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FOREX EFFICIENCY AND FINANCIAL PERFORMANCE OF INDIAN DEFENCE COMPANIES – EXAMINING CONNECTION

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ABSTRACT

This study explores the impact of financial performance on forex efficiency of the selected Indian Defence companies. To meet this objective the sample of five companies selected from nifty defence index based on availability of data. This research uses a descriptive research design and the analysis spans over ten years from April 2014 to March 2024. The financial performance indicators, including profitability, liquidity, asset efficiency, and solvency are examined in relation to forex efficiency through correlation and panel regression analysis. This research aims to address two key questions: the overall relationship between financial performance and forex efficiency in selected Defence companies and the influence of selected financial indicators on forex efficiency. The previous studies have explored related themes but they have not specifically targeted the Defence sector or detailed how particular financial indicator impact forex efficiency. This study fills this gap by providing a meticulous analysis of how financial performance influences forex efficiency. This contributes in valuable insights for strategic financial management and policy formulation in the Defence industry.

Keywords: Financial Performance, Forex Efficiency, Defence Sector, Panel Regression Analysis

INTRODUCTION

In today's globalized economy the efficiency of foreign exchange operations is an important factor influencing the

financial performance of companies and especially those in sectors with substantial international dealings like Defence. Indian Defence companies which play a important role in ensuring national security and advancing technological capabilities are particularly vulnerable to the impacts of forex management. Their extensive involvement in international trade and the acquisition of high-tech equipment & services from foreign sellers makes them susceptible to the fluctuations and volatility that is inherent in the forex markets. These companies operate in a sector where timely and efficient management of resources is paramount therefore understanding the relationship between financial performance and forex efficiency becomes essential for their sustained success and operational stability. The need for this study arises from the increasing importance of efficient forex management in the Defence sector which remains relatively underexplored in existing research. Despite the significance of forex operations in shaping the financial outcomes of Defence companies major research has broadly addressed forex management without entering into the specific impacts on firms within the Defence industry. The unique nature of Defence procurement with its complex contracts and substantial expenditures necessitates a focused examination of how forex efficiency influences financial performance of companies. This research focuses to bridge this gap by providing a comprehensive analysis of how forex efficiency impacts the financial stability and performance of selected Indian Defence companies. This research offers insights that are customised to the sector's distinct challenges and requirements.

The implications of this study are far reaching. In the strategic financial management, the understanding about impact of forex efficiency on financial performance can lead to more effective risk management practices which leads in helping Defence companies mitigate currency risks and optimize their financial resources. The Policymakers and Defence procurement agencies can leverage the findings to draft policies that support the financial health and operational efficiency of Defence firms, thereby strengthening the overall Defence infrastructure. Moreover, the investors and stakeholders will gain a clearer perspective on how forex management practices impact financial performance which facilitate them in more informed investment decisions and risk assessments. For Defence companies themselves the optimization of forex efficiency can enhance their operational effectiveness and competitive advantage in the global market.

This study is poised to make a significant contribution to the literature by examining the relationship between financial performance and forex efficiency in the Indian Defence sector. By focusing on this under-researched area this research aims to provide valuable insights that can inform financial strategies, policy development, and investment practices which ultimately supports the sustained success and operational excellence of Defence companies.

RESEARCH QUESTIONS

[1] What is the relationship between financial performance and forex efficiency in selected Indian Defence companies?

[2] How do specific financial performance indicators (e.g., profitability, liquidity, assets efficiency, and solvency) influence forex efficiency in these companies?

LITERATURE REVIEW

The literature on financial performance and forex efficiency in relation to the Defence sector found a nixed and evolving narrative. (Bowlin, 1999) conducted a study using data envelopment analysis (DEA) to compare financial performance of Defence and non-Defence business segments from 1983 to 1992. His research demonstrated that the Defence segments initially excelled and they experienced a decline through 1989 which is followed by a recovery in the early 1990s that reflects adaptive responses to market changes. This study focused on the effectiveness of DEA in providing a detailed view of financial performance and the need for ongoing strategic adjustments. Complementing this (Ogbuleke, 2019) studied the impact of diverting foreign exchange for military purposes in Nigeria and revealed that such allocations often lead to inefficiencies and corruption which exacerbates security issues rather than addressing them. The researcher found the necessity for transparency in Defence spending to improve both efficiency and national security. In a broader context (Frederiksen and Looney, 1983) analysed the relationship between the Defence expenditures and economic growth in developing countries and found that while military spending could stimulate certain economic activities it often detracted from investments in other important sectors which potentially hinders overall growth. Their study emphasised the need for a balanced approach to Defence spending in order to promote sustainable development. Similarly (Faini et al., 1984) explored how economic structures influence the effects of Defence spending on growth and found that the impact

