro variables determines firms' financial performance (Egbunike & Okerekeoti, 2018). Based on those mentioned above, this study aims to revisit the relationship between financial performance (ROA) and its determinants regarding mining and extractive companies listed in the ASE by finding out the most significant variables that impact the financial performance stability of the Jordanian economy. Specifically, exploring the elasticities relationships and casualties between firm characteristics (firm size (SZ), firm liquidity (LQ), firm leverage (LV) and sales growth (SG)), macroeconomic variables (GDP growth), and financial performance of mining and extractive firms from 2005 to 2018. So, the Pool Mean Group (PMG) methodology is applied. Also, we verified the results by comparing them with FMOLS and DOLS results. This study intends to achieve the following objectives:

1. Highlight the dynamic relationship among mining and extractive companies' financial performance and its determinants (firm size, firm liquidity, firm leverage, sales growth, and GDP growth) in Jordan.
2. Investigate the long-run elasticities between financial performance and its determinants (firm size, firm liquidity, firm leverage, sales growth, and GDP growth) in mining and extractive companies in Jordan.
3. To examine the short-run elasticities between financial performance and its determinants (firm size, firm liquidity, firm leverage, sales growth, and GDP growth) in mining and extractive companies in Jordan.
4. To identify the Granger causality between financial performance and its determinants (firm size, firm liquidity, firm leverage, sales growth, and GDP growth) in mining and extractive companies in Jordan.

The rest of this study is structured as follows. Section 2 explains the theoretical framework, including Resource-Based View Theory (RBV) and Arbitrage Pricing Theory (ABT) and past studies that explored the relationship between firm characteristics and microeconomic factors and financial performance in developed countries, developing countries, and Jordan. Section 3 highlights data sources, variables definition and discusses the model specification and methodology. Section 4 discusses the analysis of the empirical results, and section 5 summarizes the conclusion and policy implications with recommendations.

2. Theoretical Framework and Past Studies

2.1. Theoretical Framework

In the current paper, arbitrage pricing theory is utilized to describe the relationship of the external environment with the financial performance of mining and extractive companies of the ASE (GDP growth). In the meantime, resource-based view theory explains how the company's financial performance is determined by firm characteristics (internal factors).

Concerning financial markets, APT claimed that it is possible to model the expected return of financial assets as a linear function of different microeconomic variables or theoretical market indices (Matar, 2014). This theory ties the risk of an investment factor to its expected rate of return. The critical aspect of this theory is the complication of decisions under uncertainty and risk. This theory implies that investment risks emerge from market-determining adjustments, such as interest rate and equity risk, which are essential to investors when making investment decisions (Al-Smadi, 2015). Thus, many points highlight the significance of APT. First, ABT's model is a multi-variable model (Bekhet et al., 2020; Watson & Head, 2010). Hence, such a theory is used as a motivation and can articulate the relationship between microeconomic variables and financial performance regarding the market and specific risk characteristics in

emerging markets, including the Amman Stock Exchange. Second, the basic definition of APT focuses on the capability to model expected returns as a linear function of many macroeconomic factors (Matar, 2014). Thus, in addition to the present study, some prior studies on numerous stock markets have applied the Arbitrage Pricing Theory (e.g., Al-Najjar, 1998; Connor and Korajczyk, 1986). Within Jordan, the application of the APT on the Amman Stock Exchange has been investigated by Ramadan (2012). The findings have revealed that APT applies in ASE. Two reasons indicate that APT theory is relevant for the present study (Bekhet et al., 2020; Matar, 2014): (i) APT reveals the verity of the economy in Jordan; (ii) the basic concept of APT is to model expected return as a linear function of many macroeconomic factors.

Furthermore, the current study's conceptual structure was based on the Resource-Based View Theory. It assumes that a company's internal factors are predominantly responsible for achieving superior performance and sustainable competitive advantage (Bekhet et al., 2020; Kapelko, 2006). This theory implies a connection between its performance and its internal resources as the companies' resources will provide a competitive advantage for these companies (Egbunike & Okerekeoti, 2018; Hunt, 1999). Consequently, this theory supposes that a company's characteristics impact performance changes (Slijper, 2017). In addition to that, RBV argues that a company's purpose and expected and desired outcomes of managerial activity are a sustainable competitive advantage since it helps the company achieve its economic returns (Bekhet et al., 2020; Kapelko, 2006). Also, Barney (1991) argued that it is essential to demonstrate the observed disparity in performance between companies. Heterogeneity is necessary to investigate within different companies. Hence, RBV addresses economic gains or the provision of sustained above-normal returns regarding the firm's internal resources that have to be valuable, rare, inimitable, and non-substitutable (Bekhet et al., 2020; Toms, 2010). Thus, In studies that used RBV, business performance measurement includes two main categories: (a) operational, which uses non-financial performance gauges such as market share and product quality to treat performance indicators, and (b) financial, which focuses on accounting-based measures, such as profitability, share income, and sales growth, considering market measures, such as market-to-book returns and stock markets. Thus, company size, the market share of a business, and a firm's risk behavior are some typical examples of fundamental factors that affect companies' performance (Hirsch & Hartmann, 2014).

