

Heterogeneous Internal Financial Drivers of Operating Cash Flow: Evidence from Quantile Regression in an Emerging Market

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Abstract. This study aims to examine the determinants of operating cash flow (cash flow from operating activities, OCF) in dividend-paying firms in Pakistan. Using firm-level data and applying quantile regression alongside ordinary least squares (OLS), the analysis captures variations across the conditional distribution of OCF beyond mean-based estimates. The results indicate that total assets are negatively associated with OCF across most quantiles, suggesting lower efficiency in cash generation among larger firms. In contrast, sales and fixed assets exhibit consistently positive relationships, highlighting their importance for operational performance. Risk shows a positive association, particularly at higher quantiles, indicating stronger cash generation among higher-risk firms. Dividend payout is significant only at the upper quantile, implying a limited role relative to operational factors. Firm age is significant at lower and median quantiles but not at higher levels. Overall, the findings emphasize the role of operational scale, asset utilization, and risk in shaping OCF, with implications for financial decision-making in emerging markets.

Keywords: Cash from operations, quantile regression, Pakistan, Stata, risk, emerging economies.

JEL Code: M41

Introduction

Operating cash flow (cash flow from operating activities, OCF) is widely recognized as a fundamental indicator of a firm's financial health and sustainability, particularly in emerging markets where access to external financing may be constrained (Akhtar, 2024; Magerakis and Tzelepis, 2023; Nadia and Hanafi, 2023). Prior research has examined various firm-level determinants of OCF, including size, asset structure, sales performance, leverage, and risk; however, the empirical evidence remains mixed and often context-specific (Sardo et al., 2022; Serrasqueiro et al., 2025). While some studies report positive effects of firm size and asset base on cash generation, others highlight inefficiencies associated with larger firms. Similarly, the role of dividend policy, risk exposure, and liquidity in shaping OCF is not consistently established across different institutional settings (Habib et al., 2022; Laghari et al., 2023; Ahmed and King, 2025; Ofir and Elmakiess, 2023). This lack of convergence suggests that the

determinants of OCF may vary not only across countries but also across firms with different levels of cash-generating capacity.

Despite growing interest in cash flow analysis, limited evidence exists for Pakistan, particularly for dividend-paying firms operating under economic and institutional uncertainty. Moreover, most existing studies rely on mean-based estimation techniques, which may obscure important heterogeneity in the relationships between financial determinants and OCF. As a result, the literature lacks a nuanced understanding of how these determinants behave across different points of the OCF distribution, leaving an important empirical and methodological gap.

This study aims to examine the firm-specific determinants of operating cash flow (OCF) in dividend-paying companies in Pakistan, with particular emphasis on capturing heterogeneous effects across the conditional distribution of OCF. The study focuses on internal financial characteristics, including total assets, sales, dividend payout ratio, debt-to-equity ratio, risk, fixed assets, current ratio, and firm age. OCF is operationalized as cash flow from operating activities. By explicitly defining the dependent variable and linking it to firm-level characteristics, the study provides a clearer empirical framework for analyzing cash generation.

To address the limitations of prior research, the study employs quantile regression alongside conventional ordinary least squares (OLS) estimation. Unlike mean-based models, quantile regression does not impose restrictive distributional assumptions and allows the effects of explanatory variables to vary across different levels of OCF. This approach is particularly suitable in the context of emerging markets, where firms may exhibit substantial heterogeneity in financial performance and operational efficiency.

The study is grounded in established corporate finance theories. The trade-off theory suggests that firms balance the benefits and costs of debt, implying that leverage and asset structure play an important role in shaping cash flows. In contrast, the pecking order theory emphasizes the preference for internal financing, highlighting the importance of OCF in supporting investment and reducing reliance on external funds. These theoretical perspectives provide a foundation for examining how firm characteristics influence OCF, while also allowing for the possibility of varying effects across firms.

By focusing on Pakistan's dividend-paying firms and adopting a distributional approach, this study contributes to the literature in two key ways. First, it provides context-specific evidence on the determinants of OCF in an under-researched emerging market. Second, it extends existing research by capturing heterogeneity in these relationships, offering a more comprehensive understanding of operational cash generation.

1. Literature review

1.1 Theoretical background

Operating cash flow (cash flow from operating activities, OCF) plays a central role in corporate finance, particularly within the frameworks of the pecking order theory and trade-off theory. The pecking order theory posits that firms prioritise internal financing, making OCF a critical resource for investment and operational sustainability (Fazzari et al., 1988; Kadapakkam et al., 1998). In contrast, the trade-off theory emphasises the balance between the benefits and costs of external financing, suggesting that capital structure decisions influence firms' ability to generate and retain cash (Cleary, 2006). These perspectives imply that firm-specific financial characteristics shape OCF, although the direction and magnitude of these effects may vary across firms.

