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Abstract: *This study analyses the impact of macroeconomic and firm-specific variables on profitability of manufacturing firms in Pakistan from 2005 to 2022. The profitability analysis is performed through return on assets (ROA) and the Method of Moments Quantile Regression (MMQR) is used for analyzing the effect of the variables in the various quantiles of profitability. The macroeconomic variables are real gross domestic product (GDP), a measure of inflation in producer prices (PPI), and real effective exchange rate (REER). Firm-specific variables are: the size of the firm, asset turnover, liquidity, and leverage. The results show that real GDP positively and significantly influences the profitability of all the firms at all quantiles. On the other hand, REER negatively impacts ROA, especially at higher quantiles. The effects of the firm specific variables on profitability are positive for firm size, asset turnover and liquidity, and it is significantly negative for leverage. The findings indicate that a stable macro-economic environment based on a regime of economic expansion, relatively stable inflation and moderation in exchange rate fluctuations is required for improving the profitability of the manufacturing sector in Pakistan. In addition, the companies should streamline the operation, enhance the liquidity management, and refrain from over-dependence on debt financing so as to achieve sustainable growth and competitiveness.*

Introduction

Firm profitability refers to a company's ability to generate earnings from its business operations and available resources over a specific period of time. It is considered one of the most important indicators of financial performance, operational efficiency, and long-term business sustainability. In financial and economic literature, profitability reflects how effectively a firm utilizes its assets, equity, investments, and management strategies to maximize returns and achieve organizational objectives. strong profitability enhances firms' resilience against economic shocks and contributes to overall economic development (Triansyah & Karyono, 2026). Profitability is commonly measured through financial indicators such as Return on Assets (ROA), Return on Equity (ROE), and Net Profit Margin (NPM). These measures evaluate the efficiency of firms in generating profits from total assets, shareholders' equity, and sales revenue respectively. Profitable firms are more capable of attracting investors, expanding

operations, and sustaining competitive advantage in dynamic markets (Anderson, 2025). A higher level of profitability indicates better managerial performance, stronger financial stability, and greater capacity for business growth and investment.

Firm size refers to the scale or magnitude of a company's operations and business activities. It is considered an important factor in financial and economic research because it influences a firm's operational efficiency, market power, access to finance, and profitability. Firm size is commonly measured using total assets, total sales, market capitalization, or the number of employees. In empirical studies, the natural logarithm of total assets is frequently used as a proxy for firm size to reduce data variability and improve statistical analysis. In financial literature, larger firms are generally considered to have advantages such as economies of scale, better access to credit markets, stronger bargaining power, advanced technology, and greater diversification opportunities. These advantages may enhance operational efficiency and profitability. Larger firms tend to achieve better financial stability and stronger market competitiveness due to efficient resource utilization and economies of scale (Gruszczyński, 2020). Firm size positively influences profitability among manufacturing firms in developing economies (Razzaq & Malik, 2025). Conversely, smaller firms may face financial constraints, limited market access, and higher operational risks, which can negatively affect performance.

Asset turnover refers to the efficiency with which a firm utilizes its total assets to generate sales revenue. It is an important financial ratio used to measure operational efficiency and management performance. In financial and accounting literature, asset turnover indicates how effectively a company uses its assets to produce income and improve business performance. A higher asset turnover ratio suggests that the firm is efficiently utilizing its assets to generate greater sales, while a lower ratio may indicate inefficient asset management or underutilization of resources. Asset turnover is a key indicator of managerial efficiency and operational effectiveness in corporate finance analysis (Breuer & Ruiz de Vargas, 2021). Asset turnover is widely used in empirical studies as a determinant of firm profitability and operational performance. Firms with higher asset turnover are generally considered more efficient because they can generate more revenue from a given level of assets. Total asset turnover positively affects profitability among listed firms by improving sales generation and resource efficiency (Sunaryo, Lestari, & Puryandani, 2024). Efficient asset utilization may reduce operational inefficiencies, increase productivity, and enhance profitability. However, low asset turnover may reflect poor resource management, excess investment in assets, or weak sales performance.

Liquidity refers to a firm's ability to meet its short-term financial obligations using its current assets. It is an important indicator of financial stability and operational efficiency because it reflects whether a company has sufficient liquid resources to pay its current liabilities on time. In financial and accounting literature, liquidity plays a crucial role in maintaining smooth business operations, avoiding financial distress, and supporting long-term sustainability. Efficient liquidity management enhances operational stability and supports corporate growth (Breuer & Ruiz de Vargas, 2021). Liquidity is commonly measured through financial ratios such as the Current Ratio, Quick Ratio, and Cash Ratio. A higher liquidity ratio indicates that a firm has a stronger capacity to fulfill its short-term obligations, while a lower ratio may suggest financial difficulties and liquidity risk. Firms with effective liquidity management are more likely to achieve higher profitability and financial sustainability (Hoekstra, 2021). Adequate liquidity enables firms to maintain operational continuity, manage unexpected expenses, and improve investor and creditor confidence. However, excessive liquidity may also indicate inefficient utilization of resources because idle current assets may not generate productive returns.