2.2. Literature Review

Many papers have examined the relationships between financial performance and its determinants in-depth in developed and developing countries worldwide by different methodologies and variables. In these studies, mixed methodologies had applied. First, for a dynamic relationship, a generalized method of moments (GMM), fixed-effects, and feasible generalized least-squares (FGLS), panel autoregressive distributed lag (ARDL), are applied. Second, for static analysis, fixed-effect model (FEM), random-effect model (REM), two-stage least squares (2SLS), Quantile regression (QUR), pooled ordinary least square (POLS), fully modified ordinary least square (FMOLS), random effect model (REM), and simple regression analysis (SR) are used.

This paper classified the empirical studies into three main parts. The first part reviews the literature associated with developed countries' financial performance determinants. In developed countries, financial performance has caught the interest of many scholars, e.g., Vieira et al. (2019) for Portugal, Öhman and Yazdanfar (2018) for Sweden, Basarir and Sarihan (2017) for Turkey, Abeywardhana (2015) for the UK, Muhammad et al. (2015) and Borhan et al. (2014) for Australia. Furthermore, Al-Harbi (2019) employed samples from 52 developed and developing countries. The second part reviews past studies that were utilized in developing countries. Many researchers have paid significant attention to the concept of financial performance, e.g., Jadah et al. (2020) for Iraq, Bono (2020), Abebe and Abera (2019) for Ethiopia, Ruhomaun et al. (2019) for Malaysia, Hoang et al. (2019) for Vietnam, Dey et al. (2018) and Robin et al. (2018 for Bangladesh, Egbunike and Okerekeoti (2018) for Nigeria, Bayoud et al., (2018) for Morocco, Sokang and Ratanak (2018) for Cambodia, Batchimeg (2017) for Mongolia and Septiari and Nasution (2017)). Moreover, Anarfo and Appiahene (2017) employed samples from 37 countries in Sub-Sahara Africa. In contrast, the third part reviews the literature reviews in Jordan. Many researchers have carried out studies to investigate financial performance determinants, e.g., Bekhet et al. (2020); Al-abedallat (2019); Matar and Eneizan (2018); Al-Qadi and Khanji (2018); Aldalayeen (2017); AlAli (2017); Durrah et al. (2016); and Almajali et al. (2012). Table 1 summarizes these studies.

As shown in Table 1, most of these studies, either in developed or developing countries, had a mix of macro-economic variables and firm characteristics. However, the current study has a theoretical and practical significance that be summarized as follows: (1) *Theoretically:* the current study tends to extend the financial performance literature by making significant statements on the elasticities and causalities between financial performance and its determinants to fill the gap in the literature. To our knowledge, no study examined the elasticities and causalities between financial performance and its determinants in mining and extractive companies on ASE using a panel data approach. (2) *Practically:* the empirical analysis of the elasticities between financial performance and its determinants has implications for evaluating the changes in investors' and

Table 1: Summary of Selected Empirical Studies

Country	Author(s)	Sample (Firms/ Sectors)	Data Period	Methodology	Influence on Financial Performance	
					Positive Influence	Negative Influence
A. Developed Countries:						
52 Countries *	Al-Harbi (2019)	686	1989–2008	OLS/FEM	RIR; FO; C; GDPG; OSA; L; BSD; GDPC; SZ	D; MC
Portugal	Vieira et al., (2019)	37	2010–2015	GMM	CR; SZ; GDP; PD; IS;	FL; IO; BS
Sweden	Öhman and Yazdanfar, (2018)	20	2005–2014	OLS/ FGLS	CA; RG; LP; GDPG	SZ
Turkey	Basarir and Sarihan (2017)	10	1989–2015	ARDL	GDPG; TCTA	I; NL
UK	Abeywardhana (2015)	183	1998–2008	2SLS	STD; STDTD; SZ; SG	LV; TD; LTD
Australia	Muhammad et al., (2015)	76	2001–2010	FEM	EP; SZ; DY	CR; LV
	Borhan et al., (2014)	1	2004–2011	MR	LQ; QR; DR; NPM	LV; OPM
B. Developing Countries						
Iraq	Jadah et al. (2020)	18	2005–2017	FEM	GDP; GE; CA; SZ; LAR	PI; UR; RIR; I; R
Ethiopia	Bono (2020)	7	2004–2019	ARDL	NL; LG; I	CA; GDPG
	Abebe and Abera (2019)	9	2010–2015	OLS	CA; LQ; SZ; I	LV; FA; LR; GDPG
Malaysia	Ruhomaun et al., (2019)	196	2012–2016	GMM	DU	DR; ER; IR
Vietnam	Hoang et al., (2019)	269	2010–2016	OLS/QUR	GR	LV; SZ; CR; FAI; RN
Nigeria	Adeoye & Olojede (2019)	10	2012–2018	MR/GC	–	T; FA; LV
	Egbunike and Okerekeoti (2018)	21	2011–2017	OLS	GDPG; I; LQ; LV; SZ	ER; IR
Bangladesh	Dey et al., (2018)	48	2001–2017	OLS	AT; SG; SZ	LV; DR
	Robin et al., (2018)	12	1983–2012	OLS	I; SZ; PR; LAR; C; AQ	GDPG
Morocco	Bayoud et al. (2018)	6	2004–2016	FMOLS	R; DR; OPM; I	SZ; GDPG
Cambodia	Sokang and Ratanak (2018)	10	2005–2013	PLS	EG; AG; GDPG	ED; EL; LV; LG; DG; I
Mongolia	Batchimeg (2017)	100	2012–2015	REM	EPS; CATA	PG; CRR; STD; LDT; LQ
37 countries**	Anarfo and Appiahene (2017)	237	2009–2015	ARDL	I; IR; GDPG; AG	DR; SZ; T; MCT
Indonesia	Septiari and Nasution (2017)	151	2010–2014	SR	–	CA

