

SMIC Revenue Recovery Coincides with Lower Returns and Continued Investment Funding

Jiawei Zhang

School of Economics and Management, Nanjing University of Science and Technology, Nanjing,
China

348900696@qq.com

Abstract. Peer benchmarking in semiconductor manufacturing is sensitive to business-model heterogeneity, accounting classification, and capital intensity. This study applies the Harvard analytical framework to Semiconductor Manufacturing International Corporation (SMIC) through a retrospective, descriptive case analysis. An archived screening record uses 2022-2024 averages of eleven financial characteristics, K-means clustering, and weighted nearest-neighbor retrieval; annual-report data are then harmonized to evaluate SMIC's 2020-2024 trajectory and its 2024 position relative to Hua Hong Semiconductor. Hua Hong is the closest reported peer under both the original weighting description and an entropy-weighted sensitivity exercise. SMIC's revenue increased by 27.0% in 2024, yet gross margin declined to 18.0% and weighted average return on equity fell to 2.4%. Inventory turnover was 2.31 times, compared with 3.92 times for Hua Hong. Operating cash flow covered 41.4% of SMIC's cash purchases of property, plant and equipment in 2024, and the cumulative 2020-2024 shortfall was US\$14.31 billion. Harmonizing the classification of interest cash flows did not reverse the cross-company cash-flow comparison. The evidence therefore identifies a scale recovery accompanied by lower returns and continued external funding requirements for investment. Strategic assessment should integrate capacity utilization, working-capital efficiency, financing capacity, and research expenditure. Because the underlying screening matrix and estimation code are unavailable, the peer ranking remains exploratory and supports neither causal inference nor claims of predictive accuracy.

Keywords: SMIC, Harvard analytical framework, peer benchmarking, financial-statement comparability, K-means clustering, semiconductor foundry.

1. Introduction

Financial ratios are informative only when they are interpreted within a firm's business model, accounting choices, and investment cycle. The Harvard analytical framework links business strategy, accounting analysis, financial analysis, and prospective analysis, so reported outcomes can be evaluated against the operating conditions that produced them [1]. Nissim and Penman likewise show that profitability and growth analysis benefits from separating operating activities from financing activities and from treating current ratios as inputs to forward-looking assessment [2]. This integration is especially relevant to semiconductor foundries, where large equipment commitments and sustained technology expenditure can cause revenue growth, accounting returns, and cash requirements to move in different directions.

The benchmark used to interpret those ratios is equally consequential. Bhojraj and Lee ground peer selection in observable economic characteristics rather than broad industry labels [3], while De Franco, Kothari, and Verdi show that financial-statement comparability improves the information available to users [4]. These studies do not validate the present clustering procedure, but they explain why an undifferentiated semiconductor average may be misleading. Firms classified within the same industry can differ substantially in production activities, asset intensity, financing structure, and accounting presentation. A defensible comparison therefore requires both an economically plausible peer and explicit reconciliation of measurement bases.

This study examines Semiconductor Manufacturing International Corporation (SMIC) and Hua Hong Semiconductor Limited, the closest peer in the retained exploratory screening. The screening is used as an empirical check that a financial feature space drawn from a broader semiconductor

universe recovers the economically plausible foundry comparator, rather than as a substitute for industry knowledge; the unavailable firm list prevents verification of the universe's exact breadth. The study asks whether SMIC's capacity expansion and 2024 revenue recovery were accompanied by stronger profitability, operating efficiency, liquidity, and internal funding capacity. It separates archived screening outputs from newly calculated annual-report ratios and harmonizes material accounting classifications before comparing cash flows. The contribution is an evidence-bounded case analysis that links peer selection, accounting comparability, and prospective interpretation without treating descriptive associations as causal evidence.

2. Data and Methods

2.1. Study design and accounting scope

This study uses a retrospective, descriptive case design with four sequential steps: exploratory peer screening, accounting-scope reconciliation, ratio and cash-flow analysis, and prospective interpretation under the Harvard framework. The unit of analysis is the reporting entity. Comparisons are intended to identify economically relevant differences within the disclosed period; they are not estimates of population effects, investment returns, or causal relationships.