1.2 Firm size, asset structure, and OCF

Firm size and asset structure are commonly examined determinants of OCF (Kadapakkam et al., 1998; Arifaj et al., 2023). Larger firms, typically proxied by total assets, may benefit from economies of scale, leading to improved cash generation (Purba et al., 2023). However, inefficiencies associated with complex organisational structures may offset these advantages, resulting in ambiguous effects (Liu and

Zhang, 2022; Purba et al., 2023). Similarly, fixed assets are expected to enhance productive capacity and operational efficiency, thereby increasing OCF (Sultana et al., 2026). Empirical findings, however, remain mixed, with some studies reporting positive associations and others suggesting diminishing returns or inefficiencies in asset utilisation.

Hypothesis 1 (H1): Total assets are significantly associated with OCF, although the direction of the relationship may vary.

Hypothesis 2 (H2): Fixed assets are significantly associated with OCF, with potential variation across firms.

1.3 Sales performance and operational activity

Sales are a direct indicator of operational activity and revenue generation, and are therefore expected to have a positive relationship with OCF (Kreuter et al., 2022; Indriyani et al., 2024). Higher sales volumes typically translate into greater cash inflows from core business operations (Rachmat et al., 2024). Prior studies generally support a positive association; however, variations in cost structures and working capital management may weaken or alter this relationship across firms (Al-Shattarat et al., 2022).

Hypothesis 3 (H3): Sales are positively associated with OCF, although the strength of this relationship may differ across the distribution.

1.4 Capital structure and financing decisions

Capital structure, often measured by the debt-to-equity ratio, plays a critical role in shaping firms' financial flexibility and cash flow dynamics (Ahmed and King, 2025; Akhtar, 2024; Alvian and Munandar, 2022; Arifaj et al., 2023; Chava and Roberts, 2008; Naser et al., 2024; Oliner and Rudebusch, 1992; Sardo et al., 2022; Zuliyana et al., 2023). Higher leverage may constrain OCF due to increased interest obligations, but it may also discipline management and improve efficiency. Empirical evidence remains inconclusive, with both positive and negative relationships reported in the literature.

Hypothesis 4 (H4): The debt-to-equity ratio is significantly associated with OCF, with an ambiguous expected sign.

1.5 Dividend policy and internal financing

Dividend policy directly affects the availability of internal funds. According to the pecking order theory, higher dividend payouts reduce retained earnings and may limit internal financing capacity, potentially constraining OCF. Conversely, dividend-paying firms are often more mature and financially stable, which may support stronger cash generation (An et al., 2022; Laghari et al., 2023; Januarsi and Sanusi, 2024; Ojogbo et al., 2022). This duality suggests that the relationship between dividend payout and OCF is not unidirectional.

Hypothesis 5 (H5): Dividend payout ratio is significantly associated with OCF, with potentially varying effects across firms.

1.6 Risk and firm-specific characteristics

Risk, commonly measured as the volatility of returns, reflects uncertainty in firm performance. Higher risk may be associated with greater variability in OCF; however, risk-taking firms may also pursue high-return opportunities that enhance cash generation. Similarly, firm age is often linked to experience and operational stability, although younger firms may exhibit higher growth potential. These contrasting perspectives indicate that firm-specific characteristics may influence OCF in complex and non-linear ways (Didar et al., 2025; Tachiwou, 2010; Sardo et al., 2022; Rashid and Hersi, 2022).

Hypothesis 6 (H6): Risk is significantly associated with OCF, with effects varying across different levels of cash generation.

Hypothesis 7 (H7): Firm age is significantly associated with OCF, although the direction of the relationship is uncertain.

1.7 Liquidity and short-term financial position

Liquidity, often proxied by the current ratio, reflects a firm's ability to meet short-term obligations. While higher liquidity may support stable operations and cash generation, excessive liquidity may indicate inefficient resource utilisation. Prior studies provide mixed evidence, suggesting that the relationship between liquidity and OCF is context-dependent (Al-Shattarat et al., 2023; Purwanti and Warasto, 2023).

Hypothesis 8 (H8): The current ratio is significantly associated with OCF, with no uniform expected direction.

1.8 Research gap and contribution

Despite extensive research on corporate liquidity and financial performance, most studies focus on average effects using mean-based estimation techniques, thereby overlooking heterogeneity in firms' cash-generation capacity. Empirical findings on the determinants of OCF remain inconclusive, with conflicting evidence across different contexts and variables. Moreover, limited research has examined these relationships in emerging markets such as Pakistan, where firms operate under financial constraints, macroeconomic volatility, and institutional uncertainty.

This study addresses these gaps by adopting a quantile regression approach to examine how internal financial determinants influence OCF across different points of its conditional distribution. By moving beyond average effects, the study captures distributional asymmetries and provides a more nuanced understanding of cash flow dynamics. This approach contributes to the literature by integrating theoretical insights with a methodological framework capable of uncovering heterogeneous relationships, particularly in the context of emerging markets.

