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Macroeconomic Stress, Earnings Management, and Financial Reporting Quality: Evidence from PSX-Listed Firms Using Benford's Law

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Abstract

This study investigates the relationship between macroeconomic stress and financial reporting quality among non-financial firms listed on the Pakistan Stock Exchange (PSX) using Benford's Law as a digit-pattern diagnostic. Drawing on a sample of 324 continuously-listed non-financial companies spanning 29 sectors over the period 2014–2024, this study extracts first-digit distributions from 3,288 revenue and 2,415 net income observations and tests them against Benford's expected logarithmic distribution using five complementary statistical procedures. Revenue figures conform closely to Benford's Law, indicating natural reporting patterns. Net income exhibits statistically significant digit irregularities, most prominently an over-representation of digit 7 and under-representation of digit 6, consistent with systematic upward rounding near reporting thresholds. These irregularities intensify markedly during Pakistan's 2018–2021 economic crisis, with the composite Benford Digit Score rising 44.5 percent above non-crisis levels and the Distortion Factor Model reversing sign—from income inflation in stable periods to income suppression during stress. Revenue non-conformity in heavily regulated sectors reflects structural pricing constraints rather than managerial manipulation, providing a methodological refinement with direct relevance for regulators and analysts. The study contributes to the emerging-market financial reporting literature by establishing Benford's Law as a cost-effective screening instrument for identifying time periods, sectors, and firms with elevated reporting risk, with specific implications for the Securities and Exchange Commission of Pakistan (SECP), external auditors, and equity investors.

Keywords: Benford's Law; earnings management; financial reporting quality; Pakistan Stock Exchange; macroeconomic crisis; information asymmetry; digit analysis; emerging markets

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1. INTRODUCTION

Capital markets function on the premise that prices incorporate all available information. This premise depends critically on the integrity of financial information that firms disclose. When managers manipulate reported earnings—adjusting figures to meet analyst expectations, satisfy debt covenants, or secure performance bonuses—the signals embedded in financial statements become distorted. Investors who act on manipulated figures make suboptimal allocation decisions, and the resulting misallocation of capital imposes real costs on the broader economy. The severity of these costs is amplified in emerging markets, where information asymmetry between insiders and outside investors is structurally deeper, investor protection is weaker, and enforcement capacity is more limited.

Pakistan presents a particularly instructive case. The Pakistan Stock Exchange (PSX), with approximately 560 listed securities, is dominated by family-controlled and group-affiliated non-financial companies whose ownership structures create significant agency conflicts. Regulatory oversight by the Securities and Exchange Commission of Pakistan (SECP) has improved incrementally but remains inconsistent in enforcement. These structural features have been shown repeatedly to be associated with opportunistic earnings management (Shah et al., 2024). The problem is compounded by a decade that contained one of Pakistan's most severe macroeconomic disruptions: between 2018 and 2021, the country experienced a currency devaluation exceeding 50 percent, an IMF Extended Fund Facility bailout, and the economic shock of COVID-19—pressures that dramatically altered the cost-benefit calculus of earnings manipulation.

This study applies Benford's Law to detect digit-level irregularities in the financial reports of 324 continuously-listed PSX non-financial firms over 2014–2024. Benford's Law establishes that, in large naturally occurring numerical datasets, the leading digit follows a specific logarithmic distribution: digit 1 leads approximately 30.1 percent of observations, declining monotonically to digit 9 at approximately 4.6 percent. When reported numbers deviate from natural patterns—for instance, through rounding near threshold values—the actual digit frequencies diverge from this natural baseline. These deviations constitute a low-cost, externally detectable signal of potential reporting irregularity that does not require access to detailed internal accounting records.

The contribution of this study is threefold. First, it provides the first comprehensive, decade-long Benford analysis of PSX non-financial firms, covering 3,288 revenue and 2,415 net income observations across 29 sectors. Second, it demonstrates a statistically significant and economically meaningful intensification of digit irregularities during Pakistan's crisis period, documenting not only the magnitude but also a qualitative directional reversal in the nature of earnings management under stress. Third, it identifies a methodological limitation in applying Benford's Law to regulated sectors—where government-administered pricing creates structural non-conformity unrelated to manipulation—offering a refinement directly applicable by practitioners and regulators.