The first evidence component is an archived screening of listed semiconductor firms based on company-level averages for 2022-2024. The original study assembled balance-sheet, income-statement, and cash-flow data through Tushare, whose financial-statement interface identifies company codes, reporting periods, and statement categories [7]. The retained record contains the feature list, normalization choices, cluster output, and neighbor rankings. It does not contain the complete company-level matrix, extraction log, or executable estimation code. Accordingly, the screening results are transcribed and critically evaluated as documented exploratory outputs rather than presented as an independently reproduced experiment.

The second component covers SMIC's 2020-2024 financial history and a 2024 comparison with Hua Hong. Numerical evidence is drawn from the companies' 2024 annual reports, including SMIC's five-year summary and the comparative 2023 balance-sheet values [5,6]. Monetary amounts are reported in US dollars. The analysis uses SMIC's International Financial Reporting Standards (IFRS) disclosures and Hua Hong's Hong Kong Financial Reporting Standards (HKFRS) disclosures; it does not combine these values with renminbi figures reported under separate Chinese Accounting Standards. This separation is material because SMIC discloses a reconciliation between IFRS and Chinese Accounting Standards for profit attributable to owners. Calculations from the annual reports are therefore analytically distinct from the archived Tushare-based screening.

2.2. Feature construction and peer screening

Table 1. Reported screening features and the centroid of SMIC's cluster

Feature	Transformation	Cluster 1 centroid
Total assets	Min-max	0.08
Revenue	Min-max	0.14
Gross margin	Z-score	-0.63
Return on equity (ROE)	Z-score	0.07
Total liabilities / total assets	Z-score	0.92
Inventory turnover	Z-score	0.25
Total asset turnover	Z-score	0.12
Revenue growth	Z-score	-0.30
Operating liabilities / operating assets	Z-score	1.13
Operating cash flow / profit attributable to owners	Z-score	0.66
R&D / revenue	Z-score	-0.64

Values are transcribed from the retained cluster-center matrix and were rounded to two decimals in that record. Cluster 1 is an arbitrary label. Because the account mapping for operating liabilities and operating assets is undocumented, that variable is retained only as an unvalidated working-capital proxy.

The screening represents each company by eleven characteristics averaged over 2022-2024, including research and development (R&D) intensity. Total assets and revenue are min-max scaled, whereas the remaining nine characteristics are standardized as Z-scores. Table 1 reports the retained feature definitions and the centroid assigned to SMIC's cluster. A Z-score measures distance from the sample mean in standard-deviation units; a min-max value locates an observation within the observed sample range. The two scales are analytically different, and neither should be interpreted as a financial percentage.

K-means partitions observations by minimizing within-cluster squared distances [8]. The archived analysis selected eight clusters after visual inspection of an elbow plot and assigned SMIC to cluster 1. For normalized feature vector z_i and centroid μ_k , the conventional objective is:

$$J = \sum_{k=1}^K \sum_{i \in C_k} \|z_i - \mu_k\|^2, \quad K = 8. \quad (1)$$

Visual inspection of an elbow plot does not establish eight as a uniquely optimal cluster count. Moreover, combining min-max values with Z-scores leaves the feature set on non-equivalent dispersion scales. The resulting partition is therefore conditional on both the selected number of clusters and the preprocessing design.

Within the selected cluster, nearest-neighbor retrieval ranks candidate firms by financial distance; it is neither supervised classification nor predictive regression [9]. The archived description assigns twice the weight to total assets, revenue, and the operating-liabilities-to-operating-assets proxy. A conventional weighted Euclidean distance is:

$$d(i, j) = \sqrt{\sum_{r=1}^{11} w_r (z_{ir} - z_{jr})^2}. \quad (2)$$

Here, w_r weights each squared feature difference. The archived description does not distinguish this formulation from multiplying the feature coordinates before calculating distance, which would square the effective weights. Equation (2) therefore documents the intended metric but is not claimed to reproduce the archived distance values. A sensitivity exercise reports four neighbors under entropy-based weighting; however, the transformation, realized weights, and search scope are not available for independent verification.