2. Methodology

This study utilizes secondary data drawn from the audited annual financial statements of non-financial firms listed in Pakistan over the period 2012–2018. The analysis focuses on dividend-paying firms, which are typically characterized by relatively stable financial performance and consistent disclosure practices. The initial population comprises all listed non-financial firms, from which observations with missing or incomplete financial information are excluded. The final sample consists of 76 firms, yielding a balanced panel of 456 firm-year observations. While the restriction to dividend-paying firms enhances data consistency, it may introduce selection bias by excluding financially constrained firms, and this limitation is acknowledged when interpreting the results. The sample period ends in 2018 to ensure that the analysis captures firm behavior under relatively stable macroeconomic conditions prior to the disruptions caused by the COVID-19 pandemic. The pandemic introduced significant distortions in firms' cash flows, followed by a period of heightened financial and political instability in Pakistan, which may fundamentally alter cash flow dynamics. By focusing on the pre-COVID period, the study aims to provide cleaner, more internally consistent estimates of the relationship between firm-specific characteristics and operating cash flow, though this choice may limit the generalizability of the findings to more recent periods.

The dependent variable is operating cash flow (cash flow from operating activities, OCF) in absolute terms, which serves as a direct measure of firms' operational performance and financial sustainability.

The explanatory variables include total assets, sales, dividend payout ratio, debt-to-equity ratio, risk (measured as the standard deviation of return on equity), fixed assets, current ratio, and firm age. These variables are selected based on their theoretical relevance within the trade-off and pecking order frameworks and their frequent use in prior empirical studies. Monetary variables are scaled or transformed where appropriate to mitigate heteroscedasticity and improve interpretability. The

explanatory variables are primarily aligned contemporaneously with OCF, although alternative lag specifications are considered as part of robustness analysis.

To examine the relationship between firm-specific characteristics and operating cash flow, the following baseline specification is estimated:

$$OCF_{it} = \beta_0 + \beta_1 Total_assets_{it} + \beta_2 Sales_{it} + \beta_3 Dividend_Payout_{it} + \beta_4 Debt_Equity_{it} + \beta_5 Risk_{it} + \beta_6 Fixed_assets_{it} + \beta_7 Current_ratio_{it} + \beta_8 age_{it} + \varepsilon_{it} \quad (1)$$

where *i* and *t* denote firm and time dimensions, respectively. The empirical analysis employs both ordinary least squares (OLS) and quantile regression techniques. While OLS provides estimates of average effects, quantile regression allows the coefficients to vary across different points of the conditional distribution of OCF, thereby capturing potential heterogeneity in firm behavior. The analysis focuses on the 0.25, 0.50, and 0.75 quantiles, corresponding to firms with relatively low, median, and high levels of operating cash flow.

All estimations are conducted using Stata 12. To ensure reliable statistical inference, robust standard errors clustered at the firm level are employed to account for heteroskedasticity and within-firm correlation over time. In addition, a set of basic robustness checks is implemented, including alternative variable specifications and sensitivity to outliers, to assess the stability of the results. Nevertheless, potential endogeneity concerns, such as reverse causality and omitted variable bias, cannot be fully eliminated within the current empirical framework and are therefore acknowledged as a limitation. Overall, the adopted methodology provides a rigorous framework for examining the determinants of operating cash flow while allowing for heterogeneous effects across firms with different levels of cash-generating capacity.

3. Findings and interpretations

Table 1 presents the descriptive statistics of the variables used in the study, including the mean, standard deviation, minimum, and maximum values. The results indicate substantial heterogeneity across firms, which justifies the use of distribution-sensitive estimation techniques such as quantile regression.

Table 1. **Summary statistics and descriptive**

Variables	Mean	Standard deviation	Min	Max
Total_assets	3.53e+07	8.1e+07	506158	6.66e+08
Sale	3.88e+07	1.17e+08	654603	1.19e+09
Dividend_payout	0.1601	8.37	-192.16	9.77
Debt_equity	1.20	1.53	0.086	21.48
Risk	0.122	0.30	0.044	2.59
Fixed_assets	1.53e+07	3.86e+07	129154	3.35e+08
Current_ratio	2.15	1.44	0.532	10.544
Operating Cash Flow (OCF)	3660394	1.35e+07	-5.7e+07	1.86e+09
Age	38.26	20.80	5	158

Source: compiled by the authors

Total assets have a mean value of approximately PKR 35.3 million, with a very large standard deviation (PKR 81.0 million), indicating significant variation in firm size. The wide gap between the minimum (PKR 0.51 million) and maximum (PKR 666 million) suggests the presence of both small and very large firms in the sample, reflecting structural diversity in the Pakistani corporate sector.

Similarly, sales exhibit a high degree of dispersion, with an average of PKR 38.8 million and a standard deviation of PKR 117 million. The large range—from PKR 0.65 million to PKR 1.19 billion—highlights differences in operational scale and revenue-generation capacity among firms.

The dividend payout ratio shows a mean of 0.16, but an exceptionally high standard deviation (8.37) and a wide range, including negative values (−192.16). This indicates unstable dividend policies, likely driven by earnings volatility, losses, or retained earnings adjustments—an outcome consistent with firms operating under financial constraints in emerging markets.