C. Jordanian Literature						
Jordan	Bekhet et al., (2020)	4	2005–2016	RSEE	LQ; LV; GDPG; I; AS	R; FC
	Al-abedallat (2019)	11	2003–2017	MR	EE; SMR	CA; AQ; MER; LQ
	Matar and Eneizan (2018)	23	2005–2015	MR	LQ; ROE; R	LV; SZ
	Al-Qadi and Khanji (2018)	11	2008–2015	MR	QR; CR	-
	Aldalayeen (2017)	5	2007–2011	MR	SG; CG	T; SZ
	AlAli (2017)	10	2012–2015	OLS	CA	DR
	Durrah et al., (2016)	8	2012–2024	PC	CR; QR; SHR	DIR
	Almajali et al., (2012)	25	2002–2007	MR	SZ; MCI; LV; LQ; FA	-

Notes: Ordinary least square fixed effect model= OLS/FEM; Real interest rate= RIR, Foreign ownership= FO, Concentration= C, Gross domestic product growth= GDPG, Off-balance sheet activities= OSA; Loans= L; Banking sector development= BSD; Deposits= D; Market capitalisation= MC; GDP per capita= GDPC; Total credits to total assets ratio= TCTA; Inflation= I; Non-performing loans= NL; Profit growth= PG; Earnings per share= EPS; Cost to revenue ratio= CRR; Current assets to total assets= CATA; Random effect model= REM; Two stage least squares= 2SLS; Total debt to total assets= TD; Long term debt to total assets= LTD; Short term debt to total assets= STD; Short term debt to total debt= STDTD; Fully modified ordinary least square= FMOLS; Panel autoregressive distributed lag= ARDL; Interest rates= IR; Asset tangibility= T; Marginal corporate tax= MCT; Robust standard error estimation= RSEE; Risk= R; World financial crisis= FC; Arab spring= AS; Quick ratio= QR; Debt ratio= DR; Net profit margin= NPM; Operating profit margin= OPM; Management competence index= MCI; Firm age= FA; Capital ratio= PR; Concertation ratio= C; Assets quality= AQ; Loan to assets ratio= LAR; Pooled ordinary least square= OLS; Equity to deposit= ED; Equity to loan= EL; Equity growth= EG; Assets growth= AG; panel least square= PLS; Deposits growth= DG; Loans growth= LG; Multiple regression analysis =MR; Simple regression analysis =SR; Company leverage= LV; Company liquidity= LQ; Return on equity= ROE; Revenue= R; Company size= SZ; Corporate governance = CG; Sales growth= SG; Government effectiveness= GE; Capital adequacy= CA; Political instability= PI; Unemployment rate= UR; Environmental performance= EP; Dividend yield= DY; Current ratio= CR; Loss ratio= LR; Exchange rate= ER; Camels' model= CM; Management efficiency ratio= MER; Earnings ratio= ER; Sensitivity to market risk ratio= SMR; Derivatives usage= DU; Assets turnover= AS; Quantile regression= QUR; Receivable management= RN; Fixed asset investment= FAI; Pearson correlation= PC; Defensive internal ratio= DIR; Cash ratio= SHR; Fixed-effects and feasible generalized least-squares= FGLS; Revenue growth= RG; Lagged profitability= LP; Generalised method of moments= GMM; Investor sentiment= IS; Public debt= PD; COE as insider ownership= IO; Board size= BS; Granger causality= GC.

* Al-Harbi (2019) employed his study in 52 developed and developing countries.

** Anarfo and Appiahene (2017) employed 37 countries in Sub-Sahara Africa.

policymakers' economic conditions. This study will help predict the most critical factors contributing to improving the mining and extractive firms' financial performance in the Jordanian economy in the future.

According to Bulgurcu (2012), selected financial ratios derived from the financial report are standard instruments for assessing companies' financial situation performance. Thus, based on the theoretical background and past studies, the hypotheses of this study were formulated as follows:

H1: *The financial performance of mining and extractive companies and their determinants are significantly integrated with I(1), I(0), or purely mixed in Jordan.*

H2: *There is a significant dynamic relationship between the financial performance of mining and extractive companies and its determinants in Jordan*

H3: *There is significant statistical long-run elasticity between mining and extractive companies' financial performance and its determinants in Jordan.*

H4: *There is significant statistical short-run elasticity between mining and extractive companies' financial performance and its determinants in Jordan.*

H5: *Causality direction between mining and extractive companies' profitability and their determinants exists in Jordan.*

3. Data, Variables, and Methodology

In this section, data description and sources, variables definition, methodology, and stationary and co-integration tests are discussed.