Leverage refers to the use of borrowed funds or debt financing by a firm to support its business

operations, investments, and expansion activities. It indicates the extent to which a company relies on debt relative to shareholders' equity in financing its assets. High leverage levels may reduce profitability because of increased debt servicing costs and financial pressure (Adil, Hussain, Rassas, Hussain, & Irshad, 2025). In financial literature, leverage is considered an important determinant of firm performance because it can increase both the potential returns and financial risks faced by firms. A higher leverage ratio indicates greater dependence on debt financing, while a lower ratio reflects stronger reliance on internal financing and equity capital. Financial leverage can enhance shareholder returns when firms efficiently utilize borrowed funds for productive investments (Horsefall, 2022). Moderate leverage may positively affect firms by providing additional funds for investment, business expansion, and operational growth. However, excessive leverage increases interest obligations and financial risk, which may negatively influence profitability and financial stability.

Gross Domestic Product (GDP) growth refers to the increase in the total value of goods and services produced within a country over a specific period of time. It is one of the most important indicators of economic performance and reflects the overall health and expansion of an economy. GDP growth positively influences firm profitability by increasing market demand and production activities in emerging economies (Arshi, Ali, & Audi, 2025). In economic literature, GDP growth is widely used to measure economic progress, production capacity, employment opportunities, and improvements in living standards. A positive GDP growth rate indicates economic expansion, increased production, and rising business activities, while a negative growth rate reflects economic slowdown or recession. Stable economic growth strengthens financial markets, improves business confidence, and supports long-term corporate sustainability (Erumban & de Vries, 2016). Higher GDP growth generally improves investment opportunities, consumer purchasing power, industrial output, and business confidence, which positively influence firms and overall economic development.

Producer Price Index (PPI) refers to a measure of the average change in prices received by producers for goods and services over time. It is an important macroeconomic indicator used to assess inflation at the production level before products reach consumers. The Producer Price Index reflects changes in the costs of raw materials, manufacturing inputs, and industrial production, making it a significant indicator of economic conditions and business performance. Higher producer price inflation increases operational expenses and negatively impacts firm performance in manufacturing sectors (Elmahdy, Mohamed, & Ahmed, 2025). In economic and financial literature, changes in the Producer Price Index influence firms' production costs, pricing strategies, and profitability. An increase in PPI generally indicates rising production costs, which may reduce firms' profit margins if companies are unable to transfer higher costs to consumers. Fluctuations in producer prices significantly affect industrial firms' profitability and operational efficiency through changes in input costs (Baby, Mia, & Pitchay, 2024). Conversely, moderate increases in producer prices may benefit firms operating in industries with strong market power and pricing flexibility.

Exchange rate refers to the value of one country's currency in terms of another country's currency. It plays a crucial role in international trade, foreign investment, and global financial transactions. Exchange rate volatility affects firms' operational costs and profitability, particularly in emerging economies dependent on imports and exports (Rehman, Hasan, Singh, & Almaqtari, 2024). In economic literature, exchange rates are considered an important macroeconomic indicator because they influence import and export prices, inflation, foreign direct investment, and overall economic performance. An appreciation of the domestic currency means that the local currency gains value relative to foreign currencies, making imports cheaper and exports relatively more expensive. Stable exchange rate

policies contribute to macroeconomic stability, business confidence, and sustainable economic growth (Margineanu, Cernit, & Moroi, 2024). Conversely, depreciation of the domestic currency makes exports cheaper and imports more expensive. Therefore, fluctuations in exchange rates directly affect production costs, international competitiveness, trade balances, and business profitability.

Literature Review

Profitability

Firm profitability is widely recognized as a major indicator of a company's financial performance, operational efficiency, and long-term sustainability. Profitability demonstrates how efficiently firms utilize their resources and investments to generate earnings (Ross et al., 2019). In financial literature, profitability is commonly measured through indicators such as Return on Assets (ROA), Return on Equity (ROE), and Net Profit Margin (NPM), which are frequently used to evaluate firm performance across industries and countries. Empirical studies have identified both internal and external determinants of firm profitability. Internal factors such as firm size, liquidity, leverage, managerial efficiency, and capital structure significantly influence firms' financial outcomes. Efficient financial management and optimal resource allocation positively contribute to profitability in emerging economies (R. U. Khan, Salamzadeh, Abbasi, Amin, & Sahar, 2022). Likewise, external factors including inflation, market competition, economic growth, political uncertainty, and environmental risks also affect firm profitability. Recent literature has increasingly emphasized the role of environmental challenges, particularly water availability and water scarcity, in shaping firm performance.

Firm size and profitability

In empirical finance literature, firm size is generally considered to be a key predictor of profitability by corporation. It is usually quantified by the total assets or total sales and is used to measure the scale and strength of operations and market of a firm. The bigger firms are often supposed to enjoy the economies of scale, greater market power, increased access to finance, and diversification of the business operations which can lead to profitability. Bigger firms will tend to have lesser financial limitations and external funds will be accessible at a cheaper rate, which will avert better performance (Arulraj & Annamalai, 2020). The contradiction in the empirical evidence is in the fact that raising Total Assets has two effects. As much as growth may cause economies of scale, there is also a threat of managerial diseconomies where growth in complexity would result in increased cost of coordination and unproductive distribution of resources. As a result, there is the probability that the numerator (earnings) is not keeping up with an increasing denominator (Mo, Huang, Yang, & Ren, 2026). Firm size positively moderates the relationship between financial factors and company profitability among firms listed on the Indonesia Stock Exchange (Contesa & Contesa, 2025). Therefore, firm size is widely regarded as an important determinant of firm profitability and corporate financial performance.