The debt-to-equity ratio has a mean of 1.20, suggesting that, on average, firms rely more on debt than equity financing. The maximum value (21.48) signals the presence of highly leveraged firms, while the moderate standard deviation (1.53) points to uneven capital structure choices across firms.

Firm risk, measured by volatility or earnings uncertainty, has a relatively low mean (0.122) but a high maximum (2.59), indicating that while most firms face moderate risk, a subset experiences substantial financial uncertainty. This variability is important when examining cash flow behavior across different firm conditions.

Fixed assets average PKR 15.3 million, with a large standard deviation (PKR 38.6 million), reflecting variation in capital intensity. The wide range suggests that some firms are asset-light, while others are heavily invested in long-term tangible assets, which may influence operational cash generation differently across quantiles.

The current ratio has a mean of 2.15, indicating that, on average, firms maintain adequate short-term liquidity. However, the maximum value (10.54) reveals that some firms hold excessive current assets, potentially reflecting precautionary liquidity motives or inefficient working capital management.

Cash holdings display extreme dispersion, with a mean of PKR 3.66 million and a very large standard deviation (PKR 13.5 million). The presence of negative minimum values suggests cash overdrafts or short-term borrowing, while the extremely high maximum indicates cash-rich firms. This skewness reinforces the relevance of analyzing cash generation behavior beyond the mean.

Finally, firm age averages 38 years, with a standard deviation of 20.8 years, indicating a mix of mature and relatively young firms. The maximum age of 158 years reflects the presence of long-established firms, which may benefit from experience, reputation, and stable cash flows.

Table 2 reports the quantile regression estimates at the 0.25 quantile, representing firms with relatively low levels of cash generated from operations (OCF). This quantile captures financially constrained firms for whom internal cash generation is particularly critical.

Table 2. The quantile regression results at 0.25 quantile

Independent variables	Coefficient	Standard errors	t-statistics	P> t
Total_assets	0.0603**	0.0275	2.19	0.029
Sale	-0.0601***	0.0097	-6.14	0.000
Dividend_payout	102.80	6461.74	0.02	0.987
Debt_equity	-1725975***	450027	-3.84	0.000
Risk	370582	2223038	0.17	0.868
Fixed_assets	0.091**	0.044	2.04	0.042
Current_ratio	-1849843***	345070.8	-5.36	0.000
Age	15793.84	26974.88	0.59	0.559

Note: * means significance at 10 percent, ** means significance at 5 percent and *** means significance at 1 percent.

Source: compiled by the authors

The coefficient of total assets is positive and statistically significant at the 5% level, indicating that firm size contributes positively to operational cash generation among low-OCF firms. This suggests that

even at the lower tail of the cash flow distribution, larger firms benefit from scale efficiencies and more stable operations that enhance cash inflows.

In contrast, sales exhibit a negative and highly significant relationship with OCF at the 1% level. This counterintuitive result implies that for firms in the lower quantile, higher sales do not necessarily translate into higher operational cash flows, possibly due to extended credit terms, weak receivables management, or high operating costs. This finding highlights working capital inefficiencies commonly observed among financially constrained firms in emerging markets.

The dividend payout ratio is statistically insignificant, suggesting that dividend policy does not influence operational cash generation for low-OCF firms. This result is expected, as firms with weak cash flows are less likely to rely on dividends as a signaling or cash management mechanism.

The debt-to-equity ratio shows a negative and highly significant effect at the 1% level, indicating that higher leverage substantially reduces operational cash generation at the lower quantile. This reflects the burden of debt servicing costs and heightened financial distress, which disproportionately affect firms with limited cash-generating capacity.

Firm risk is positive but statistically insignificant, implying that risk exposure does not play a decisive role in explaining OCF for firms at the lower tail of the distribution. This may indicate that survival-oriented firms prioritize liquidity preservation over risk-taking.

Fixed assets have a positive and significant impact at the 5% level, suggesting that greater investment in tangible assets enhances operational cash generation even among low-OCF firms. This finding supports the view that productive capacity and asset utilization contribute positively to cash flows, particularly when firms rely heavily on internal financing.

The current ratio is negative and highly significant at the 1% level, indicating that excessive short-term liquidity is associated with lower operational cash generation. This result suggests inefficient working capital management, where overinvestment in current assets may lock up cash and reduce operational efficiency.

Finally, firm age is statistically insignificant, indicating that organizational maturity does not materially affect operational cash generation for firms at the 0.25 quantile. This suggests that experience alone does not shield firms from cash flow constraints.

Table 3 reports the quantile regression estimates at the 0.50 quantile, indicating that operational activity, productive assets, liquidity, and firm maturity contribute positively to cash generation at the median level.

Table 1. The quantile regression results at 0.50 quantile

Independent variables	Coefficient	Standard errors	t-statistics	P> t
Total_assets	-0.100***	0.002	-48.13	0.000
Sale	0.010***	0.0006	16.19	0.000
Dividend_payout	-9405.40***	443.02	-21.23	0.000
Debt_equity	17797.17	24709.52	0.72	0.473
Risk	461896.4***	123311.2	3.75	0.000
Fixed_assets	0.3801***	0.0034	110.83	0.000
Current_ratio	84214.8***	2570.44	3.27	0.001
Age	5966.58***	1836.06	3.25	0.001

Note: * means significance at 10 percent, ** means significance at 5 percent and *** means significance at 1 percent.