varied significantly based on a country's economic context. Their findings highlighted the importance of tailoring Defence budgets to specific economic conditions to maximize positive outcomes. (Verma, 2024) contributed to the discussion by examining the impact of Foreign Direct Investment on India's current account transactions and revealed that FDI often leads to net foreign exchange outflows due to high import costs and limited export benefits. This study pointed to the need for careful policy management to mitigate the adverse effects of FDI on the current account. Furthermore, (Upadhyay and Ghosh, 2016) challenged traditional views on exchange rate impacts by finding minimal effects of exchange rate fluctuations on India's software and services exports and suggested that macroeconomic factors may play a more significant role. Lastly, (Sharma, 2023) employed panel regression methodology to assess the impact of trade investment strategies on the financial performance of selected Indian companies. The analysis indicated that these strategies had a significant influence on liquidity, efficiency, and profitability, underscoring the importance of strategic trade investments in enhancing financial performance and forex efficiency. Collectively these previous studies provide a detailed holistic view of the complex interactions between financial performance and forex efficiency and highlights the need for strategic and context-aware approaches in Defence and economic policy.

RESEARCH GAP:

Existing research studies offer valuable insights into financial performance and forex efficiency but lack specific focus on the Defence sector and its unique characteristics. It is observed that previous studies do not address how specific financial indicators like profitability, liquidity, asset efficiency, solvency, and cash flow management directly influence forex efficiency in Indian Defence companies. Moreover, the previous studies on foreign investment and Defence spending do not target the specific interplay of financial performance and forex efficiency in the Defence industry. Therefore, there is a need for targeted research to understand how financial performance affect forex efficiency within this sector.

RESEARCH METHODOLOGY

The research methodology for this study involves a descriptive research design, focusing on a sample of five companies from the Defence Index. The sample includes Astra Microwave Products Ltd., Hindustan Aeronautics Ltd., Ideaforge Technology Ltd., M T A R Technologies Ltd., and Solar Industries India Ltd. Data has been collected for these companies over a period of ten years, from April 2014 to March 2024. The analysis employs accounting ratios to assess various financial indicators and uses correlation and panel regression analysis to understand the relationships between these indicators and the companies' financial performance. This approach allows for a detailed examination of how different financial variables impact the performance of Defence companies over the specified time frame.

DATA ANALYSIS & DISCUSSION

Table 1: Net Profit Ratio of Selected Indian Defence Companies

Net Profit Ratio = Profit After Tax / Sales					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	9.41	15.25	-221.77	-5.72	9.66
2016	12.83	11.73	22.86	0.22	9.67
2017	14.41	14.33	6.22	-18.04	10.58
2018	16.81	10.79	-10.70	4.02	10.29
2019	4.22	11.80	-56.45	21.34	11.51
2020	10.25	13.37	-96.10	14.65	14.12
2021	4.02	14.38	-40.91	18.70	11.93
2022	5.46	20.84	33.74	18.91	10.34
2023	9.49	22.00	17.17	18.15	10.55
2024	12.50	26.82	15.09	9.70	15.78
Mean	9.94	16.13	-33.08	8.19	11.44
SD	4.13	5.02	73.94	12.26	1.91
CV	41.53	31.14	-223.48	149.67	16.72

The Net Profit Ratio (NPR) analysis of selected Indian Defence companies over the period from 2015 to 2024 reveals varied financial performances. Astra Microwave Products Ltd. experienced fluctuating but generally positive NPRs, with a moderate mean of 9.94% and some variability which indicates a stable yet inconsistent profit pattern. Hindustan Aeronautics Ltd. showed a strong upward trend, achieving the highest NPR in 2024 (26.82%) and maintaining consistent profitability with a mean NPR of 16.13% and relatively low variability which reflects its solid financial health. Conversely, Ideaforge Technology Ltd. faced significant challenges with extreme volatility in NPRs including substantial negative values in several years which leads to an overall mean NPR of -33.08%. This indicates high financial risk and instability. M T A R Technologies Ltd. also exhibited considerable fluctuations particularly negative NPRs in earlier years but managed to recover in later years which results in a moderate mean NPR of 8.19% but with high variability and signifying financial uncertainty. Solar Industries India Ltd. demonstrated consistent performance with stable and positive NPRs and the highest mean NPR of 11.44% and the lowest variability among the companies which underscores its steady profitability and low financial risk. Overall, while some companies like Hindustan Aeronautics Ltd. and Solar Industries India Ltd. displayed strong and stable profitability the others like Ideaforge Technology Ltd. and M T A R Technologies Ltd. faced significant financial challenges indicated by high volatility and risk.