3.1. Data Sources and Variables Definition

This paper used balanced panel data of mining and extractive firms listed in ASE from 2005 to 2018. The data sources were annual financial reports such as the Statement of Comprehensive Income and the Statement of Financial Position of the mining and extractive in ASE for 2005–2018. Meanwhile, the macroeconomic variable data was obtained from the website of the World Bank. Besides, to minimize heteroscedasticity and achieve the related factors' growth rate through their different logarithms, all of the study's variables have been transformed into natural logarithmic (Li et al., 2020; Matar, 2014). Table 2 shows all details of the data used in this study.

3.2. Model Specification and Methodology

Based on the theoretical background, past studies, and following Al-Qudah (2020), Al-Harbi (2019), Robin et al. (2018), and Bayoud et al. (2018), a linear equation is used to perform the regression analysis. The model used for this analysis is represented by equation (1) to investigate the elasticities between financial performance and its determinants.

$$\begin{aligned} \mathrm{LROA}_{it} &= \mu + \alpha_1 \mathrm{LSZ}_{it} + \alpha_2 \mathrm{LSG}_{it} + \alpha_3 \mathrm{LLV}_{it} \\ &\quad + \alpha_5 \mathrm{LLQ}_{it} + \alpha_6 \mathrm{LGDP}_{it} + \varepsilon_{it} \end{aligned} \tag{1}$$

where, all variables are defined in Table 2. i = 1, 2, …, 10 denote the companies; t = 2005, 2006, …, 2018 denote period; ε_{it} represents error term. Many steps are used before estimating the elasticities between financial performance and its determinates in ASE. These initials testing would help choose the appropriate model for estimating the magnitude and direction of the elasticities for ROA and its determinants. (a) Data quality measurements, initial techniques, descriptive statistics, interrelationship are applied. (b) Stationary panel tests and co-integration were employed. Maddala and

Table 2: Variables Definition and Past Studies Used.

Variables	Data Description	Data Source	Previous Studies
LROA	Returns on Assets, a proxy of financial performance = net income / total assets	Amman stock exchange	Al-Harbi (2019); Sokang and Ratanak (2018); Batchimeg (2017).
LSZ	Company Size proxied by the natural log of total assets	Amman stock exchange	Jadah et al., (2020); Al-Harbi (2019); Anarfo and Appiahene (2017).
LSG	Sales Growth = (current year's sales - sales of the previous year) / sales of the previous year	Amman stock exchange	Aldalayeen (2017); Batchimeg (2017); Abeywardhana (2015).
LLV	Company leverage = total liabilities of a company/shareholder's equity	Amman stock exchange	Bekhet et al., 2020; Sokang and Ratanak (2018); Abeywardhana (2015).
LLQ	Company Liquidity proxied by current ratio = current assets / current liabilities	Amman stock exchange	Bekhet et al., 2020; Batchimeg (2017); Abeywardhana (2015).
LGDP	Gross domestic product is a proxy of economic growth in Jordan	World Bank	Jadah et al., (2020); Al-Harbi (2019); Bayoud et al., (2018).

Wu (1999), Hadri (1999), Breitung (2000), Levin, Lin, and Chu (2002), and Im Pesaran and Shin (2003) tests are employed. Then, Kao and Pedroni Panel Co-integration test was applied to confirm the dynamic relationship among the variables. (c) The sign and size of the relationships between financial and its determinants are needed after long-term relationships between the panel series based on the co-integration tests. According to Kumaran et al. (2020), researchers reached no consensus about estimating less biased and robust coefficients. So, panel dynamic ordinary least squares (DOLS), panel fully modified ordinary least squares (FMOLS), and the Pooled Mean Group (PMG) method are used in this study by applying the E-views version 9.5 statistical package.

The fundamental idea behind the FMOLS approach is to consider the serial correlation and check for the endogeneity in the explanatory variables arising from the presence of a co-integration relationship (Tuna & Yildiz, 2016). The FMOLS approach produces accurate estimates for the small sample size and tests the findings' robustness (Bashier & Siam, 2014). FMOLS is non-parametric and takes into account the autocorrelation issue by default. Thus, endogeneity and serial correlation problems of OLS regression are rectified in the FLOMS approach (Pasha & Ramzan, 2019). In other words, the OLS estimator is biased as a result of problems of endogeneity. The DOLS estimator of the co-integration regression takes this bias (in first difference) into account by increasing the fixed regression with contemporaneous values, leads, and lags (Muye & Muye, 2017; Monsura & Villaruz, 2021). In the panel data regression, the DOLS estimator considers the endogeneity and autocorrelation problems (Pasha and Ramzan, 2019). Hence, the DOLS method can be applied as a more robust method, especially in small samples, regardless of variables integration (Demirgunes, 2016).