Source: compiled by the authors

The total assets are the significant negative determinant of OCF. The coefficient is negative and the P value of the coefficient is less than 0.01. But the sales are the positive significant determinant of OCF. Both the findings are opposite to the quantile regression at 0.25 quantile.

The dividend payout ratio is negative significant determinant of OCF. Now the debt to equity is the insignificant determinant of OCF.

Finally the risk, fixed assets, current ratio and age all are positive and significant determinants of OCF. Table 3 shows findings according to the hypotheses. Only total assets and dividend policies are negative significant determinants of OCF. But other all determinants are positive determinants of OCF.

Table 4 shows the summary of the findings based on median regression (quantile regression at 0.50 quantile). The findings in table 4 are meaningful for the policy makers. Those are discussed in detail in discussion and conclusion section. Finally, the recommendations and limitations section guide the policy makers on the basis of the findings of this study.

Table 2. Results based on quantile regression at 0.50 quantile

Hypothesis	Variable	Expected relationship in revised hypothesis	Coefficient at 0.50 quantile	p-value	Assessment at 0.50 quantile
H1	Total assets	Significant association; direction may vary	-0.100***	0.000	Supported; significant negative association
H2	Fixed assets	Significant association; may vary across firms	0.3801***	0.000	Supported; significant positive association
H3	Sales	Positive association; strength may vary	0.010***	0.000	Supported; significant positive association
H4	Debt-to-equity ratio	Significant association; ambiguous expected sign	17,797.17	0.473	Not supported at the median quantile
H5	Dividend payout ratio	Significant association; effects may vary	-9,405.40***	0.000	Supported; significant negative association
H6	Risk	Significant association; effects may vary	461,896.4***	0.000	Supported; significant positive association
H7	Firm age	Significant association; direction uncertain	5,966.58***	0.001	Supported; significant positive association
H8	Current ratio	Significant association; no uniform expected direction	84,214.8***	0.001	Supported; significant positive association

Note: * means significance at 10 percent, ** means significance at 5 percent and *** means significance at 1 percent.

Source: compiled by the authors

Table 5 presents the quantile regression estimates at the 0.75 quantile, indicating that operational performance and productive asset utilization are important drivers of cash generation among firms with relatively high operating cash flows.

Table 3. The quantile regression results at 0.75 quantile

Independent variables	Coefficient	Standard errors	t-statistics	P> t
Total_assets	-0.33***	0.003	-9.50	0.000
Sale	0.653***	0.009	68.04	0.000
Dividend_payout	1292	879	1.47	0.142
Debt_equity	-143903***	47720	-3.02	0.003

Independent variables	Coefficient	Standard errors	t-statistics	P> t
Risk	1573934***	160819	9.79	0.000
Fixed_assets	0.30***	0.0060	50	0.000
Current_ratio	23302	38894	0.60	0.549
Age	19959***	2793	7.15	0.000

Note: * means significance at 10 percent, ** means significance at 5 percent and *** means significance at 1 percent.

Source: compiled by the authors

The total assets are negative and significant determinant of OCF at 0.75 quantile. The P value of the coefficient is 0.000 which is less than 1 percent, so the result is highly significant. But the sales are positive determinant, and the P value of the coefficient is also 0.000 so the coefficient is also significant at 1 percent.

The dividend payout is insignificant but the debt to equity ratio is negative but significant determinant of OCF. Risk, fixed assets, current ratio and age are significant and positive determinants of cash.

Table 6 presents the quantile regression results at the 0.75 quantile, representing firms with high levels of cash generated from operations (OCF). This quantile captures relatively cash-rich and operationally efficient firms, for which internal cash generation plays a strategic rather than survival-oriented role.

Table 4. Results based on quantile regression at 0.75 quantile

Hypothesis	Variable	Expected relationship in revised hypothesis	Coefficient at 0.75 quantile	p-value	Assessment at 0.75 quantile
H1	Total assets	Significant association; direction may vary	-0.33***	0.000	Supported; significant negative association
H2	Fixed assets	Significant association; may vary across firms	0.30***	0.000	Supported; significant positive association
H3	Sales	Positive association; strength may vary	0.653***	0.000	Supported; significant positive association
H4	Debt-to-equity ratio	Significant association; ambiguous expected sign	-143,903***	0.003	Supported; significant negative association
H5	Dividend payout ratio	Significant association; effects may vary	1,292	0.142	Not supported at the 0.75 quantile
H6	Risk	Significant association; effects may vary	1,573,934***	0.000	Supported; significant positive association
H7	Firm age	Significant association; direction uncertain	19,959***	0.000	Supported; significant positive association
H8	Current ratio	Significant association; no uniform expected direction	23,302	0.549	Not supported at the 0.75 quantile

Note: * means significance at 10 percent, ** means significance at 5 percent and *** means significance at 1 percent.