Table 2: Current Ratio of Selected Indian Defence Companies

Current Ratio = Current Assets / Current Liabilities					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	2.34	1.54	2.23	1.59	1.93
2016	5.16	1.40	2.73	2.05	1.71
2017	3.13	1.56	2.35	1.35	1.76
2018	2.76	1.40	9.93	1.83	2.00
2019	3.74	1.39	8.58	1.58	1.72
2020	2.01	1.32	5.36	1.51	2.12
2021	1.98	1.55	3.42	4.46	1.92
2022	2.26	1.71	1.66	2.80	1.69
2023	2.52	1.61	2.54	2.04	1.79
2024	2.80	1.67	8.42	2.75	2.47
Mean	2.87	1.52	4.72	2.20	1.91
SD	0.92	0.13	2.96	0.89	0.23
CV	31.96	8.27	62.71	40.48	12.11

The analysis of the Current Ratio for selected Indian Defence companies from 2015 to 2024 reveals insights into their liquidity positions. Astra Microwave Products Ltd. maintains a relatively strong and consistent liquidity position with a mean Current Ratio of 2.87 which indicates that it has a healthy buffer of current assets over current liabilities. The company exhibits moderate variability as reflected in its coefficient of variation (CV) of 31.96 and shows a stable financial position over time. Hindustan Aeronautics Ltd. consistently displays a lower Current Ratio with a mean of 1.52, suggesting a tighter liquidity position but with minimal variability (CV of 8.27%) which indicates strong control over its working capital. Ideaforge Technology Ltd. presents the most volatile liquidity position with a highly fluctuating Current Ratio peaking at 9.93 in 2018 and dropping to 1.66 in 2022. This results in a high CV of 62.71% which signals considerable instability in managing its short-term obligations. M T A R Technologies Ltd. shows a moderate Current Ratio with a mean of 2.20 but with significant fluctuations particularly in 2021 when it reached 4.46 which leads to a CV of 40.48% indicating moderate risk in its liquidity management. Solar Industries India Ltd. maintains a relatively stable Current Ratio averaging 1.91 with the lowest variability among the companies (CV of 12.11%) which suggests a consistent approach to managing its short-term liabilities. Overall, the analysis indicates that while Astra Microwave Products Ltd. and Solar Industries India Ltd. have strong and stable liquidity positions which Ideaforge Technology Ltd. faces significant volatility which raising concerns about its ability to consistently meet short-term obligations.

Table 3: Total Assets Turnover Ratio of Selected Indian Defence Companies

Total Assets Turnover Ratio = Sales / Total Assets					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	1.34	0.24	0.20	0.26	1.40
2016	0.80	0.30	0.50	0.30	1.22
2017	0.62	0.35	0.75	0.32	1.17
2018	0.51	0.37	0.20	0.55	1.16
2019	0.47	0.38	0.20	0.60	1.27
2020	0.51	0.39	0.18	0.59	1.08
2021	0.63	0.41	0.28	0.41	0.97
2022	0.74	0.39	0.77	0.44	1.24
2023	0.75	0.37	0.37	0.54	1.52
2024	0.60	0.34	0.42	0.58	1.16
Mean	0.70	0.35	0.39	0.46	1.22
SD	0.24	0.05	0.21	0.12	0.15
CV	34.23	13.51	54.75	26.60	12.14