Assets Turn over and profitability

Asset turnover is an important financial ratio that measures how efficiently a firm utilizes its total assets to generate sales revenue. It reflects the effectiveness of management in using company resources to improve operational performance and profitability. A higher asset turnover ratio indicates that a firm is efficiently using its assets to produce more revenue, which may ultimately enhance profitability and financial performance. In financial and accounting literature, profitability refers to the firm's ability to generate earnings from its operations, assets, and shareholders' investments. Profitability is generally measured through indicators such as Return on Assets (ROA), Return on Equity (ROE), and Net Profit Margin (NPM). Studies suggest that efficient asset utilization positively contributes to firm profitability because firms that effectively manage their assets can increase sales while minimizing operational

inefficiencies. Recent empirical studies support the positive relationship between asset turnover and profitability. Total asset turnover significantly influences profitability among State-Owned Enterprises listed on the Indonesia Stock Exchange (Ahmed Abo Alkomsan, 2024). Total asset turnover positively affects the financial performance of firms listed on the Egyptian Stock Exchange (Raza, Tursoy, Shaikh, & Shaikh, 2024). Asset turnover has significant long-run effects on Return on Assets (ROA) in the Turkish banking industry (Raza et al., 2024). These findings indicate that firms with higher asset utilization efficiency are more likely to achieve stronger profitability and sustainable financial performance.

Liquidity and profitability

Liquidity refers to a firm's ability to meet its short-term financial obligations using its current assets. It indicates the financial strength and operational stability of a company in managing day-to-day business activities. In financial management literature, liquidity is considered an essential determinant of firm performance because adequate liquidity enables firms to maintain smooth operations, avoid financial distress, and respond effectively to unexpected financial needs. Liquidity is commonly measured through ratios such as the Current Ratio, Quick Ratio, and Cash Ratio. Existing literature suggests that liquidity and profitability are closely related. Firms with adequate liquidity are generally better positioned to finance operational activities, pay short-term obligations, and maintain business continuity, which can positively influence profitability. However, excessive liquidity may also reduce profitability because idle current assets may not be efficiently invested in productive activities. Therefore, firms must maintain an optimal balance between liquidity and profitability. Liquidity management has a positive effect on profitability among manufacturing firms in emerging economies (JINJIRI, 2024). Firms with efficient liquidity management achieve better financial performance and operational sustainability (Nazeer, Saleem, & Amin, 2025). Strong liquidity positions enhance firms' resilience against economic and financial shocks, thereby improving profitability and long-term growth prospects (Abdullayev, Tkachenko, Metreveli, Maziashvili, & Bichai, 2025).

Leverage and profitability

Leverage refers to the use of debt financing by a firm to support its business operations, investments, and expansion activities. It indicates the extent to which a company relies on borrowed funds relative to its equity capital. In financial literature, leverage is considered an important determinant of firm profitability because the use of debt can increase the firm's earning potential while also exposing it to financial risk. Firms generally use leverage to finance projects and business activities when internal funds are insufficient. The relationship between leverage and profitability has been widely discussed in corporate finance literature. Moderate levels of leverage may enhance profitability because debt financing allows firms to invest in productive assets and expand business operations. However, excessive leverage can increase interest expenses and financial risk, which may negatively affect profitability. Financial leverage has a significant negative effect on profitability due to increased debt servicing costs among manufacturing firms (Khoza, 2025). Efficient debt management can positively influence profitability by improving firms' investment capacity and operational growth (Nazeer, Mukarram, & Saleem, 2025). Firms with balanced leverage structures are better able to sustain financial stability and long-term profitability in competitive markets (da Conceição-Heldt & Dörfler, 2024). Therefore, maintaining an optimal capital structure is essential for improving firm profitability while minimizing financial risk.

GDP growth and profitability

Gross Domestic Product (GDP) growth refers to the increase in the total value of goods and services produced within an economy over a specific period of time. It is considered one of the most important

indicators of economic performance and macroeconomic stability. In economic and financial literature, GDP growth plays a significant role in influencing firm profitability because a growing economy generally increases consumer demand, business investment, production activities, and market opportunities for firms. Existing literature suggests that higher GDP growth positively affects firm profitability because economic expansion increases purchasing power, improves market confidence, enhances investment opportunities, and raises business revenues. During periods of strong economic growth, firms are more likely to experience higher sales, improved productivity, and greater profitability. Conversely, slow economic growth or economic recession may reduce consumer demand and business performance, thereby negatively affecting profitability. GDP growth significantly improves firm profitability in emerging economies by increasing market demand and investment activities (Naqvi, Shakir, & Siddiqui, 2024). Macroeconomic growth positively influences corporate earnings and financial stability among listed firms (M. A. Khan, Ali, Shabbir, Noor, & Majid, 2024). Stable economic growth enhances business confidence, strengthens corporate performance, and improves profitability across various sectors (Economic, 2025). Therefore, GDP growth is widely considered a key macroeconomic determinant of firm profitability in both developed and developing economies.