Source: compiled by the authors

The coefficient of total assets is negative and statistically significant at the 1% level, leading to a rejection of the positive relationship. This finding suggests that among high-OCF firms, larger size may be associated with operational rigidity, bureaucratic inefficiencies, or diminishing marginal returns to scale, which reduce incremental cash generation. This result highlights that size advantages observed at lower quantiles do not persist uniformly across the cash flow distribution.

In contrast, sales have a positive and highly significant effect at the 1% level, confirming the hypothesized relationship. For firms in the upper quantile, higher sales translate effectively into operational cash flows, indicating superior revenue quality, efficient receivables management, and strong market positioning.

The dividend payout ratio exhibits a positive but statistically insignificant coefficient, implying that dividend policy does not materially influence operational cash generation even for cash-rich firms. This suggests that dividends are more a consequence of cash availability than a determinant of OCF.

The debt-to-equity ratio shows a negative and significant effect at the 1% level, leading to rejection of the hypothesized positive direction. This indicates that leverage constrains operational cash generation even among high-OCF firms, reflecting debt servicing obligations and conservative cash management preferences consistent with pecking order theory.

Firm risk has a positive and statistically significant impact at the 1% level, suggesting that high-OCF firms are better able to absorb and manage risk, converting uncertainty into higher returns and cash flows. This result supports the risk–return trade-off and indicates superior risk management capabilities among financially strong firms.

Fixed assets exhibit a positive and highly significant relationship with OCF, confirming the hypothesis. This implies that capital-intensive firms in the upper quantile benefit from efficient asset utilization, economies of scale, and stable production processes that enhance operational cash flows.

The current ratio is positive but statistically insignificant, indicating that short-term liquidity management does not significantly affect OCF for high-OCF firms. This suggests that such firms face fewer working capital constraints and can optimize liquidity without adversely affecting cash generation.

Finally, firm age has a positive and highly significant effect at the 1% level, confirming the hypothesized relationship. This finding indicates that mature firms benefit from accumulated experience, reputation, established customer bases, and institutional credibility, all of which contribute to stronger and more stable operational cash flows.

Table 7 shows the results of simple regression. The total assets are negative and significant determinant of OCF whereas the sales, fixed assets and age are significant positive determinants of OCF. The R square value is 0.5663 which shows that simple regression model can explain the variation in the dependent variable up to 56 percent. The F statistics value shows that model is reliable as the P value of the F statistics is less than 1percent which shows that the findings of the model are reliable and valid.

Table 5. Results based on simple regression

Independent variables	Coefficient	Standard errors	t-statistics	P> t
Total_assets	-0.1684***	0.0265	-6.34	0.000
Sale	0.0288***	0.0083	3.47	0.001
Dividend_payout	-7226	46571	-0.16	0.877
Debt_equity	139408	384337	0.36	0.717
Risk	963444	1549596	0.62	0.534
Fixed_assets	0.5222***	0.04230	12.35	0.000
Current_ratio	393413	316085	1.24	0.214
Age	5266	20988	0.25	0.802

Note: * means significance at 10 percent, ** means significance at 5 percent and *** means significance at 1 percent. The value of R-square is 0.5663; The value of F-statistics is 72.96.

Source: compiled by the authors

Table 8 provides the clear picture for conclusions and discussion; in fact the OCF has significant impact on the worth of the companies. It provides better picture than profitability and liquidity for the stakeholders and the policy makers.

Table 6: Summary of quantile regression results

Independent variables	Coefficient at simple OLS	Coefficient at 0.25 quantile	Coefficient at 0.50 quantile	Coefficient at 0.75 quantile	Coefficient at 0.90 quantile
Total_assets	-0.1684***	0.0603**	-0.100***	-0.33***	-0.019**
Sale	0.0288***	-0.0601***	0.010***	0.653***	0.053***
Dividend_payout	-7226	102.80	-9405.40***	1292	5222.5***
Debt_equity	139408	-1725975***	17797.17	-143903***	-328943***
Risk	963444	370582	461896.4***	1573934***	3421129***
Fixed_assets	0.5222***	0.091**	0.3801***	0.30***	0.46568***
Current_ratio	393413	-1849843***	84214.8***	23302	-43930
Age	5266	15793.84	5966.58***	19959***	7321

Note: * means significance at 10 percent, ** means significance at 5 percent and *** means significance at 1 percent.

Source: compiled by the authors

The Figure 1 highlights the advantages of quantile regression in identifying differences that are not visible in average-based regression models.