2.3. Financial-ratio definitions

Gross margin equals gross profit divided by revenue. Inventory turnover equals cost of sales divided by average opening and closing inventories, and total asset turnover equals revenue divided by average total assets. The liabilities-to-assets ratio and current ratio use year-end statement-of-financial-position values. R&D intensity equals expensed research and development divided by revenue. SMIC's weighted average return on equity is taken directly from its disclosure and uses profit and equity attributable to owners. Operating cash flow (OCF) and profit attributable to owners are kept separate because they differ in consolidation scope and because accrual earnings and cash flows have different timing and matching properties [10]. OCF minus cash purchases of property, plant and equipment (PPE) is reported only as a partial investment-funding indicator; it is not labeled as free cash flow because it excludes other investing flows and financing sources.

The cash-flow comparison also reconciles interest classification. Under the version of IAS 7 applicable to the 2024 reports, interest paid and received could be classified consistently within operating, investing, or financing activities, subject to the standard's alternatives [11]. SMIC included both interest paid and interest received in operating activities, whereas Hua Hong classified interest received as investing and interest paid as financing [5,6]. Two diagnostic bases are therefore calculated. The including-interest basis leaves SMIC's published OCF unchanged and adds Hua Hong's interest received while subtracting its interest paid. The excluding-interest basis adds interest paid to, and subtracts interest received from, SMIC's published OCF while leaving Hua Hong's published OCF unchanged. These adjustments alter category placement but not total cash movement.

All comparisons are descriptive; the two-company design does not support inferential tests, and no p-values are reported.

3. Results

3.1. Peer identification and interpretation

Hua Hong is the closest reported peer under the original weighting description and remains first in the entropy-weighted sensitivity exercise. The latter ranks Hua Hong, Sanan Optoelectronics, Goke Microelectronics, and GalaxyCore in that order (Table 2). Agreement across the two reported weighting choices supports Hua Hong as a plausible comparator for the subsequent accounting analysis. It does not establish that Hua Hong is the optimal peer under every feature definition, weighting system, or business criterion.

Table 2. Reported nearest peers in the entropy-weighted sensitivity exercise

Rank	Company	Reported distance
1	Hua Hong Semiconductor	1.9617
2	Sanan Optoelectronics	2.3839
3	Goke Microelectronics	2.8179
4	GalaxyCore	2.8199

Source: retained sensitivity-output image. Smaller values indicate closer matches under that run's metric. These are reported output values, not newly estimated distances.

The cluster centroid is informative about relative feature positions but is not a company-level diagnosis. Its liabilities-to-assets Z-score of 0.92 is above the sample mean, whereas the gross-margin Z-score of -0.63 is below it. The return-on-equity score of 0.07 is approximately average and therefore does not support a claim of below-average return on equity. Total assets and revenue, at 0.08 and 0.14, use min-max scaling and cannot be compared numerically with the Z-scores. Nor can a financial cluster be assigned a definitive industrial subsector without verifying the operating activities of its constituent firms.

3.2. SMIC's financial trajectory

SMIC's revenue increased from US\$3.91 billion in 2020 to US\$8.03 billion in 2024, a compound annual growth rate of 19.7%, but accounting returns did not improve in parallel (Table 3). Gross margin peaked at 38.0% in 2022 and declined to 18.0% in 2024. Although revenue grew by 27.0% in 2024, profit attributable to owners fell by 45.4% from 2023. SMIC attributes the decline in owner earnings primarily to lower investment and financial income [5]. The evidence therefore separates two developments: manufacturing scale recovered, while the contribution from non-operating financial items weakened.