Volume 5 Issue No 2 (2026)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

2. THEORETICAL FOUNDATION AND LITERATURE REVIEW

2.1 Agency Theory, Information Asymmetry, and Earnings Management

The theoretical foundation for earnings management rests on agency theory (Jensen & Meckling, 1976). When ownership and management are separated, managers have both the information advantage and the incentive to report figures that serve their private interests—maximising bonuses, minimising debt covenant violations, or signalling competence to the board. The degree to which these incentives translate into actual manipulation depends on the monitoring environment: weak boards, concentrated ownership, and lax enforcement reduce the cost of manipulation and increase its frequency.

Watts and Zimmerman (1986) formalised three conditions under which earnings management is most prevalent: bonus-linked contracts, debt covenant proximity, and regulatory scrutiny. Healy and Wahlen (1999) broadened the definition to include any use of judgment in financial reporting that either misleads stakeholders about underlying economic performance or influences contractual outcomes. In Pakistan's context, all three Watts-Zimmerman conditions are present across a significant portion of listed firms, making the country an ideal setting for testing manipulation detection methods.

Information asymmetry, originally modelled by Akerlof (1970), is a structural feature of equity markets in which insiders know more than outside investors. Manipulated financial statements exacerbate this asymmetry: they are designed to conceal negative information while projecting an appearance of performance. In equilibrium, rational investors will price the expected asymmetry into their required returns, raising firms' cost of capital—an outcome documented empirically by Dechow et al. (2010). Reducing manipulation through better detection mechanisms therefore has direct welfare implications for market efficiency and capital allocation.

2.2 Benford's Law as a Reporting Quality Diagnostic

Benford (1938) formalised the logarithmic first-digit law: $P(d) = \log_{10}(1 + 1/d)$, for $d \in \{1, 2, ..., 9\}$. This distribution arises naturally in any dataset produced by multiplicative random processes spanning multiple orders of magnitude—precisely the characteristics of firm-level revenues and profits across industries and years. Carslaw (1988) pioneered its application to accounting data, identifying abnormal second-digit patterns in New Zealand earnings consistent with rounding-up behaviour. Nigrini and Mittermaier (1997) formalised it as an audit procedure. Durtschi et al. (2004) provided the critical methodological guidance that Benford analysis is valid only for data generated by freely varying multiplicative processes, and not for assigned or administratively determined numbers.

The method's validity as a manipulation proxy was established by Amiram et al. (2015), who showed that firms with larger Benford deviations were significantly more likely to subsequently restate their financial statements. Nguyen et al. (2025) extended this across five ASEAN emerging markets (Indonesia, Malaysia, Philippines, Thailand, and Vietnam), confirming a positive link between Benford divergence and abnormal accruals. Hassan et al. (2024) conducted a multi-country study across 87,165 firm-years spanning both developed and emerging markets, finding that PSX-

Volume 5 Issue No 2 (2026)
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Print ISSN: 3006-2039

listed firms exhibit above-average Benford deviations relative to developed-market peers—the direct empirical motivation for the present study.

Crisis-period behaviour has also been examined. Grammatikos and Papanikolaou (2021) found that US bank digit irregularities expanded during the 2008 global financial crisis. Tran (2024) showed that SOX enforcement in the US significantly reduced earnings management practices as measured by Benford deviation scores—quantifying the direct effect of regulatory enforcement on reporting quality. For Pakistan specifically, Zheng et al. (2025) linked earnings management to reduced annual report readability among PSX-listed firms, suggesting managers use multiple channels simultaneously to conceal manipulation. No study prior to the present one has applied Benford's Law systematically across the full PSX, covering all non-financial sectors, all years from 2014 to 2024, and separately testing crisis and non-crisis periods.

2.3 Hypotheses

Drawing on the theoretical and empirical background, three hypotheses are tested:

H1: The first-digit distribution of net income reported by PSX non-financial firms deviates significantly from Benford's Law, consistent with systematic earnings manipulation.

H2: The degree of net income non-conformity differs between governance-sensitive and heavily regulated sectors, with governance-sensitive sectors exhibiting greater irregularity.

H3: Benford non-conformity in net income is significantly more pronounced during Pakistan's 2018–2021 economic crisis compared to non-crisis periods.