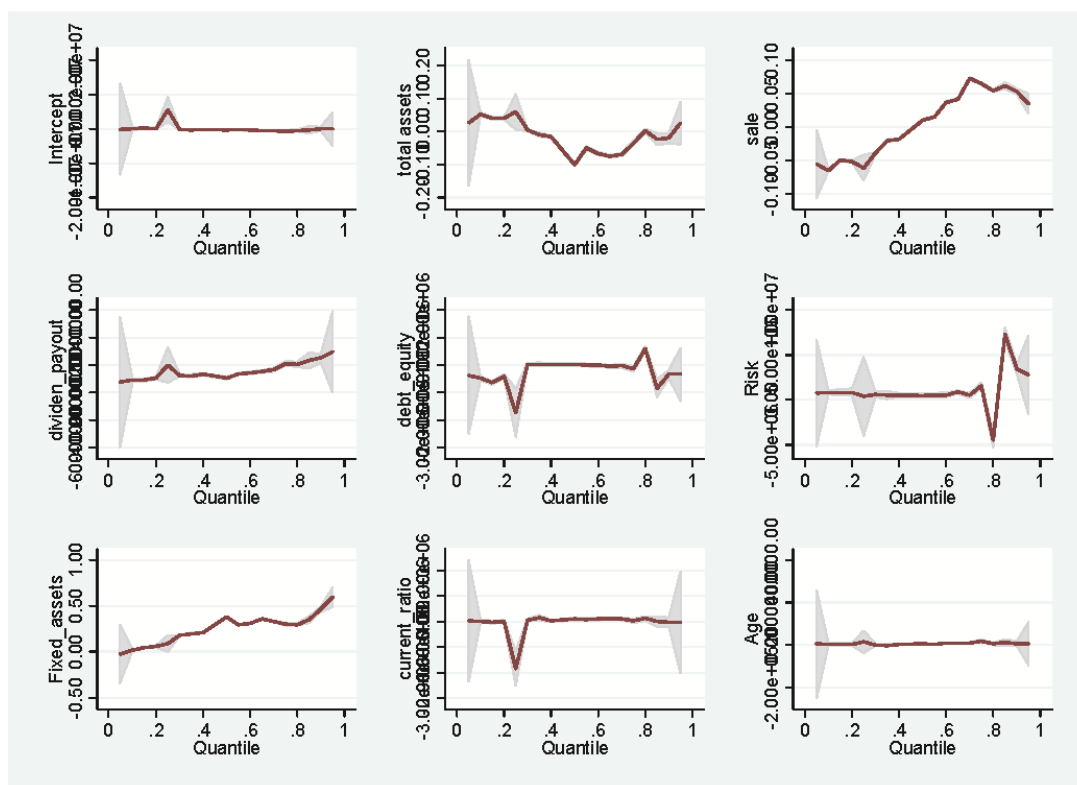


Figure 1. Graphical representation of quantile regression results

Figure 1 visually confirms the heterogeneous nature of the relationships between firm characteristics and operating cash flow. The graphical patterns show that the effects of explanatory variables differ

across quantiles, indicating that firms with low, medium, and high levels of cash generation respond differently to financial and operational factors. These results reinforce the suitability of quantile regression as the primary analytical framework of the study.

Overall, the results reveal substantial heterogeneity in the determinants of operating cash flow across firms with different levels of cash-generating capacity. While sales, fixed assets, and risk generally exhibit positive associations with operating cash flow, the effects of total assets, leverage, liquidity, and dividend policy vary across quantiles. These findings demonstrate that average-based estimates may mask important distributional differences and underscore the value of quantile regression for analyzing operating cash flow dynamics in emerging-market firms.

4. Conclusions and discussion

This paper analyzed the determinants of operating cash flow (OCF) for dividend-paying firms in Pakistan through the use of quantile regression techniques. Unlike conventional mean-based regression models, the quantile regression methodology enabled the current study to establish how different firm-level factors influenced OCF at various quantiles of its distribution. The results indicate substantial heterogeneity in the determinants of OCF, supporting the argument that firm characteristics affect cash generation differently across firms.

Among the most important findings is the predominantly negative relationship between total assets and OCF across the median and upper quantiles. This implies that companies which have higher total assets may not be able to produce better OCF. The finding may reflect lower asset utilization efficiency, operational complexity, or diminishing returns to scale among larger firms. This finding is supported by previous research showing inefficiencies and greater operational complexity in larger companies (Liu and Zhang, 2022; Purba et al., 2023). Based on this research, one can argue that small dividend-paying firms in Pakistan can effectively carry out their operations.

In contrast, fixed assets exhibit a consistently positive and statistically significant relationship with OCF across the examined quantiles. This outcome confirms the hypothesis stating that the investment in productive assets improves operational efficiency and the ability to generate cash flows. The findings are consistent with the research by Sultana et al. (2026), who claim that fixed assets improve operational efficiency through improved production and services. The stability of this relationship across quantiles highlights the importance of fixed assets as a determinant of operating cash flow.