The Total Assets Turnover Ratio (TATR) analysis for selected Indian Defence companies from 2015 to 2024 highlights their efficiency in utilizing assets to generate sales. Astra Microwave Products Ltd. shows a moderate TATR with a mean of 0.70 indicating reasonable asset utilization though with notable variability (CV of 34.23%) this suggests fluctuations in its efficiency over time. Hindustan Aeronautics Ltd. consistently demonstrates lower asset turnover with a mean TATR of 0.35 and minimal variability (CV of 13.51%) this reflects stable but less aggressive use of its assets to drive sales. Ideaforge Technology Ltd. presents a highly variable TATR with a mean of 0.39 and significant fluctuations as evidenced by a CV of 54.75%. This variability indicates inconsistent asset utilization which potentially may leads to inefficiencies in its operations. M T A R Technologies Ltd. has a moderate TATR with a mean of 0.46 and variability reflected in a CV of 26.60% this suggests moderate efficiency in asset use with some fluctuations. Solar Industries India Ltd. stands out with the highest mean TATR of 1.22 indicating strong asset utilization. It also has the lowest variability (CV of 12.14%) reflecting consistent and efficient use of assets to generate sales. Overall, while Solar Industries India Ltd. excels in asset utilization the other companies like Astra Microwave Products Ltd. and M T A R Technologies Ltd. show moderate efficiency and Ideaforge Technology Ltd. struggles with consistency, leading to potential inefficiencies in its operations.

Table 4: Proprietary Ratio of Selected Indian Defence Companies

Proprietary Ratio = Total Equity Capital / Total Assets					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	0.60	0.26	0.17	0.68	0.66
2016	0.72	0.19	0.31	0.77	0.60
2017	0.67	0.24	0.50	0.63	0.61
2018	0.71	0.19	0.89	0.70	0.68
2019	0.79	0.23	0.90	0.77	0.68
2020	0.61	0.24	0.87	0.62	0.73
2021	0.60	0.28	0.49	0.80	0.70
2022	0.59	0.30	0.58	0.71	0.67
2023	0.60	0.33	0.65	0.58	0.63
2024	0.64	0.35	0.88	0.67	0.72
Mean	0.65	0.26	0.62	0.69	0.67
SD	0.06	0.05	0.25	0.07	0.04
CV	9.89	19.52	39.60	9.68	6.20

The Proprietary Ratio analysis for selected Indian Defence companies from 2015 to 2024 offers insights into their

financial stability and reliance on equity capital. Astra Microwave Products Ltd. consistently maintains a strong Proprietary Ratio with a mean of 0.65 which indicates a healthy reliance on equity financing and minimal debt coupled with low variability (CV of 9.89%) which suggests stable financial management. Hindustan Aeronautics Ltd. shows a lower Proprietary Ratio with a mean of 0.26 which reflects a higher reliance on debt compared to equity. The variability is moderate (CV of 19.52%) indicating some fluctuations in its equity structure over the years. Ideaforge Technology Ltd. exhibits a more volatile Proprietary Ratio with a mean of 0.62 and significant fluctuations (CV of 39.60%) indicating inconsistency in its equity financing which may raise concerns about financial stability. M T A R Technologies Ltd. demonstrates a strong Proprietary Ratio with a mean of 0.69 indicating a high proportion of equity capital relative to total assets. The low variability (CV of 9.68%) suggests consistent financial stability. Solar Industries India Ltd. maintains the highest and most stable Proprietary Ratio with a mean of 0.67 and the lowest variability (CV of 6.20%) indicating a robust reliance on equity financing and strong financial health. Overall, while most companies exhibit strong and stable equity positions, Hindustan Aeronautics Ltd. relies more on debt, and Ideaforge Technology Ltd. shows significant volatility which could indicate financial risk.

Table 5: Net Operating Cash Liquid Ratio of Selected Indian Defence Companies

Net Operating Cash Liquid Ratio = Net Cash Flow from Operating Activity / Current Liabilities					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	-0.01	0.04	-0.48	0.07	0.78
2016	0.76	0.09	-0.57	0.64	0.83
2017	0.15	-0.02	0.54	0.12	0.27
2018	1.00	-0.03	-0.67	0.23	1.06
2019	0.02	-0.26	-1.72	0.44	0.73
2020	-0.01	0.05	-1.94	0.49	0.81
2021	-0.03	0.56	-1.33	0.10	0.45
2022	0.30	0.36	0.75	-0.18	0.65
2023	-0.07	0.26	-0.35	0.03	0.18
2024	-0.43	0.21	1.08	0.27	1.35
Mean	0.17	0.13	-0.47	0.22	0.71
SD	0.40	0.22	0.97	0.23	0.33
CV	238.06	173.78	-207.13	106.01	46.66