3. DATA AND METHODOLOGY

3.1 Sample Construction

The initial universe consists of all securities listed on the PSX as of the 2024 financial year-end, totalling approximately 560. A sequential exclusion procedure is applied: financial sector firms are removed first (banks, insurance, investment companies), followed by non-equity instruments, firms listed after January 2014, firms suspended or wound up during the study period, and firms with sector reclassifications, non-standard share structures, or missing revenue data in any year. The resulting sample comprises 324 non-financial companies continuously listed over all eleven financial years from 2014 to 2024, generating a balanced panel of 3,564 firm-year observations. Table 1 summarises the sample construction procedure.

Table 1
Sample Selection Procedure

Step	Description	Firms Removed	Remaining	Observations
I	Total securities on PSX (FY2024)	—	560	6,160
II	Less: Financial sector firms (banks, insurance, modarabas, investment companies, ETFs, mutual funds, REITs)	141	419	4,609

Volume 5 Issue No 2 (2026)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

III	Less: Non-equity instruments (rights issues, preferred shares, sukuk, TFCs, fund symbols)	11	408	4,488
IV	Less: Firms listed on or after 01 January 2014 (incomplete panel)	48	360	3,960
V	Less: Firms suspended or wound-up during 2014–2024	24	336	3,696
VI	Less: Firms with sector/name changes, non-standard share classes, or nil revenue reporters	12	324	3,564
Final	**Non-financial, continuously-listed PSX firms (324 firms × 11 years)**	—	**324**	**3,564**
	Of which: Revenue-positive observations (revenue digit test)			**3,288**
	Of which: Net income-positive observations (NI digit test)			**2,415**

Note. PSX securities register and audited annual financial statements, 2014–2024. Revenue-positive and net income-positive counts reflect firm-years with positive values for each variable, as Benford's Law applies only to positive numbers.

The study period is divided into three sub-periods for analytical purposes. Years 2014–2017 represent macroeconomic stability. The crisis period, 2018–2021, captures three compounding shocks: a currency devaluation of over 50 percent between 2018 and 2019, an IMF Extended Fund Facility approved in July 2019, and the COVID-19 pandemic from March 2020. Years 2022–2024 represent gradual recovery. This classification allows direct testing of H3 and places the empirical analysis within a natural experiment framework. The non-crisis subsample (n = 1,481) is approximately 58.60 percent larger than the crisis subsample (n = 934), which by construction reduces the chi-squared test's power for the non-crisis period relative to the crisis period. The comparative Benford Digit Score metric, being scale-independent, is therefore the preferred basis for magnitude comparison between the two sub-periods.

3.2 Variables and Sector Classification

Two variables are analysed. Revenue is defined as total net sales as reported on the face of the consolidated income statement, excluding non-operating items. Net income is defined as profit after taxation attributable to ordinary shareholders. Only positive observations are retained for each variable, as Benford's Law applies exclusively to positive numerical values. The leading digit is extracted using the formula: d = floor(x / 10floor(log10(x))), applied uniformly across all observations.

The 29 sectors in the sample are classified into two groups. Heavily regulated sectors include those operating under dedicated government bodies that set or constrain pricing—NEPRA for power generation and distribution, OGRA for oil and gas, DRAP for pharmaceuticals, and PTA for technology and communication.

Volume 5 Issue No 2 (2026)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

All remaining sectors are classified as governance-sensitive, as their revenues and profits are determined by market forces and are more susceptible to managerial discretion.

3.3 Statistical Tests

Five complementary tests are applied to assess Benford conformity, as relying on any single test risks drawing conclusions sensitive to that test's specific weaknesses.

The Chi-Squared (χ^2) Goodness-of-Fit Test measures the overall divergence between observed and Benford-expected digit frequencies. With eight degrees of freedom, the critical value at $\alpha = 0.05$ is 15.507. Its limitation is sensitivity to large samples, where even trivial deviations may achieve statistical significance. The Mean Absolute Deviation (MAD) computes the average absolute difference between observed and expected proportions across all nine digits, free of sample-size influence. Nigrini (2012) classifies MAD results as: below 0.006 (close conformity), 0.006–0.012 (acceptable), 0.012–0.015 (marginal), and above 0.015 (non-conformity).