Producer Price Index (PPI) and profitability

Producer Price Index (PPI) refers to a measure of the average change in prices received by producers for goods and services over time. It is an important macroeconomic indicator used to monitor inflation at the production level. PPI reflects changes in input costs, raw material prices, and production expenses faced by firms before products reach consumers. In economic literature, the Producer Price Index is considered a significant determinant of firm profitability because fluctuations in production costs directly influence firms' revenues, pricing decisions, and profit margins. Existing literature suggests that changes in the Producer Price Index significantly affect firm profitability. An increase in PPI may raise production and operational costs, reducing profit margins if firms are unable to transfer higher costs to consumers through increased prices. Conversely, moderate increases in producer prices may improve profitability in industries where firms possess strong pricing power and market competitiveness. Rising producer prices significantly affect corporate profitability through increased manufacturing and input costs (Zhang, Wang, Yuan, & Chen, 2026). producer price inflation negatively influences profitability among industrial firms in developing economies due to higher operational expenditures (Ahmad, Hussain, Bibi, & Saeed, 2025). Fluctuations in producer prices create cost pressures for firms and influence overall business performance and financial sustainability (IM, 2009). Therefore, the Producer Price Index is widely considered an important macroeconomic factor affecting firm profitability, especially in production-intensive industries.

Exchange Rate and profitability

Exchange rate refers to the value of one country's currency in relation to another country's currency. It plays a significant role in international trade, investment, and business performance. In economic and financial literature, exchange rate fluctuations are considered an important macroeconomic factor affecting firm profitability, particularly for firms engaged in international trade, imports, exports, and foreign investment activities. Changes in exchange rates influence production costs, export competitiveness, foreign revenues, and import prices, which ultimately affect firms' financial performance. Existing literature suggests that exchange rate appreciation or depreciation can have both positive and negative effects on firm profitability depending on the nature of the business. Currency depreciation may increase export competitiveness and improve profitability for exporting firms, while it may raise production costs for firms dependent on imported raw materials and foreign debt. Similarly,

exchange rate volatility creates uncertainty in business operations, investment decisions, and financial planning, which may negatively affect profitability. Exchange rate volatility significantly affects corporate profitability in emerging economies through its impact on trade costs and financial uncertainty (Faisal, Ramakrishnan, Rahman, Ali, & Sulimany, 2025). Exchange rate depreciation positively influences export-oriented firms' profitability, while import-dependent firms experience declining profit margins (Zhu, Liang, & Yao, 2025). Stable exchange rate policies contribute to financial stability, business confidence, and sustainable corporate profitability (IBRAHIM, HASSAN, & SHAFIE, 2026). Therefore, exchange rate movements are widely recognized as an important macroeconomic determinant of firm profitability.

Methodology

The data for our research was gathered from reputable and common sources. The World Bank was used to obtain data from the years 2005-2022 to use in our study. World Bank compiles development data called world developmental indicators. It provides statistics across countries of different aspects of development including economic growth, trade and globalization, poverty and inequity, education, health, environment, infrastructure and urbanization. The only data for the producer price index (PPI) which we used as a proxy for inflation, collected manually from the Pakistan bureau of statistic. In the present study, the profitability (Y) is the dependent variable which is measure through the Return on Assets (ROA). At the same time, Real gross domestic product (GDP), producer price index (PPI), and Real effective exchange rate as the independent variable Firm size(FZ),Assets turn over (ATO),liquidity (LQ),Leverage(LG) as the control variables.

Table 1. Descriptions of the data and variables

Variables name	Variables short form	Unit of Measurement	Sources
Profitability	(y)	Measured through return on assets (ROA) (Net income/total assets)	State bank of Pakistan (2025).
Independent variables			
Real GDP	(GDP)	Nominal GDP/GDP deflator×100=PKR	World Bank (2025)
Producer price index	(PPI)	Index points PPI=current price/base year price ×100	Pakistan bureau of statistics(2025)
Exchange effective Exchange Rate	(REER)	Index points relative to the selected based year.	World Bank (2025)
Controlled Variables			
Firm Size	(FS)	Current assets and Non-current assets.	State Bank of Pakistan (2025)
Assets Turn over	(ATO)	Million Rupees (PKR) (Sales/Total assets)	State Bank of Pakistan (2025)
Liquidity	(LQ)	Current ratio. (Current assets/ Current	State Bank of Pakistan (2025)

		liabilities)	
Leverage	(LG)	Current Ratio Total debt/Total assets	State Bank of Pakistan (2025).