Table 3. SMIC's financial performance from 2020 to 2024

Indicator	2020	2021	2022	2023	2024
Revenue	3,907.0	5,443.1	7,273.3	6,321.6	8,029.9
Gross margin (%)	23.6	30.8	38.0	19.3	18.0
Profit attributable to owners	715.6	1,701.8	1,817.9	902.5	492.7
Total assets	31,320.6	36,110.9	43,807.8	47,787.3	49,161.2
PPE carrying amount	12,138.0	14,260.8	18,855.5	23,945.0	28,092.0
R&D expense	677.4	638.8	733.1	707.3	765.3
Operating cash flow	1,660.4	3,011.9	5,347.9	3,358.3	3,175.6
Cash purchases of PPE	5,274.7	4,120.3	6,172.1	7,630.4	7,664.2

US\$ million except percentages. Source: SMIC 2024 annual report, printed p. 16 [5]. Values are converted from US\$ thousands and rounded to one decimal; calculations use unrounded figures. Cash purchases of PPE are the cash-flow-statement line, not an alternative management definition of capital expenditure.

Table 4. Selected year-on-year movements in SMIC's 2024 results

Line item	2023	2024	Change
Revenue	6,321.6	8,029.9	+1,708.4
Cost of sales	5,103.8	6,582.0	+1,478.1
Gross profit	1,217.7	1,448.0	+230.2
Profit from operations	357.7	473.9	+116.2
Depreciation and amortization	2,667.3	3,223.1	+555.8
Depreciation and amortization / cost of sales (%)	52.3	49.0	-3.3 pp
Interest income	736.6	546.1	-190.5
Finance costs	209.4	297.1	+87.7
Other gains, net	262.6	96.8	-165.8
Profit attributable to owners	902.5	492.7	-409.8

US\$ million except percentages. Finance costs are positive expense amounts, so their increase is adverse. Depreciation and amortization is the group-wide disclosed amount; dividing it by cost of sales is a scale diagnostic, not a decomposition of cost of sales. The selected rows should not be added as an independent reconciliation. Source: SMIC 2024 annual report [5].

Table 4 explains why revenue growth did not translate into higher owner earnings. Cost of sales increased by 29.0%, faster than the 27.0% increase in revenue, which limited the gross-margin recovery. Group-wide depreciation and amortization rose by 20.8% to US\$3.22 billion and equaled 49.0% of cost of sales, compared with 52.3% in 2023. The charge is therefore economically material, but the declining ratio does not support treating depreciation alone as the cause of margin compression. Gross profit and operating profit increased, whereas lower interest income, higher finance costs, and lower other gains weakened owner earnings. Weighted average return on equity fell from 10.0% in 2022 to 4.6% in 2023 and 2.4% in 2024. Product mix, pricing, yield, utilization, and new-fab ramp-up cannot be separated with the disclosed aggregate data.

Table 5. Investment-funding indicators for SMIC, 2020-2024

Indicator	2020	2021	2022	2023	2024
OCF / cash purchases of PPE (%)	31.5	73.1	86.6	44.0	41.4
OCF less cash purchases of PPE	-3,614.3	-1,108.4	-824.2	-4,272.1	-4,488.7

Cash-flow amounts are US\$ million. The cumulative difference between OCF and cash purchases of PPE was -US\$14.31 billion for 2020-2024. This partial indicator excludes other investing cash flows and financing sources and is not labeled free cash flow. Source: calculations from SMIC's five-year summary [5].

OCF did not fully cover cash purchases of PPE in any year from 2020 through 2024 (Table 5). Coverage reached 86.6% in 2022 but fell to 41.4% in 2024 while equipment purchases remained above US\$7.6 billion. The cumulative gap of US\$14.31 billion indicates that expansion required funding beyond contemporaneous operating cash generation, including some combination of existing liquidity, financing cash flows, maturing financial assets, government support, or other sources. The measure does not demonstrate a liquidity crisis, because SMIC also reported substantial cash and financial assets, but it makes the financing burden associated with capacity expansion explicit.

3.3. Operating efficiency and liquidity relative to Hua Hong

The 2024 comparison distinguishes SMIC's scale and gross-margin advantages from its weaker inventory turnover and liquidity ratios (Table 6). SMIC generated approximately four times Hua Hong's revenue and reported an 18.0% gross margin, compared with 10.2% for Hua Hong. Its inventory turnover was 2.31 times versus 3.92 times, while total asset turnover was similar at 0.166 and 0.172 times, respectively. Company-reported capacity utilization was 85.6% for SMIC and 99.5% for Hua Hong; the difference is directionally relevant to fixed-cost absorption but is not a controlled comparison because the firms use their own capacity conventions. Inventory turnover uses the same average-balance denominator for both firms.