The Kolmogorov-Smirnov (KS) Test evaluates whether the cumulative digit distribution matches the Benford cumulative baseline, with critical value $1.36/\sqrt{n}$ at $\alpha = 0.05$. Per-digit Z-statistics identify which specific digits drive observed overall non-conformity, with $|Z| > 1.96$ indicating significance at $\alpha = 0.05$. Z-statistics are computed as: $z = (|O/n - p| - 1/(2n)) / \sqrt{p(1-p)/n}$, where O is the observed count, n is the sample size, and p is the Benford expected proportion for digit d; the $1/(2n)$ term is the continuity correction recommended by Nigrini (2012). The Sum of Squared Deviations (SSD) amplifies the contribution of large single-digit departures; values below 25 indicate close conformity, 25–100 acceptable, and above 100 non-conformity.

Two supplementary measures from Nigrini (2012) are computed for crisis-period comparisons: the Benford Digit Score (BDS), a composite measure of overall digit-level distortion (higher value = more distortion); and the Distortion Factor Model (DFM), which captures the directional orientation of distortion (positive DFM = digits higher than expected, consistent with income inflation; negative DFM = income suppression).

4. EMPIRICAL RESULTS

4.1 Revenue: Market-Wide Conformity

Revenue figures for the full sample of 3,288 positive observations conform closely to Benford's Law across all five tests (Table 2). The Chi-Squared statistic is 4.790 ($p = 0.780$), well below the critical value of 15.507. The MAD is 0.0031, firmly within the close conformity band. The KS statistic of 0.0080 falls well below its critical value of 0.0237, and the SSD of 1.358 is also within close conformity range. No individual digit produces a Z-statistic approaching significance. Revenue reporting at the PSX market level therefore shows no sign of digit-level manipulation.

Volume 5 Issue No 2 (2026)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

Table 2

First-Digit Distribution – Revenue, Overall Market (n = 3,288)

Digit	Benford %	Expected (n)	Observed (n)	Obs. %	Diff	Z-stat
1	30.10%	989.8	1,016	30.90%	+0.80%	1.18
2	17.61%	579.0	572	17.40%	−0.21%	0.27
3	12.49%	410.8	412	12.53%	+0.04%	0.06
4	9.69%	318.6	316	9.61%	−0.08%	0.14
5	7.92%	260.3	248	7.54%	−0.38%	0.74
6	6.69%	220.1	209	6.36%	−0.34%	0.71
7	5.80%	190.7	181	5.50%	−0.29%	0.67
8	5.12%	168.2	165	5.02%	−0.10%	0.22
9	4.58%	150.5	169	5.14%	+0.56%	1.39
Test Statistics	**χ^2 = 4.790, p = 0.780 ✓ │ MAD = 0.0031 (Close Conformity) │ KS = 0.0080 ✓ │ SSD = 1.358 (Close Conformity)**					

Note. ***Benford P(d) = $\log_{10}(1 + 1/d)$. MAD critical thresholds follow Nigrini (2012). KS critical value = 1.36/√3,288 = 0.0237. Z-statistics computed as $z = (|O/n - p| - 1/(2n)) / \sqrt{p(1-p)/n}$ with continuity correction (Nigrini, 2012). ✓ = fail to reject H_0 (conforms to Benford's Law).***

4.2 Net Income: Statistically Significant Irregularities

Net income presents a markedly different picture (Table 3). For the 2,415 positive net income observations, the Chi-Squared statistic is 18.601 (p = 0.017), exceeding the critical threshold of 15.507. The MAD of 0.0065 falls in the acceptable conformity band, and the SSD of 6.013 remains within the close conformity range—indicating that the deviation, while statistically significant, is of moderate practical magnitude. Examination of individual digit Z-statistics reveals the driver of the departure: digit 6 is significantly under-represented (Z = 2.864, $p < 0.01$) while digit 7 is significantly over-represented (Z = 2.390, $p < 0.05$).

This pattern—an observed shift in probability mass from digit 6 toward digit 7—is compatible with upward rounding behaviour near reporting thresholds, consistent with the incentive mechanisms predicted by agency theory and Watts and Zimmerman's (1986) bonus hypothesis, though Benford analysis alone cannot confirm intentional managerial action. H1 is supported.