The Net Operating Cash Liquid Ratio (NOCLR) analysis for selected Indian Defence companies from 2015 to 2024 reveals significant differences in their ability to generate cash from operating activities relative to their current liabilities. Astra Microwave Products Ltd. shows considerable volatility in its NOCLR, with a mean of 0.17, indicating inconsistent cash flow generation and a high coefficient of variation (CV) of 238.06% reflecting significant fluctuations and potential cash flow management challenges. Hindustan Aeronautics Ltd. also displays variability in its NOCLR with a mean of 0.13 and a CV of 173.78% suggesting a mixed ability to cover current liabilities with operating cash flows although it has some years of negative ratios which indicates operational inefficiencies. Ideaforge Technology Ltd. consistently struggles with its cash flow generation showing a mean NOCLR of -0.47 which is the indicative of persistent difficulties in covering current liabilities with extreme volatility as reflected in its CV of -207.13%. M T A R Technologies Ltd. demonstrates moderate performance with a mean NOCLR of 0.22 indicating a generally positive but variable cash flow position as suggested by a CV of 106.01%. Solar Industries India Ltd. stands out with a relatively strong and stable cash flow position with a mean NOCLR of 0.71 and the lowest CV of 46.66% indicating its consistent ability to generate sufficient operating cash flow to cover current liabilities. Overall, while Solar Industries India Ltd. maintains robust cash flow management, other companies like Astra Microwave Products Ltd. and Ideaforge Technology Ltd. exhibit significant volatility and financial challenges in maintaining adequate liquidity.

Table 6: Operating Cash to Profit Ratio of Selected Indian Defence Companies

Operating Cash to Profit Ratio = Cash Flow From Operating Activity / Profit After Tax					
Years	Astra Microwave	Hindustan	Ideaforge	M T A R	Solar Industries

	Products Ltd.	Aeronautics Ltd.	Technology Ltd.	Technologies Ltd.	India Ltd.
2015	-0.03	0.54	0.42	-1.33	1.19
2016	1.06	1.57	-1.52	186.17	1.60
2017	0.36	-0.16	3.53	-0.62	0.53
2018	2.87	-0.37	2.47	2.24	1.58
2019	0.13	-3.28	1.31	0.77	1.10
2020	-0.10	0.54	1.27	1.79	0.91
2021	-0.43	4.67	2.22	0.19	0.78
2022	2.50	2.00	1.20	-0.49	1.12
2023	-0.28	1.52	-1.66	0.09	0.30
2024	-1.66	1.08	1.61	0.99	1.29
Mean	0.44	0.81	1.08	18.98	1.04
SD	1.30	1.91	1.56	55.74	0.40
CV	294.64	236.07	144.13	293.67	38.42

The Operating Cash to Profit Ratio (OCPR) analysis for selected Indian Defence companies from 2015 to 2024 highlights significant variability in their ability to convert profit into operating cash flow. Astra Microwave Products Ltd. has a low mean OCPR of 0.44 indicating inconsistent cash conversion from profits with extreme fluctuations reflected in a high coefficient of variation (CV) of 294.64%. Hindustan Aeronautics Ltd. shows a moderate mean OCPR of 0.81 suggesting some ability to generate operating cash relative to profit, but with considerable variability (CV of 236.07%) indicating inconsistent performance. Ideaforge Technology Ltd. has a mean OCPR of 1.08 which suggests a relatively better conversion of profit into cash flow. However, the high variability (CV of 144.13%) points to irregular cash generation. M T A R Technologies Ltd. stands out with an extraordinarily high mean OCPR of 18.98 driven by extreme values particularly in 2016, when the ratio spiked due to significant fluctuations in operating cash flow as evidenced by a CV of 293.67%. This indicates highly volatile cash flow management. Solar Industries India Ltd. exhibits the most consistent performance with a mean OCPR of 1.04 and the lowest variability (CV of 38.42%) reflecting a stable and reliable conversion of profit into cash flow. Overall, while Solar Industries India Ltd. demonstrates robust and consistent cash flow management the other companies particularly M T A R Technologies Ltd., show extreme volatility which raises concerns about their financial stability and cash management practices.