Nevertheless, the pooled mean group (PMG) is also known as Panel ARDL. This method takes into account the dynamic heterogeneity of the adjustment process as well as the long-term equilibrium. PMG permits the short-term parameters, error variances, and intercepts to vary across the panel while forcing "a restriction on the long-term parameters to be similar across panel members" (Muye & Muye, 2017). Besides, ARDL has many advantages. First, the non-stationary property and the order of integration are not necessary to be examined as ADRL can be applied whether the regressors are $I(0)$ or $I(1)$ or a combination. Second, it can estimate the long-run and short-run composition of the models; meanwhile, Error Correction Model (ECM) can be derived by utilizing a simple linear transformation. Third, it can also determine the co-integration relationship in a small sample (Ridzuan, 2017; Matar, 2014). Following Ridzuan (2017), Equation (2) is used to examine the existence of a long-term relationship.

$$\begin{aligned}\Delta \mathrm{LROA}_t = {} & \mu_0 + \alpha_0 \mathrm{LROA}_{t-1} + \alpha_1 \mathrm{LSZ}_{t-1} + \alpha_2 \mathrm{LSG}_{t-1} \\ & + \alpha_3 \mathrm{LLV}_{t-1} + \alpha_4 \mathrm{LLQ}_{t-1} + \alpha_5 \mathrm{LGDP}_{t-1} \\ & + \sum_{i=1}^{p} \beta_i \Delta \mathrm{LROS}_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta \mathrm{LSZ}_{t-i} \\ & + \sum_{i=0}^{r} \delta_i \Delta \mathrm{LSG}_{t-i} + \sum_{i=0}^{s} \lambda_i \Delta \mathrm{LLV}_{t-i} \\ & + \sum_{i=0}^{t} \vartheta_i \Delta \mathrm{LLQ}_{t-i} + \sum_{i=0}^{u} \xi_i \Delta \mathrm{LGDP}_{t-i} + \upsilon_t\end{aligned} \quad (2)$$

Where, μ_0 represents the intercepts, α_0, ..., α_5 denote the long-run elasticities for regressors. β_i, γ_i, δ_i, λ_i, ϑ_i, and ξ_i stand for short-run elasticities for regressors. p, q, r, s, t and u represents the lag length. Δ stands for the first difference operator and υ_t denotes the white-noise disturbance term. The residuals should be uncorrelated serially, and the model stability should exist. The hypothesis for testing dynamic relationships is defined ($H_0 = \alpha's = 0$, there is no long-term relationship, and $H_1 = \alpha's \neq 0$, there is a long-term relationship). ECM is applied if confirming long-term elasticity among the variables, which shows Equation (3).

$$\begin{aligned}\Delta \mathrm{LROA}_t = {} & \mu_0 + \phi \mathrm{ECT}_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \mathrm{LROA}_{t-i} \\ & + \sum_{i=0}^{q} \gamma_i \Delta \mathrm{LSZ}_{t-i} + \sum_{i=0}^{r} \delta_i \Delta \mathrm{LSG}_{t-i} \\ & + \sum_{i=0}^{s} \lambda_i \Delta \mathrm{LLV}_{t-i} + \sum_{i=0}^{t} \vartheta_i \Delta \mathrm{LLQ}_{t-i} \\ & + \sum_{i=0}^{u} \xi_i \Delta \mathrm{LGDP}_{t-i} + \upsilon_t\end{aligned} \quad (3)$$

Where ϕ is the error correction term coefficient, *ECT* indicates the variable's speed to converge to equilibrium, and its value is to be negative and significant (Ridzuan, 2017; Al-Smadi, 2015). β_i, γ_i, δ_i, λ_i, ϑ_i, ζ_i represents the short-run dynamics elasticities used to highlight the causalities between ROA and its determinants.

Forth, policymakers need clarity on casual elasticity between variables for implementing effective policies. In this paper, Dumitrescu and Hurlin test (2012) is used to check the causal relationship between factors. This test is very beneficial for panel data as both standard causality test disadvantage and non-heterogeneous assumption can resolve using the Granger causality test (Assi et al., 2021). Therefore, following Li et al. (2020) and Behringer et al. (2015), the Granger causality test equation can be formulated as follows:

$$\Delta \mathrm{ROA}_{it} = \propto_i + \sum_{p=1}^{5} \beta_{ip} \Delta \mathrm{ROA}_{i,t-p} + \sum_{q=1}^{5} \delta_{iq} \Delta Y_{i,t-q} + \varepsilon_{it} \quad (5)$$

Where β's and δ's represent the coefficients used to highlight the causalities between ROA and its determinants, Y_i is the independent variable, p and q are the lag parameters. At the same time, 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:

$$H_0 : \delta_i = 0, \text{ and } H_1 \begin{cases} \delta_i = 0 \forall i = 1,2,\ldots N1 \\ \delta_i \neq 0 \forall i = N1+1, N1+2,\ldots N \end{cases}$$

4. Empirical Results

4.1. Descriptive Statistics, Interrelationship Analysis

The data quality measurements for financial performance and its determinants for mining and extractive companies listed in Jordan's financial market are checked. As can be observed, the highest mean (7.61) recorded is from LSZ, while the lowest mean (0.09) detected is from LSG. There is a slight increase from the minimum value to the maximum value in LGDP, whereas the highest difference is recorded in LLV, followed by LSG, LLQ, LSZ, and LROA, respectively. Therefore, LLV has the highest standard deviation, whereas LGDP has the lowest one. Nevertheless, The degree of interrelationship between ROA and its determinants for mining and extractive companies indicates that the leverage was negatively correlated with ROA, which indicates that the more financed firms have lower financial performance. However, there was a positive correlation between ROA and firm size, sales growth, firm liquidity, and GDP. The positive correlation between firm sales growth and firm liquidity implies that the increase in sales or liquidity will push the financial performance in the same direction. Also, the macroeconomic variable (GDP) was positively correlated with financial performance. This relationship supports the view that GDP growth is positively related to its performance (Abebe & Abera, 2019; Nguyen et al., 2021). Moreover, the correlation matrix indicates that all independent variables had moderate correlations with return on assets except firm leverage and firm liquidity, which have a weak correlation.