The current empirical study was conducted to identify the Impact of Macroeconomic and Firm-Specific Determinants on Profitability of Manufacturing Firms in Pakistan. This section focuses on the methodologies of different analyses conducted in the study including the Method of Moments Quantile Regression (MMQR) is used for analyzing the effect of the variables in the various quantiles of profitability. The main objective of this research work is to find the impact of macroeconomic and firm-specific variables on profitability of manufacturing firms in Pakistan from 2005 to 2025. For the mentioned purpose, the study used annual panel data from 2005 to 2025.

Method of Moment Quantile Regression Model. (MM-QR)

The Method of Moments Quantile Regression (MM-QR) model is an advanced econometric technique developed to examine the impact of independent variables across different quantiles of the dependent variable distribution. Unlike traditional regression models that estimate only the average effect of explanatory variables, the MM-QR approach allows researchers to analyze how relationships vary at different points such as lower, middle, and upper quantiles. This makes the model particularly useful when the effects of explanatory variables are heterogeneous across firms, countries, or time periods. The MM-QR model was introduced by Victor Chernozhukov and later extended by Sokbae Lee and Antonio Galvao for panel data analysis. The model combines the advantages of quantile regression with the method of moments estimation approach, providing robust and efficient estimates even in the presence of heterogeneity, non-normality, outliers, and endogeneity issues.

The general form of the MM-QR model can be expressed as:

$$Q_{y_{it}}(\varphi | X_{it}) = X'_{it}\beta(\varphi) + \alpha_i \dots \dots \dots (a)$$

Where:

$Q_{y_{it}}(\varphi | X_{it})$ Represents the conditional quantile of the dependent variable.

φ Denotes the quantile level (e.g., 0.25, 0.50 and 0.75).

X'_{it} Represents the vector of explanatory variables.

$\beta(\varphi)$ Indicates the quantile-specific coefficients.

α_i Captures individual fixed effects.

The MM-QR model is widely used in economic and financial research because it provides a more comprehensive understanding of variable relationships across different levels of firm performance or economic conditions. For example, in studies examining firm profitability, MM-QR helps determine whether factors such as liquidity, leverage, firm size, GDP growth, or exchange rates affect low-profit firms differently from high-profit firms. The model is also robust to heteroskedasticity and non-normal error distributions, which are common in panel data studies.

$$Q_T(ROA_{it}) = \beta_{0T} + \beta_{1,T}ROA_{i,t-1} + \beta_{2,T}LEV + \beta_{3,T}SIZE + \beta_{4,T}ATO + \beta_{5,T} + \beta_{6,T}LGDP_t + LnREER + \varepsilon_{it} \dots \dots \dots (1)$$

Q = Quantile operator

T = (0.25 Quantile) (0.50 Quantile) (0.75 Quantile)

ROA_{it} = Firm profitability

$t-1$ = Lagged variables capture dynamic adjustment and persistence in profitability.

β_0 = Intercept (Constant term)

$\beta_1 + \beta_2 \dots \dots =$ Coefficient of Independent variables.

ε_{it} = Error term (Capture unobserved Factors)

The model specification utilizes a conditional quantile framework to map the relationship between firm-level characteristics and macroeconomic indicators. By employing lagged independent variables, the model accounts for temporal precedence, thereby reducing simultaneity bias. The inclusion of T specific quantile coefficients (β_T) allows the identification of heterogeneous effect, providing more granular analysis of Pakistan stock exchange than a traditional mean-base estimators. The MM-QR results reveal substantial heterogeneity in the determinants of firm profitability, indicating that macroeconomic conditions and firm-specific characteristics exert asymmetric effects across low-, medium-, and high-profit manufacturing firms.

Recent studies have increasingly applied MM-QR in finance, environmental economics, and corporate performance analysis. MM-QR provides reliable estimates for panel data models with fixed effects and heterogeneous distributions (Chiang, Galvao, & Wei, 2026). MM-QR improves estimation efficiency and captures distributional heterogeneity more effectively than conventional regression techniques (Lee, Lee, & Lee, 2025). Therefore, MM-QR is considered an appropriate and powerful method for analyzing complex relationships in panel data research.

Results and Discussions

Table 2. Descriptive statistics results

Table 2. represents presents the descriptive statistics of variables incorporated in the study, that is, firm profitability (ROA), macroeconomic variables (lnGDP, PPI, REER), and firm-specific variables (size, ATO, LIQ, and LEV).

Variables	N	Mean	Std. Dev.	Min	Max
ATO	165	.043	.174	-1.235	2.66
Real GDP	165	31.018	.194	30.703	31.344
REER	165	104.52	7.506	96.487	121.634
PPI	165	4.52	.489	3.666	5.48
LEV	165	.437	.382	.005	2.846
ATO	165	1.102	.716	0	4.148
LIQ	165	1.322	.963	.02	5.886
SIZE	165	15.261	1.627	11.387	19.416

Table 2 presents the descriptive statistics of the variables used in the study, including the number of observations (N), mean, standard deviation, minimum value, and maximum value. The total number of observations for all variables is 165, indicating a balanced panel dataset with complete observations across the study period.

The dependent variable, firm profitability, represented by Return on Assets (ROA), has a mean value of 0.043, which indicates that firms on average generate approximately 4.3% profit from their total assets. The standard deviation of 0.174 suggests moderate variation in profitability among firms. The minimum and maximum values of -1.235 and 2.66 respectively indicate that some firms experienced substantial losses, while others achieved high profitability during the study period.