Volume 5 Issue No 2 (2026)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

Table 3
First-Digit Distribution – Net Income, Overall Market (n = 2,415)

Digit	Benford %	Expected (n)	Observed (n)	Obs. %	Diff	Z-stat
1	30.10%	727.0	741	30.68%	+0.58%	0.73
2	17.61%	425.3	445	18.43%	+0.82%	1.22
3	12.49%	301.7	306	12.67%	+0.18%	0.32
4	9.69%	234.0	206	8.53%	−1.16%	1.82
5	7.92%	191.2	191	7.91%	−0.01%	0.01
6	6.69%	161.7	126	5.22%	−1.48%	2.864**
7	5.80%	140.1	168	6.96%	+1.16%	2.39*
8	5.12%	123.5	128	5.30%	+0.18%	0.36
9	4.58%	110.5	104	4.31%	−0.27%	0.53
Test Statistics	**χ^2 = 18.601, p = 0.017* ✗ | MAD = 0.0065 (Acceptable) | KS = 0.0157 ✓ | SSD = 6.013 (Close Conformity)**					

Note. Highlighted rows (digits 6 and 7) indicate deviations exceeding ±1.0 percentage point with significant Z-statistics. Z-statistics computed using the Nigrini (2012) continuity-corrected formula. * p < 0.05; ** p < 0.01. KS critical value = 1.36/√2,415 = 0.0277. ✓ = fail to reject H_0; ✗ = reject H_0.

4.3 Crisis vs. Non-Crisis Period: Intensification and Directional Reversal

Table 4 reports the central finding of the study: a pronounced intensification of net income digit irregularities during Pakistan's 2018–2021 economic crisis. Crisis-period net income (n = 934) produces a Chi-Squared of 25.000 (p = 0.002), an MAD of 0.0152—the only pooled sub-group in the study to cross into the non-conformity band—and a BDS of 26.163. By contrast, non-crisis net income (n = 1,481) shows a Chi-Squared of 17.337 (p = 0.027), an MAD of 0.0097 (acceptable band), and a BDS of 18.102. The BDS ratio of 1.445 confirms that digit-level distortion is 44.5 percent more intense during the crisis. Although the crisis-period KS statistic (0.0348) falls marginally below its critical value (0.0445), the KS test is known to have substantially lower power than the chi-squared test for detecting concentrated single-digit deviations (Nigrini, 2012). The highly significant χ^2 result (p = 0.002) and MAD in the non-conformity band (0.0152) together provide stronger and more diagnostic evidence of non-conformity; the KS non-rejection therefore does not contradict the overall finding. H3 is supported.

Volume 5 Issue No 2 (2026)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

Table 4
Crisis vs. Non-Crisis Benford Results – Net Income

Period	*n*	χ^2	Sig.	MAD	MAD Band	BDS	DFM	KS
Crisis (2018–2021)	934	25.000	**	**0.0152**	**Non-Conformity**	26.163	−0.185	0.0348
Non-Crisis (2014–17, 2022–24)	1,481	17.337	*	0.0097	Acceptable	18.102	+0.048	0.0269
Crisis vs. Non-Crisis Ratio	—	**+44.2%**	—	**+56.7%**	—	**+44.5%**	**Sign ↔**	—

Note. BDS = Benford Digit Score; DFM = Distortion Factor Model. KS critical values are 0.0445 for the crisis period and 0.0353 for the non-crisis period, calculated as 1.36/√n. ** $p < 0.01$; * $p < 0.05$. Sign ↔ denotes a reversal in the direction of the DFM between sub-periods. Percentage changes are calculated relative to the non-crisis period (+44.2% for χ^2 and +44.5% for BDS). Adapted from Nigrini (2012).

The Distortion Factor Model reveals a finding not previously documented in the Pakistan literature: a sign reversal between crisis and non-crisis periods. In non-crisis years, the DFM is +0.048, indicating a digit-level upward bias compatible with income-increasing reporting incentives. During the crisis, the DFM turns sharply negative at −0.185, a pattern consistent with income-decreasing reporting behaviour—potentially reflecting loss avoidance, income smoothing, or 'big bath' provisioning under severe economic pressure, though the method does not permit direct attribution of these patterns to managerial intent. At the individual year level, statistically significant Chi-Squared results are recorded for 2017 ($\chi^2 = 16.836$, $p = 0.032$), 2018 ($\chi^2 = 18.719$, $p = 0.016$), and 2020 ($\chi^2 = 20.088$, $p = 0.010$), with 2017's significance suggesting that digit irregularities were already elevated before the formal onset of the crisis.