4.2. Stationary and Co-integration Tests Results

Unit root tests are essential for both panel and time series findings. So, it is crucial to check for each variable before model estimation. Table 3 reveals the panel unit root tests, consisting of two different tests suggested by Levin, Lin, and Chu (2002) and Im Pesaran and Shin (2003). All tests were tested at a level and then at the first difference. The findings provide the researchers with crucial information in choosing appropriate long-run estimates. Therefore, the findings indicate the tested variables' mixed stationarity at *I*(0) and *I*(I).

Table 3: Panel Unit Root Test (Stationary Tests)

Variables	*I*(0)		*I*(I)	
	Individual Intercept	Individual Intercept and Trend	Individual Intercept	Individual Intercept and Trend
Levin, Lin, and Chu (2002), *t-Statistics**				
LROA	–5.908 (2)[a]	–8.982 (1)[a]	–11.480 (1)[a]	–9.386 (1)[a]
LSZ	–2.542 (2)[a]	–3.607 (1)[a]	–5.290 (1)[a]	–6.672 (1)[a]
SG	–10.121 (1)[a]	–7.907 (1)[a]	–11.002 (1)[a]	–9.434 (1)[a]
LLV	–3.504 (2)[a]	–2.504 (1)[a]	–6.661 (1)[a]	–7.261 (1)[a]
LLQ	–3.409 (2)[a]	–3.522 (1)[a]	–6.092 (1)[a]	–5.260 (1)[a]
LGDP	–1.124 (0)	0.436 (0)	–8.700 (0)[a]	–7.766 (0)[a]
Im, Pesaran and Shin (2003), *W*-Statistic				
LROA	–3.201 (2)[a]	–4.919 (1)[a]	–9.070 (1)[a]	–6.501 (1)[a]
LSZ	–0.964 (2)	–0.173 (1)	–4.162 (1)[a]	–4.454 (1)[a]
LSG	–7.045 (1)[a]	–4.676 (1)[a]	–8.546 (1)[a]	–5.863 (1)[a]
LLV	–1.553 (2)[c]	–2.589 (1)[a]	–7.612 (1)[a]	–7.355 (1)[a]
LLQ	–0.823 (2)	–1.496 (1)[c]	–6.895 (1)[a]	–5.536 (1)[a]
LGDP	1.278 (0)	1.594 (0)	–4.874 (0)[a]	–2.623 (0)[a]

Note: [a,b,c]indicate significant at 1%, 5% and 10% significance level respectively.

Moreover, Kao and Pedroni Panel Co-integration test is used to confirm a dynamic relationship 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). Based on these findings, there is a dynamic relationship between financial performance and its determinants for mining and extractive companies.

Generally, the individual series are either $I(0)$ or $I(1)$, while none of the variables are integrated of $I(2)$. Also, it confirms a dynamic relationship between the financial performance of mining an extracting company and its determinants. Then, panel FMOLS, DOLS, and panel ARDL analysis (PMG) are appropriate for deriving its short-run and long-run elasticity.

4.3. Long-Run And Short-Run Elasticities Results

4.3.1. Long-Run Elasticities

Table 4 indicates the outcomes of long-run elasticities derived by using FMOLS, DOLS, and PMG techniques. All three methods have shown that company size has a positive and significant relationship with mining and extraction companies' financial performance in ASE. Higher-sized companies can lead to sound financial performance. Most companies are enormous companies and still heavily invest in fixed assets such as machines as they need them for a long time and used in these companies' primary purpose. Technically, a 1% increase in size can increase the firms' financial performance by 13.30% (FMOLS), 17.00% (DOLS), and 4.00% (PMG). These findings are in the same line with the studies of Jadah et al. (2020), Robin et al. (2018), Bayoud et al. (2018), Anarfo and Appiahene (2017), Almajali et al. (2012) and in contrast with the study of Al-Harbi (2019) that indicated the negative relationship between company size and financial performance. Furthermore, Aldalayeen (2017) reported that there is no relationship between company size and financial performance.

Next, the increase in sales growth for mining and extraction companies can lead to higher financial performance. Technically, a 1% increase in sales growth increases financial performance by 3.6%, PMG estimation. This finding means that higher sales growth can improve financial performance by increasing revenues, reflecting on the profits. These findings are in the same line with the study of Aldalayeen (2017) and in contrast with the study of Batchimeg (2017) and Abeywardhana (2015), which reported that there is no relationship between sales growth and financial performance. Furthermore, company leverage outcomes exhibit opposite expected signs. It has a positive and significant relationship with mining and extraction companies' financial performance, as proven by FMOLS and PMG estimations. Higher leverage experienced in these companies can lead to sound financial performance. It could mean that mining and extraction firms in Jordan are using the banks' loans in a proper way that leads to cover the interests and get some profits. For instance, a 1% increase in leverage would increase financial performance by 1.6% (FMOLS) and 1.1% (PMG). These findings are in the same line with the studies of Bekhet et al. (2020) and Almajali (2012) and contrast with the studies of Sokang and Ratanak (2018). Abeywardhana (2015) and Borhan et al. (2014) reported a negative relationship between company leverage and financial performance.