Real GDP has a mean value of 31.018 with a relatively low standard deviation of 0.194, indicating that economic growth remained comparatively stable throughout the sample period. The minimum and

maximum values range from 30.703 to 31.344, reflecting slight fluctuations in macroeconomic growth conditions.

The Real Effective Exchange Rate (REER) shows a mean value of 104.52 and a standard deviation of 7.506, suggesting moderate volatility in exchange rate movements over the study period. The minimum value of 96.487 and maximum value of 121.634 indicate noticeable changes in currency competitiveness and external economic conditions.

Producer Price Index (PPI) has an average value of 4.52 with a standard deviation of 0.489, indicating relatively stable producer price inflation during the sample period. The minimum and maximum values of 3.666 and 5.48 respectively suggest moderate fluctuations in production costs and inflationary pressures.

Leverage (LEV) records a mean value of 0.437, implying that firms finance approximately 43.7% of their assets through debt. The standard deviation of 0.382 indicates variation in firms' capital structures and debt dependency. The minimum value of 0.005 and maximum value of 2.846 show that some firms use very low debt financing while others rely heavily on leverage.

Asset Turnover (ATO) has a mean value of 1.102 and a standard deviation of 0.716, indicating that firms generate approximately 1.10 units of sales from each unit of assets on average. The minimum value of 0 and maximum value of 4.148 suggest significant differences in operational efficiency among firms.

Liquidity (LIQ) reports a mean value of 1.322, indicating that firms generally possess sufficient current assets to cover short-term liabilities. The standard deviation of 0.963 reflects moderate variation in liquidity positions across firms. The minimum and maximum values of 0.02 and 5.886 respectively indicate differences in firms' short-term financial strength and working capital management.

Firm Size (SIZE) has a mean value of 15.261 with a standard deviation of 1.627, suggesting moderate variation in the scale of firms included in the study. The minimum value of 11.387 and maximum value of 19.416 indicate the presence of both relatively small and large firms within the sample.

Overall, the descriptive statistics indicate reasonable variation among the study variables, suggesting that the dataset is suitable for econometric analysis and empirical investigation of the determinants of firm profitability.

Table 3. Pairwise correlations

Variables	ROA	Real GDP	Ln PPI	Ln REER	SIZE	ATO	LIQ	LEV
ROA	1.000							
Real GDP	0.010	1.000						
Ln PPI	0.019	0.953	1.000					
Ln REER	0.009	0.130	0.026	1.000				
Size	0.060	0.273	0.271	0.025	1.000			
ATO	0.156	-0.097	-0.056	-0.015	-0.013	1.000		
LIQ	0.106	0.011	0.024	0.002	0.015	0.018	1.000	
LEV	0.198	-0.004	-0.004	-0.031	-0.190	-0.035	-0.070	1.000

Table 3 presents the pairwise correlation matrix among the study variables, including Return on Assets (ROA), Real GDP, Producer Price Index (Ln PPI), Real Effective Exchange Rate (Ln REER), Firm Size (SIZE), Asset Turnover (ATO), Liquidity (LIQ), and Leverage (LEV). The correlation matrix is used to examine the

strength and direction of relationships between variables and to identify the potential presence of multicollinearity.

The results show that ROA has a positive correlation with all explanatory variables, although the relationships are generally weak. Specifically, ROA is positively correlated with Real GDP (0.010), Ln PPI (0.019), Ln REER (0.009), SIZE (0.060), ATO (0.156), LIQ (0.106), and LEV (0.198). Among these variables, leverage (LEV) and asset turnover (ATO) show relatively stronger positive associations with firm profitability, suggesting that firms with higher leverage and efficient asset utilization tend to achieve better profitability.

The correlation between Real GDP and Ln PPI is relatively high at 0.953, indicating a strong positive relationship between economic growth and producer prices. However, the remaining correlations among explanatory variables are comparatively low. For instance, Ln REER shows weak correlations with Real GDP (0.130), Ln PPI (0.026), SIZE (0.025), ATO (-0.015), LIQ (0.002), and LEV (-0.031). Similarly, SIZE has weak positive relationships with Real GDP (0.273) and Ln PPI (0.271), while it is negatively associated with leverage (-0.190).

Asset turnover (ATO) has weak negative correlations with Real GDP (-0.097), Ln PPI (-0.056), Ln REER (-0.015), SIZE (-0.013), and LEV (-0.035), whereas it has a slight positive relationship with liquidity (0.018). Liquidity (LIQ) also demonstrates generally weak relationships with other explanatory variables, indicating low interdependence among variables.

Overall, most correlation coefficients are below the commonly accepted threshold of 0.80, suggesting the absence of serious multicollinearity problems in the model. Although the correlation between Real GDP and Ln PPI is relatively high (0.953), the remaining variables exhibit weak to moderate correlations. Therefore, the correlation analysis indicates that the dataset is generally suitable for further econometric estimation and regression analysis.