4.4 Sector Classification: A Methodological Finding

Table 5 reports Benford test results disaggregated by sector type. Governance-sensitive sector revenue shows near-perfect conformity: Chi-Squared = 2.350 ($p = 0.968$), MAD = 0.0030, strongly suggesting that revenue manipulation is not widespread in market-sensitive sectors. Heavily regulated sector revenue, by contrast, fails all five Benford tests simultaneously—the only group in the study to do so. Chi-Squared = 27.002 ($p < 0.001$), MAD = 0.0177. This result does not indicate manipulation: it reflects the structural characteristic that in sectors where government bodies set tariffs or control prices, revenue is generated by a formula (rate × physical quantity) whose mathematical structure produces digit distributions anchored to the periodicity of tariff schedules rather than the logarithmic law that governs market-determined figures.

This finding provides a concrete empirical demonstration of Durtschi et al.'s (2004) theoretical warning and constitutes a methodological contribution: any Benford screening by the SECP, auditors, or researchers must first verify whether the revenue-

Volume 5 Issue No 2 (2026)
Online ISSN: 3006-2047
Print ISSN: 3006-2039

generation mechanism satisfies the multiplicative precondition. H2 is rejected: contrary to the prediction, heavily regulated sector firms exhibit greater net income non-conformity (MAD = 0.0127, marginal band) than governance-sensitive firms (MAD = 0.0072, acceptable band). This reversal is consistent with the Big Bath provisioning and loss-deferral strategies that are particularly prevalent in tariff-regulated industries facing margin compression. The methodological contribution—that revenue non-conformity in regulated sectors is structural, not manipulative—is, however, the more enduring finding from this hypothesis.

Table 5

Benford Conformity by Sector Type

Sector Group	Variable	*n*	χ^2	Sig.	MAD	MAD Band	KS	SSD
Governance-Sensitive	Revenue	2,480	2.350	ns	0.0030	Close Conformity	✓	1.128
Heavily Regulated	Revenue	808	**27.002**	*******	0.0177	**Non-Conformity**	✗	**18.7**
Governance-Sensitive	Net Income	1,756	15.909	*	0.0072	Acceptable	✓	7.834
Heavily Regulated	Net Income	659	**17.297**	******	0.0127	**Marginal**	✗	**11.203**

***Note.* *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; ns = not significant. ✓ = fail to reject H_0 (conforms to Benford); ✗ = reject H_0. KS critical value = $1.36/\sqrt{n}$ for each group separately. ✓ indicates KS statistic below the critical value (conformity); ✗ indicates KS statistic above the critical value (non-conformity). Highlighted cells indicate non-conforming results in heavily regulated sector revenue.**

5. DISCUSSION AND IMPLICATIONS

5.1 Financial Reporting Quality and Information Economics

The finding that PSX net income exhibits systematic digit irregularities while revenue does not is consistent with the broader information economics literature. From an asymmetric information perspective, the pattern of digit irregularities confined to net income rather than revenue is consistent with the theoretical prediction that income figures are more susceptible to discretionary adjustments: revenue-level changes require external coordination with customers, distributors, and auditors, and carry much higher detection risk, whereas income-level changes through cost recognition, provisioning, and accrual timing are more difficult for external parties to observe.

The digit shift from 6 toward 7 is compatible with threshold-targeting behaviour, as figures whose leading digit is 7 project a stronger performance signal than those beginning with 6. This pattern, if attributable to reporting discretion, would introduce an upward bias in income-based multiples that is modest per firm but, given its consistency across the market, may represent a structural overvaluation risk for PSX equity investors.

5.2 The Economics of Crisis-Period Reporting

The 44.5 percent increase in the Benford Digit Score during Pakistan's crisis period is both statistically significant and economically meaningful. From a Positive Accounting Theory perspective (Watts & Zimmerman, 1986), the intensification is expected: debt covenant pressure, performance shortfalls, and heightened regulatory attention all increase the manager's incentive to manage reported numbers during a crisis. What is novel is the directional reversal documented by the Distortion Factor Model.