Next, the outcomes of company liquidity exhibit similar expected signs to size. It has positive and significant elasticities with mining and extraction companies' financial performance, as proven by FMOLS, DOLS, and PMG estimation. Higher liquidity experienced in these companies can lead to sound financial performance as mining and extraction companies need vast expenses. High liquidity means that the companies can cover current liabilities without any difficulties. It could be as a reaction to the

Table 4: Results of Long-Run and Short-Run Elasticities

Long-Run				Short-Run	
Regressor	**FMOLS**	**DOLS**	**PMG (1, 1, 1, 1, 1, 1, 1)**	**Regressor**	**PMG (1, 1, 1, 1, 1, 1, 1)**
LSZ	0.133[c]	0.170[b]	0.040[c]	D(LSZ)	0.962[a]
LSG	0.020	0.026	0.036[a]	D(LSG)	–0.003
LLV	0.016[c]	0.008	0.011[b]	D(LLV)	–0.253[a]
LLQ	0.103[a]	0.097[a]	0.023[a]	D(LLQ)	–0.012
LGDP	0.043	0.042	0.012[b]	D(LGDP)	0.005
R^2	0.502	0.500	–	C	–0.252[a]
Adjusted R^2	0.437	0.439	–	ECT_{t-1}	–0.758[a]

Note: [a,b,c]as define under Table 5.

high-interest rate in Jordan. For instance, 1% increase in liquidity increases the financial performance by 10.30% (FMOLS), 9.70% (DOLS) and 2.3% (PMG). These findings are similar to the studies of Bekhet et al. (2020), Borhan et al. (2014), and Almajali (2012), and in contrast with the studies of Batchimeg (2017) that reported no relationship between company liquidity and financial performance. Also, Al-abedallat (2019) and Abeywardhana (2015) reported a negative relationship between company liquidity and financial performance.

Furthermore, the GDP growth findings reveal a similar expected sign, which has a positive and significant Elasticity with mining and extraction companies' financial performance as proven by PMG estimation. Higher GDP growth experienced can lead to sound financial performance. For instance, a 1% increase in GDP increases financial performance by 1.2%. These findings are similar to the studies of Jadah et al. (2020), Al-Harbi (2019), Sokang & Ratanak (2018), Basarir & Sarihan (2017, and Anarfo & Appiahene (2017), and in contrast with the studies of Robin et al. (2018) and Bayoud et al. (2018) which reported that no relationship between GDP growth and financial performance.

Finally, for the above analysis's credibility, the ROA model has passed the diagnostic tests via the PMG framework. These tests are serial correlation, heteroscedasticity, and normality test. Also, it indicates the model-free misspecification problem. Furthermore, this research extends the analysis by carrying out short-term elasticities and testing the speed of adjustment (ECT) toward the equilibrium relationship among the variables for mining and extraction companies listed (see next subsection).

4.3.2. Short-Run Elasticities Results

Table 4 indicates the outcomes of short-run elasticities derived from PMG estimation. The outcomes have shown that company size has a positive and significant relationship with mining and extraction companies' financial performance in the short run. Higher-size experienced in these companies can lead to sound financial performance. These outcomes are compatible with the long-run elasticities. Technically, a 1% increase in size can increase the firms' financial performance by 69.20% (PMG). Besides, the outcomes of company leverage in the short-run exhibit similar expected signs. It has a negative and significant relationship with mining and extraction companies' financial performance, as proven by PMG estimation. In the short run, lower leverage experienced in these companies can lead to sound financial performance. These outcomes are in contrast with the long-run elasticities. For instance, a 1% increase in leverage decreases financial performance by 25.3% (PMG). Thus, according to the pecking order theory, managers prefer to use debts after using the firms' retained earnings to fund the investment opportunities. These findings contrast with Basarir and Sarihan's (2017) study, which reported a positive elasticity between company leverage and financial performance in the short run.

Table 4 indicates the dynamics equilibrium elasticity speed between mining and extractive companies' financial performance and its determinants in the same vein. Hence, the error correction term (ECT_{t-1}) in PMG regression reveal the adjustment speed to restore equilibrium (Bekhet and Al-Smadi, 2015). If ECT_{t-1} coefficients' is significant with a negative sign, then the presence of a long-run equilibrium relationship between the factors is verified. It shows the adjustment speed in fixing any disequilibrium, and therefore, the economy will return to its equilibrium (Bekhet & Matar, 2013). As shown in Table 5, the coefficient of ECT_{t-1} in PMG regression, the mining and extractive companies are negative and statistically significant [–0.758, 0.000] with the appropriate sign for the model. It implies that more than 75.8% of adjustment to get back to long-run equilibrium would complete within less than a year for mining and extractive companies listed in ASE.