Table 4. Variance inflation Factors

Variables	VIF	1/VIF
Ln GDP	12.656	.079
Ln PPI	12.364	.081
Ln REER	1.14	.877
LEV	1.047	.888
ATO	1.027	.955
LIQ	1.007	.974
Mean VIF	4.338	.993

Table 4 Presents the Variance Inflation Factor (VIF) and tolerance values (1/VIF) for the explanatory variables used in the study. The VIF test is employed to detect the presence of multicollinearity among independent variables in the regression model. Generally, a VIF value below 10 and a tolerance value above 0.10 indicate the absence of severe multicollinearity problems.

The results show that Ln GDP and Ln PPI have relatively higher VIF values of 12.656 and 12.364 respectively, with corresponding tolerance values of 0.079 and 0.081. These values suggest the presence of a high correlation between these two variables, which is also supported by the pairwise correlation matrix where the correlation coefficient between Ln GDP and Ln PPI is very high. This indicates a potential multicollinearity issue between these macroeconomic variables.

However, the remaining explanatory variables exhibit low VIF values, including Ln REER (1.14), LEV (1.047), ATO (1.027), and LIQ (1.007), with tolerance values substantially above 0.10. These results indicate that these variables do not suffer from multicollinearity and are statistically suitable for regression estimation.

Furthermore, the Mean VIF value is 4.338, which is below the commonly accepted threshold value of 10. This suggests that, overall, the regression model does not suffer from serious multicollinearity problems. Therefore, despite the relatively high multicollinearity between Ln GDP and Ln PPI, the overall VIF results indicate that the explanatory variables are generally appropriate for econometric analysis and model estimation.

Table 5. Method of moment Quantile Regression (MM-QR)

Quantile- 25 Low profit or Struggling firms			
Variables	Coefficients	Slandered errors	P-values
Lag ROA	0.087	0.012	0.000
Ln GDP	0.012	0.008	0.012
Ln REER	0.012	0.013	0.038
Ln Size	0.026	0.017	0.12
ATO	0.050	0.004	0.000
LIQ	0.016	0.06	0.000
LEV	-0.05	0.008	0.06
Constant	-0.932	0.027	0.001
Quantile-50 Averaged firms or Moderate firms			
Lag ROA	0.080	0.012	0.000
Ln GDP	0.024	0.008	0.004
Ln REER	-0.013	0.012	0.025
Ln Size	0.018	0.017	0.030
ATO	0.053	0.004	0.000
LIQ	0.017	0.002	0.000
LEV	-0.061	0.007	0.000
Constant	-0.798	0.255	0.002
Quantile -75 High earning Profit-Elite Firms			
Lag ROA	0.073	0.015	0.000
Ln GDP	0.027	0.010	0.008
Ln REER	-0.039	0.013	0.003
Ln Size	0.010	0.022	0.065
ATO	0.057	0.004	0.000
LIQ	0.019	0.002	0.000
LEV	-0.055	0.007	0.000
Constant	-0.662	0.034	0.002

In order to obtain a heterogeneous effect of macroeconomics and firm specific determinants on the level of profitability, this paper used the quantile regression of the 25th percentile, 50th percentile and 75 th percentile of the profitability distribution. This methodology allows a better insight on the impact of determinants at the different levels of performance of firms that are at the low level of profitability

(struggling) and moderate and high levels of profitability (elite) firms.

The 25th quantile was the point of firms that have lower levels of profitability. Findings indicate that the coefficient of lagged profitability (Lag ROA) is positive and its value is statistically significant ($\beta = 0.087$, $p=0.01$). This means that a 1 percent growth in the ROA of the prior year causes an increment in the ROA of the current year by 0.087 percent. This observation validates the persistence of profits by the poor performing firms and is in line with the dynamic firm performance theory and the hypothesis of persistence of profits (Mueller, 1977). It implies that despite rigidities of the market, adjustment costs and some latency, even struggling firms would have a somewhat greater structural persistence of profitability.

Also a positive statistically significant effect will be evident in economic growth (Ln GDP) ($\beta = 0.012$, $P=0.05$). Through a one percent change in the GDP, an increment of 0.012 percent ROA will be realized. This helps to support the macroeconomic growth theory, which states that growth of the aggregate economy is seen to enhance firm performance since it will boost firm performance by increasing firm performance due to high demand and better market conditions.

The coefficient of the real effective exchange rate (Ln REER) is positive and significant ($\beta = 0.012$, $P=0.05$) which means that increase in the exchange rate by 1 percent leads to increment of ROA by 0.012 percent. This is an indication that poor performing companies can enjoy the appreciation of the currency and this could be attributed to lower prices of imported inputs. Such a finding is in line with the exchange rate pass-through theory, which indicates that the appreciation of currency has the potential of decreasing the input prices of import-based companies.

The effect of Firm size (Ln Size) is positive although the value is statistically insignificant ($\beta = 0.026$). Though the improvement in ROA by 1 percent of increase in size is 0.026, the insignificance of this value implies that there is weak evidence of economies of scale in the struggling companies. Asset turnover (ATO) shows that it has a strong and significant effect ($\beta = 0.050$, $p = 0.01$). The impact of the 1% growth of asset turnover is that it increases the profitability by 0.050% of the ROA, which is significant in turnover in enhancing profitability of the low-performing firms. This observation aligns with the efficiency theory which is able to highlight the importance of efficient utilization of assets in improving the financial performance.