In non-crisis conditions, the positive DFM reflects digit patterns compatible with income-increasing reporting incentives. Under the simultaneous pressures of currency collapse, IMF conditionality, and pandemic disruption, the DFM turns sharply negative. This reversal is consistent with two reporting strategies that crisis conditions are known to incentivise. First, income smoothing: digit patterns suggestive of downward adjustments in severe crisis years would be consistent with the creation of reserves releasable in subsequent periods. Second, loss avoidance reclassification: digit clustering near zero in net income distributions is compatible with figures adjusted to remain marginally positive. The analogy with Tran (2024) is instructive: SOX enforcement in the United States significantly reduced earnings management as measured by Benford divergence; the Pakistani crisis increased the Benford Digit Score by 44.5 percent. Both findings taken together suggest that regulatory enforcement and macroeconomic stress exert powerful but opposing influence on reporting quality—a finding with significant implications for SECP policy.

5.3 Implications for Regulators, Auditors, and Investors

For the SECP, the results suggest a practical monitoring architecture. A rolling annual Benford screen of all PSX non-financial firms using the MAD statistic can be implemented with publicly available financial data at minimal cost. Firms producing a net income MAD above 0.015 in any given year should be automatically shortlisted for closer review. Before extending Benford screening to regulated-sector revenue, SECP staff should first verify whether the revenue-generation mechanism is market-determined or tariff-determined; the latter requires a different analytical approach entirely.

For external auditors, Benford's first-digit analysis is a natural addition to the engagement planning phase, providing an objective, low-cost analytical procedure that complements substantive testing by flagging high-risk firms and firm-years. Financial years 2018 and 2020 warrant heightened retrospective scrutiny, and auditors of Textile sector clients in particular should apply additional substantive procedures to provisioning and accrual-related accounts.

For equity investors and portfolio managers, the study highlights a systematic reporting risk that is time-varying and sector-specific. Earnings-based valuation multiples applied to PSX non-financial firms during crisis years should be discounted to reflect the demonstrated intensification of digit-level irregularity. Minority shareholders can compute Benford divergence metrics directly from publicly available annual reports, providing a no-cost tool for independent earnings quality screening prior to investment decisions.

Volume 5 Issue No 2 (2026)
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6. CONCLUSION

This study presents a comprehensive Benford’s Law analysis of financial reporting quality among PSX non-financial firms over a full decade, 2014–2024. The principal findings can be summarised as follows: (i) revenue reporting conforms naturally to Benford’s Law at the market level, confirming the validity of the dataset and method; (ii) net income exhibits statistically significant digit irregularities—specifically an over-representation of digit 7 and under-representation of digit 6—suggestive of potential upward rounding near threshold values, supporting H1; (iii) digit irregularities intensify 44.5 percent during Pakistan’s 2018–2021 economic crisis, with a qualitative directional reversal from digit patterns compatible with income-increasing reporting to patterns compatible with income-decreasing reporting, supporting H3; (iv) H2 is rejected in its directional prediction—net income irregularity is more pronounced in regulated sectors than governance-sensitive ones, consistent with crisis-period provisioning behaviour in margin-constrained industries—while revenue non-conformity in heavily regulated sectors reflects structural pricing constraints rather than manipulation, offering a methodological refinement relevant to future applications of Benford analysis in regulated industries.

These findings contribute to the literature on financial reporting quality in emerging markets in three ways. They provide the first decade-long, multi-sector, crisis-stratified Benford analysis of PSX non-financial firms. They document a novel DFM sign reversal under severe macroeconomic stress not previously reported for Pakistan. And they provide a concrete empirical demonstration of the theoretical limitation of Benford analysis in regulated sectors, offering a practical decision rule for analysts and regulators.

Several limitations should be acknowledged. Only the first-digit test is applied; extending to second-digit and first-two-digit tests is a natural next step. The exclusion of approximately 32 percent of firm-years due to negative net income introduces a conservative bias; the true extent of PSX reporting irregularity is likely larger. Benford analysis detects digit-level signals, not intentional fraud; all findings should be treated as risk indicators warranting further investigation. Future research should pair Benford divergence scores with firm-level governance and accrual data, apply a continuous macroeconomic stress index in place of the binary crisis classification, and extend the analysis to PSX financial sector firms.

In conclusion, Benford's Law offers regulators, auditors, and investors a simple, scalable, and low-cost instrument for identifying elevated financial reporting risk in Pakistan's capital market. In an environment where enforcement capacity is constrained, digit-pattern analysis represents a viable first line of screening that can direct limited oversight resources toward the firms, sectors, and time periods most likely to exhibit elevated digit-level reporting irregularities.

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