Table 6. Comparison of SMIC and Hua Hong in 2024

Indicator	SMIC	Hua Hong
Revenue (US\$ million)	8,029.9	2,004.0
Revenue growth (%)	27.0	-12.3
Gross margin (%)	18.0	10.2
Consolidated profit or loss (US\$ million)	730.0	-140.4
Profit attributable to owners (US\$ million)	492.7	58.1
Inventory turnover (times)	2.31	3.92
Total asset turnover (times)	0.166	0.172
Total liabilities / total assets (%)	35.2	28.3
Current ratio (times)	1.69	3.73
PPE / total assets (%)	57.1	47.2
Inventories / total assets (%)	6.0	3.8
Capacity utilization (%)	85.6	99.5
Operating cash flow (US\$ million)	3,175.6	459.5

Sources: SMIC, printed p. 9 and pp. 95-101 [5]; Hua Hong, printed p. 37 and pp. 302-309 [6]. Ratios follow Section 2.3. Capacity utilization is company-reported and based on each firm's disclosed capacity convention. Hua Hong's positive profit attributable to owners coexists with a consolidated loss because non-controlling interests absorb part of the loss.

Table 7. Cash-flow classification adjustment for the 2024 comparison

Indicator (US\$ million)	SMIC	Hua Hong
Published OCF	3,175.6	459.5
Interest received	304.7	82.0
Interest paid	206.0	105.7
OCF including interest	3,175.6	435.8
OCF excluding interest	3,076.8	459.5
Cash generated from operations before interest and tax	3,125.2	516.9

OCF including interest applies both cash interest flows to the operating category; OCF excluding interest removes both from that category. "Cash generated from operations" is the subtotal reported before interest and income tax for SMIC and before income tax for Hua Hong, whose interest cash flows are outside OCF. Source: company cash-flow statements [5,6].

The adjustment confirms a material classification difference but does not reverse the directional comparison. On the including-interest basis, OCF was US\$3.18 billion for SMIC and US\$0.44 billion for Hua Hong; on the excluding-interest basis, the corresponding amounts were US\$3.08 billion and US\$0.46 billion. These values still require scale and investment context. Hua Hong's reported purchases combine PPE, prepaid lease payments, and intangible assets, whereas SMIC separately identifies cash purchases of PPE. The harmonized comparison therefore supports a directional assessment of operating cash generation, not a claim that either company has uniformly superior cash-flow quality.

SMIC's liabilities represented 35.2% of assets, compared with 28.3% for Hua Hong, and SMIC also reported the lower current ratio. At the same time, SMIC disclosed negative net debt of US\$3.37 billion under a company-defined measure that deducts cash, restricted cash, and specified financial assets from debt [5]. Taken together, these indicators support monitoring the composition, accessibility, and maturity of funding rather than a conclusion of immediate financial distress. In particular, restricted cash and longer-term financial assets should not automatically be treated as resources available for every short-term obligation.

4. Discussion and Strategic Implications

The results identify a qualified recovery: SMIC regained revenue scale and increased operating profit in 2024, but returns remained compressed and operating cash flow funded less than half of cash purchases of PPE. SMIC's annual report also identifies semiconductor cyclicality, potential capacity

oversupply, and tightening export controls as operating risks [5]. These conditions help explain why capacity decisions involve both market-return and supply-security considerations, but they do not prove that continued expansion is financially optimal. Separating operations from financing [2,10] shows that the central question is whether operating improvements are sufficient relative to the enlarged asset base and continuing investment commitments.

4.1. Inventory and production assets

Both annual reports measure inventories at the lower of cost and net realizable value using a weighted-average cost basis [5,6]. Hua Hong describes a portfolio centered on specialty IC and power discrete processes, whereas SMIC reports a broader platform mix and export-control exposure [5,6]. Product mix, customer qualification cycles, and precautionary stocks could therefore affect turnover, so SMIC's 2.31 times should not be read mechanically as inefficiency relative to Hua Hong's 3.92 times. The inference remains provisional because the statements do not isolate safety stocks, process-stage inventories, or comparable write-down rates.