The impact of Liquidity (LIQ) on the profitability is also positive and significant ($\beta = 0.016$, $P = 0.01$). One percent enhancement of liquidity raises ROA by 0.016, which may be attributed to the working capital management theory which states that the liquidity condition allows to increase short-term financial stability and operational flexibility.

The negative coefficient which is ($\beta = 0.050$, $p = 0.06$) means that a one percent leverage increases ROA by 0.05 percent less. This finding confirms the trade-off theory of capital structure, which states that over dependency on debt maximizes the cost of financial distress, especially to firms that are in poor financial conditions.

The 50th percentile is used to indicate that of an average profitability of firms. The value of rail lagged profitability is positive and significant ($\beta = 0.080$, $p = 0.01$). An increase in previous profitability by 1 percent will result in a 0.080 percent increment in the present ROA and this supports the continuity of profits among the mediocre companies.

The growth of the economy (Ln GDP) is stronger at this quantile ($\beta = 0.024$, $p = 0.01$). A 1 percent GDP growth boosts ROA by 0.024% which means that salient firms enjoy the macroeconomic growth more significantly. This result supports the pro-cyclicality of the profitability of firms. Conversely, the actual effective exchange rate (Ln REER) performs a negative effect ($\beta = 0.013$, $p = 0.05$) which is statistically

significant. Increase in REER by 1-percent has a negative impact on ROA, decreasing by 0.013%. This finding favors the competitiveness theory, which implies that appreciation of currency undermines competitiveness in exports as well as negatively impacting on the profits made by firms. In general, the median quantile outcomes may indicate that macroeconomic variables are stronger in factoring in when firms are at moderate level of profitability and firm-specific factors like the persistence still take their place.

The 75th the quantile brings in very lucrative firms. Lagged profitability is statistically significant and ($\beta=0.073$, $p=0.01$) which is positive implying that a 1% change in prior ROA raises the current ROA by 0.073%. This proves that profit persistence is substantial and it conforms to the competitive advantage theory which holds that companies that have the best capabilities can continue to remain profitable in the long-term.

There is a positive significant effect of economic growth (Ln GDP) on it ($\beta=0.027$, $P=0.01$). The positive correlation between a 1 percent growth in GDP and ROA is 0.027 which indicates that the ROA of high performing companies would be in a better place to take advantage of the favorable macroeconomic environment. The actual effective exchange rate (Ln REER) is found to have negative and significant effect ($\beta=0.039$, $P=0.01$). A 1 percent growth of REER has a negative impact on ROA of 0.039, which shows that elite firms are more vulnerable to the exchange rates. This observation is consistent with the exchange rate exposure theory which implies that export and internationally integrated companies are worse hit by appreciation of currency. The size of the firm, Firm size (Ln Size), has a low positive impact ($\beta=0.010$, marginally significant) indicating small scale economies of scale across firms that are performing well. The positive effect of asset turnover (ATO) is high ($\beta=0.057$, $p=0.01$), meaning that improvement of the efficiency leads to the increase in the profitability considerably at the higher level of the performance.

Liquidity (LIQ) has a significant positive influence on profitability ($\beta=0.019$, $p=0.01$), which suggests that profitable companies can have a significant advantage of having sufficient liquidity holding. The coefficient of leverage (LEV) is found to have negative and significant value ($\beta=0.055$, $P=0.01$) that means a 1 percentage point increase in leverage decreases ROA by 0.055%. Nevertheless, this observation confirms the financial distress cost theory which indicates that high debt levels have adverse effects on the profitability even in high-quality firms.

Conclusion and Policy Recommendations

The study concludes that both macroeconomic factors and firm-specific characteristics significantly influence the profitability of manufacturing firms listed on the Pakistan Stock Exchange, and these effects vary across low-, medium-, and high-performing firms. Using the Method of Moments Quantile Regression (MM-QR), the findings reveal that profitability is highly persistent over time, economic growth benefits high-performing firms more strongly, and exchange rate appreciation negatively affects firms with greater export and import exposure.

The findings suggest that policymakers should prioritize macroeconomic stability by promoting sustainable GDP growth, controlling inflation, and maintaining a stable exchange rate environment to enhance the profitability of Pakistan's manufacturing sector. Manufacturing firms should improve operational efficiency, strengthen liquidity management, increase asset utilization, and adopt conservative financing strategies by reducing excessive dependence on debt. Furthermore, both policymakers and firm managers should encourage industrial competitiveness through infrastructure development, risk management, local sourcing of inputs, and long-term strategic reforms to ensure sustainable growth and resilience in the sector.

Limitations of the study

This study provides important insights into the profitability of manufacturing firms in Pakistan; however, some limitations remain. The study covers only 2005–2022 and focuses on listed firms, excluding SMEs and unlisted companies, which may limit generalizability. Moreover, factors such as corporate governance, innovation, and market competition were not included, and future studies may use additional profitability measures and cross-country comparisons for broader analysis.

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