4.4. Granger Causality Test

Table 5 reveals the granger causality test findings, which show that *Z*-stat and *W*-stat values are significant. These findings indicate the rejection of the null hypothesis for two variables (GDP and LV), which implies both causal financial performances.

The findings reveal a strong bidirectional causal elasticity between GDP and ROA. Also, it is quite logical that better

Table 5: Dumitrescu-Hurlin Granger Causality Test Results.

Hypotheses	*W*-Stat.	*Z*-Stat.	*P*-value	Result	Conclusion
GDP ↔ ROA	5.61298	2.07979	0.0375	Reject [H1]	bi-directional causality
SZ ─ ROA	3.57815	0.57533	0.5651	Accept [H0]	Neutral
LQ ─ ROA	3.23080	0.31851	0.7501	Accept [H0]	Neutral
LV ↔ ROA	6.88443	3.01985	0.0025	Reject [H1]	bi-directional causality
SG ─ ROA	1.49648	–0.96376	0.3352	Accept [H0]	Neutral

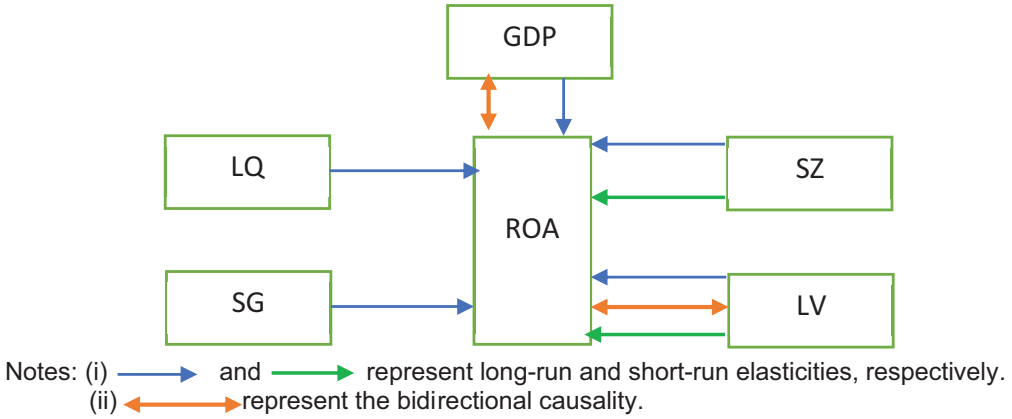

Figure 1: Long-Run and short-Run Relationships and Causality Between ROA and Its Determinants

GDP growth has a positive casual on financial performance. Meanwhile, bidirectional causal elasticity exists between financial leverage and ROA. This finding is not consistent with Adeoye and Olojede (2019) whose reported no causal relationship between financial leverage and financial performance. However, the null hypothesis is accepted for the other variables (SZ, LQ, and SG), which implies no causal elasticity between these variables and return on assets of mining and extractive companies in ASE.

Finally, Figure 1 summarizes the results of the elasticities and casualties among the variables, highlighting the decision of this paper's hypotheses as listed earlier.

5. Conclusion and Recommendations

This study investigates the elasticities and casualties between mining and extractive companies' financial performance listed in the ASE and its determinants. Also, it explores the interrelationship between firm characteristics (size, sales growth, leverage, and liquidity), GDP, and financial performance of Jordanian mining and extractive over the (2005–2018) period. Panel data techniques (FMOLS, DOLS, and PMG) are employed. In the long run, results indicated that firm size, sales growth, leverage, liquidity, and GDP growth significantly impact mining and extractive companies' financial performance. In the short run, firm size and leverage significantly impact financial performance, while the rest of the variables are insignificant. Moreover, there is a bidirectional causal elasticity between GDP and financial leverage and return on assets. Earlier literature reviews supported these outcomes.

The findings show a high degree of importance in understanding why mining and extractive companies in Jordan are fluctuating and underperforming, which can avoid the collapse and exposure of mining and extractive firms to financial problems. Furthermore, the analysis of the elasticities between financial performance, company's characteristics, and the macroeconomic variable may shed some light on financial market responses to a company's characteristics and macroeconomic variables for similar emerging markets. Hence, it argues that variations in financial performance are ultimately related to macroeconomic and company characteristics. Thus, these results have consequences for policymakers and investors in determining the changes in economic conditions.

Therefore, the company's characteristics and GDP growth should give greater attention, as they are the critical determinants of Jordan's financial performance. So, growing the company's assets should be highly considered by policymakers at mining and extractive companies. Since the company's size is a significant variable that affects its competitive power, it should be more diversified, and therefore their values are likely to be growing. Policymakers at mining and extractive firms should carefully control their current assets and current liabilities to prevent default payment. Furthermore, they should try to create new strategies to improve sales growth, reflecting positively on the financial performance.

Moreover, government and policymakers should pay more attention to the strategies that enhance GDP growth, reflecting in all ASE sectors, including mining and extractive companies. Finally, in further studies, the number of explanatory variables is increased to generate more useful information and further enhance future studies' scope. Future researchers may also consider comparing mining and extractive companies' performance with other subsectors at ASE or extending the study by evaluating the financial performance using Multi-criteria Decision Analysis.

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