PPE is central to SMIC's accounting and operating profile. Machinery and equipment are depreciated over five to ten years, whereas construction in progress is not depreciated until ready for use [5]. Table 4 shows that group-wide depreciation and amortization increased to US\$3.22 billion, while Table 6 reports 85.6% capacity utilization. Together, these observations make fixed-cost absorption a relevant mechanism: newly commissioned capacity can raise depreciation before output reaches a mature level. However, the disclosed depreciation total is broader than manufacturing cost and its ratio to cost of sales declined in 2024. Product-level depreciation, wafer starts, yield, selling prices, and utilization are therefore required before attributing the margin decline to ramp-up costs.

4.2. Profit quality and investment funding

SMIC generated positive OCF of US\$3.18 billion in 2024 but spent US\$7.66 billion in cash on PPE, leaving a partial funding gap of US\$4.49 billion. Reading OCF relative only to owner earnings would obscure this investment requirement and would also combine group-level cash flow with earnings attributable solely to owners. Depreciation and amortization of US\$3.22 billion further explain how positive operating cash flow can coexist with weak accounting returns [5]. The partial gap is informative about funding needs, but it is not a measure of insolvency and does not incorporate every investing or financing transaction.

Hua Hong exposes a second boundary of cash-conversion ratios: the group reported a consolidated loss but positive earnings attributable to owners in 2024 [6]. Changing the earnings denominator would therefore change both the sign and magnitude of an OCF-to-profit ratio. For this reason, the analysis retains OCF, consolidated profit or loss, and owner earnings as separate observations. The screening ratio is used only as a matching feature with a known scope mismatch, not as a standalone measure of earnings quality.

4.3. Capital allocation and prospective analysis

The prospective implication is to evaluate expansion through explicit utilization scenarios rather than revenue growth alone. The disclosed 85.6% utilization rate provides a baseline; recovery scenarios should vary utilization together with selling prices, yields, production depreciation, and financing costs. If depreciation is fixed over the scenario horizon, higher utilization should reduce depreciation per wafer, but weaker prices or yields may offset that benefit. The available disclosures do not permit a credible numerical margin elasticity for 90% or 95% utilization. The evidence therefore supports a transparent scenario model in future work, not an unconditional recommendation to expand or contract capacity.

Research commitments also require both absolute and relative measures. SMIC's R&D expense increased by 8.2% in 2024 even as R&D intensity declined from 11.2% to 9.5% of revenue [5]. The lower ratio therefore reflects revenue growth as well as spending and cannot by itself establish research underinvestment. Capacity and R&D should instead be evaluated jointly against project

milestones, technical progress, and commercialization evidence. This implication remains prospective: the present study does not test whether either investment category caused subsequent profitability.

5. Limitations

The peer ranking has material reproducibility constraints. The retained record does not provide a verified sample count, complete firm list, extraction date, missing-value policy, outlier treatment, random seed, initialization settings, or final weighting vector. The account mapping for the working-capital proxy is also incomplete. No independent validation sample, matching-accuracy assessment, or cluster-stability estimate is available. A reproducible extension should release these inputs, compare alternative scaling rules and cluster counts, and report diagnostic measures such as silhouette widths [12]. The recurrence of Hua Hong as the leading peer in two reported runs is supportive but is narrower than a general robustness result.

The annual-report comparison is descriptive and limited to two firms and one focal year for cross-company benchmarking. Differences in product mix, technology platforms, ownership structures, accounting estimates, and investment timing can persist after financial matching. In addition, the reconstructed annual-report measures use a controlled disclosure basis that is separate from the archived screening inputs. Historical associations cannot identify causal effects of R&D, capital investment, utilization, or industrial policy. The observation period ends in 2024 and supports neither a stock-price forecast nor an enterprise valuation. Generalization would require an auditable firm-level panel linked to operating data beyond the published financial statements.