Moreover, positive and significant relationships between the dependent variable and the independent variable sales were revealed at all quantiles. Although the relationship is negative at the lower quantile (0.25), it becomes positive and significant at the median and upper quantiles. This pattern suggests that higher sales do not automatically translate into stronger cash generation among companies with relatively weak cash flows, possibly because of working capital inefficiencies or delayed receivables collection. However, for companies with stronger cash-generating capacity, higher sales are associated with improved operating cash flows. This finding aligns with previous studies showing a relationship between sales and operating cash flows: the higher the sales, the better the cash flow from operations (Kreuter et al., 2022; Indriyani et al., 2024). The main advantage of the quantile regression approach is that it shows that sales have a positive effect on operating cash flow not only for companies with high levels of OCF but also those positioned in middle quantiles.

The results on the relationship between dividend policy, risk, and firm age become even more complex across different quantiles. The dividend-payout ratio appears to be positively correlated with OCF only at the upper quantile (0.90), suggesting that dividend policy plays a limited role compared with operational factors in explaining OCF. Thus, this result is partly consistent with the pecking order theory which emphasizes the importance of internal financing capabilities. Risk exhibits a positive association with OCF, particularly at higher quantiles, indicating that firms capable of managing greater uncertainty may also achieve stronger cash generation. Firm age is significant at the median and upper quantiles,

implying that organizational experience and maturity may contribute to operating cash flow, although the effect is not uniform across all firms.

Generally, the study contributes to the academic discourse in the field by offering empirical evidence on the determinants of OCF in an emerging market environment. The comparison between OLS and quantile regression results further shows that average-based estimates may conceal important differences across firms with varying levels of cash-generating capacity. Quantile regression contributes to existing knowledge of the heterogeneity in the factors affecting OCF by showing that the determinants vary across locations along the distributional space. The empirical results of the study are consistent with the theoretical approaches of pecking order theory and trade-off approach, among others.

Furthermore, the results in Table 8 provide additional insights into the heterogeneity of factors influencing operating cash flows across different quantiles. Quantile regression analysis shows that the importance and significance of explanatory variables vary across companies, depending on their OCF levels. First, the variable "total assets" has a negative association with OCF for various quantiles, which implies that large companies suffer from inefficiencies, high costs, or poor asset utilization when transforming resources into OCF. In other words, the negative relationship between total assets and OCF does not imply that companies have no need for such resources to conduct business operations. On the contrary, excessive growth or inefficient asset use reduces firms' ability to generate cash from operations. These results are consistent with those of previous researchers, who reported inconsistent evidence on the effect of firm size on efficiency (Liu and Zhang, 2022; Purba et al., 2023). Finally, fixed assets and sales show positive relationships with OCF for almost all quantiles.

Moreover, the empirical results partially support the proposed hypotheses. The findings for hypotheses H2 and H3, concerning fixed assets and sales, are strongly supported, as they are significantly positive across the conditional distribution of OCF. In addition, hypothesis H1 is supported, but its influence on OCF varies by the sign of the coefficient from positive to negative, thus reflecting the inconsistent nature of the relationship described in the literature. In addition, the results regarding the effects of dividend payout ratio, risk, and firm age on OCF partially validate hypotheses H5, H6, and H7, as they change in sign across quantiles. These results confirm the significance of the usage of quantile regression in comparison with ordinary least squares estimation since different determinants influence OCF depending on a firm's ability to generate cash flows. Moreover, in line with the reviewer's suggestion, future studies may include operating profit as an additional independent variable to explain the relationship between accounting profitability and OCF.

The empirical evidence offers several practical implications. For managers, the results suggest that improving operational efficiency, asset utilization, and sales performance may contribute more to cash generation than simply increasing firm size. For investors and other stakeholders, operating cash flow provides valuable information regarding firms' financial sustainability and operational effectiveness. For policymakers in emerging markets, the findings highlight the importance of encouraging efficient resource allocation and productive investment as mechanisms for strengthening firms' cash-generating capacity.

Future research may extend the analysis by incorporating industry-specific effects, macroeconomic conditions, and comparisons between dividend-paying and non-dividend-paying firms. Additional studies may also examine more recent periods and address potential endogeneity concerns through alternative econometric approaches.

Limitations

This research is based on dividend-paying companies in Pakistan; the upcoming researchers may increase the scope of the study by using panel data of Pakistan by increasing the number of years, as this study is based from 2012 to 2018. The upcoming researchers should use data from 2000 to 2018 to find results that are more generalizable. The use of panel regression may find results deviated from quantile regressions.

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Artificial intelligence use statement

Regarding the use of artificial intelligence, AI-based tools were utilized solely for language refinement, grammatical correction, and academic writing enhancement at later stages of manuscript preparation. The use of artificial intelligence did not influence the study's conceptualization, data collection, econometric analysis, interpretation of results, or conclusions. All empirical analyses, interpretations, and final decisions remain entirely the responsibility of the authors.

Data availability statement

The data supporting the findings of this study are not publicly available but are available from the corresponding author upon reasonable request.

Authors' contributions

Muhammad Aamir Ali: conceptualization; methodology; formal analysis; investigation; data curation; software; visualization; writing – original draft. **Nazish Aamir:** supervision; validation; writing – review and editing; project administration; resources. **Ali Raza Sattar:** conceptualization; methodology; formal analysis; investigation.

All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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