6. Data Availability

The public financial statements used for the ratio and cash-flow calculations are available in the 2024 annual reports of SMIC and Hua Hong Semiconductor cited in References [5] and [6]. The complete company-level screening matrix, extraction log, and executable estimation code were not present in the retained course-project materials and therefore cannot be supplied as a reproducibility package. All screening outputs used in this study are identified as archived results rather than newly estimated values.

7. Conclusion

The Harvard framework links peer selection, accounting comparability, and prospective interpretation in a single assessment of SMIC. Hua Hong is a plausible comparator in the retained screening, and the harmonized annual-report analysis identifies a qualified recovery: SMIC regained revenue scale and reported a higher gross margin than its peer, yet inventory turnover and liquidity ratios were weaker and owner returns remained compressed. Positive operating cash flow did not fully fund cash purchases of PPE in any year from 2020 through 2024, producing a cumulative partial gap of US\$14.31 billion. Reclassifying interest cash flows did not alter the directional peer comparison. The evidence therefore supports evaluating capital allocation through the joint lenses of capacity utilization, working-capital efficiency, financing accessibility, and research progress. These conclusions are bounded by the two-firm descriptive design and the incomplete screening record; they characterize the disclosed period and should not be read as causal estimates, forecasts, or investment advice.

References

- [1] Palepu K. G., Healy P. M. *Business Analysis & Valuation: Using Financial Statements*. 5th ed. New Delhi: Cengage Learning India, 2015. ISBN: 9788131526644.
- [2] Nissim D., Penman S. H. Ratio Analysis and Equity Valuation: From Research to Practice. *Review of Accounting Studies*, 2001, 6(1): 109-154. doi:10.1023/A:1011338221623.
- [3] Bhojraj S., Lee C. M. C. Who Is My Peer? A Valuation-Based Approach to the Selection of Comparable Firms. *Journal of Accounting Research*, 2002, 40(2): 407-439. doi:10.1111/1475-679X.00054.
- [4] De Franco G., Kothari S. P., Verdi R. S. The Benefits of Financial Statement Comparability. *Journal of Accounting Research*, 2011, 49(4): 895-931. doi:10.1111/j.1475-679X.2011.00415.x.
- [5] Semiconductor Manufacturing International Corporation. Annual Report 2024. Shanghai: SMIC, 2025. Available: <https://www.smics.com/uploads/67f6423d/e00981.pdf> (accessed 16 September 2026).
- [6] Hua Hong Semiconductor Limited. Annual Report 2024. Shanghai: Hua Hong Semiconductor, 2025. Available: <https://www1.hkexnews.hk/listedco/listconews/sehk/2025/0327/2025032702315.pdf> (accessed 16 September 2026).
- [7] Tushare. Income Statement Interface Documentation. Available: https://tushare.pro/document/2?doc_id=33 (accessed 16 September 2026).
- [8] Lloyd S. P. Least Squares Quantization in PCM. *IEEE Transactions on Information Theory*, 1982, 28(2): 129-137. doi:10.1109/TIT.1982.1056489.
- [9] Scikit-learn Developers. Nearest Neighbors. *Scikit-learn User Guide*. Available: <https://scikit-learn.org/stable/modules/neighbors.html> (accessed 16 September 2026).
- [10] Dechow P. M. Accounting Earnings and Cash Flows as Measures of Firm Performance: The Role of Accounting Accruals. *Journal of Accounting and Economics*, 1994, 18(1): 3-42. doi: 10.1016/0165-4101(94)90016-7.
- [11] International Accounting Standards Board. IAS 7: Statement of Cash Flows. London: IFRS Foundation, 2021. Available: <https://www.ifrs.org/content/dam/ifrs/publications/pdf-standards/english/2021/issued/part-a/ias-7-statement-of-cash-flows.pdf> (accessed 16 September 2026).
- [12] Rousseeuw P. J. Silhouettes: A Graphical Aid to the Interpretation and Validation of Cluster Analysis. *Journal of Computational and Applied Mathematics*, 1987, 20: 53-65. doi:10.1016/0377-0427(87)90125-7.