Table 7: External Financing Index Ratio of Selected Indian Defence Companies

EFIR = Cash Flow from Operating Activity / Cash Flow from Financing Activity					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	-4.28	-0.99	-2.18	-0.42	-1.04
2016	0.38	-1.87	-2.62	-0.89	-0.37
2017	1.89	0.39	0.18	-0.46	0.51
2018	-0.34	3.46	-11.68	-0.31	-0.65
2019	-61.80	-0.30	0.42	-0.19	-0.31
2020	-6.75	0.04	-0.12	-0.74	-0.73
2021	-2.09	-0.47	-1.38	20.90	-0.45
2022	-0.66	-0.14	-0.14	-1.81	-0.12
2023	-3.50	-0.20	-3.31	3.63	1.30
2024	-1.25	-0.24	2.46	0.46	-0.28
Mean	-7.84	-0.03	-1.84	2.02	-0.21
SD	18.14	1.31	3.65	6.44	0.64
CV	-231.40	-3918.86	-198.85	319.31	-298.51

The External Financing Index Ratio (EFIR) analysis for selected Indian Defence companies from 2015 to 2024 reveals significant insights into their reliance on external financing compared to internally generated cash flows. Astra Microwave Products Ltd. Displays a highly negative mean EFIR of -7.84, indicating a heavy reliance on external financing relative to its operating cash flows with substantial volatility as reflected by an extremely high

coefficient of variation (CV) of -231.40%. Hindustan Aeronautics Ltd. Has a near-zero mean EFIR of -0.03 suggesting a balanced though inconsistent approach to external financing with an Extremely high CV of -3918.86% which indicates erratic financial management. Ideaforge Technology Ltd. Also shows a negative mean EFIR of -1.84 indicating a dependency on external financing but with notable variability (CV of -198.85%) which suggests inconsistent cash flow management practices. M T A R Technologies Ltd. Stands out with a positive mean EFIR of 2.02 indicating a stronger reliance on internally generated cash flows compared to external financing although the high CV of 319.31% reflects significant fluctuations particularly influenced by extreme values in certain years like 2021. Solar Industries India Ltd. Has a slightly negative mean EFIR of -0.21 indicating a minor reliance on external financing but with a high CV of -298.51% which points to considerable variability in its financing approach. Overall, the analysis reveals that while some companies like M T A R Technologies Ltd., demonstrate a preference for internal financing, others, like Astra Microwave Products Ltd. And Ideaforge Technology Ltd. Exhibit a substantial reliance on external financing coupled with significant variability which raises concerns about the consistency and stability of their financial strategies.

Table 8: Investment Efficiency Ratio of Selected Indian Defence Companies

Investment Efficiency Ratio = Cash Flow from Investing Activity / Cash Flow from Operating Activity					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	13.50	-7.36	0.09	-0.18	-0.12
2016	-0.36	0.43	0.55	-0.17	-0.63
2017	-5.87	-7.14	-0.11	-0.59	-1.43
2018	-0.54	-0.81	11.31	-0.09	-0.37
2019	52.33	-0.69	-1.60	-0.75	-0.62
2020	5.69	-0.86	-0.26	-0.21	-0.05
2021	0.42	-0.08	0.34	-2.57	-0.67
2022	-0.27	-1.26	-0.64	4.87	-0.95
2023	1.29	-0.65	2.80	-9.96	-2.04
2024	0.23	-0.78	-1.40	-0.97	-0.71
Mean	6.64	-1.92	1.11	-1.06	-0.76
SD	15.96	2.70	3.59	3.47	0.57
CV	240.38	-140.78	323.93	-325.86	-74.84

The Investment Efficiency Ratio (IER) analysis for selected Indian Defence companies from 2015 to 2024 highlights the varying degrees of efficiency in converting cash flows from operating activities into productive investments. Astra Microwave Products Ltd. shows a highly positive mean IER of 6.64 suggesting that its cash flow from operating activities is significantly leveraged for investment purposes but the extreme variability (CV of 240.38%) indicates inconsistent investment practices marked by some exceptionally high values like in 2019. Hindustan Aeronautics Ltd. displays a negative mean IER of -1.92 indicating that the company typically uses more cash for investing activities than it generates from operating activities with a CV of -140.78%, reflecting substantial volatility in its investment efficiency. Ideaforge Technology Ltd. shows a modestly positive mean IER of 1.11 but with a very high CV of 323.93% which points to significant fluctuations and instability in investment efficiency as seen in the dramatic shifts from positive to negative values across the years. M T A R Technologies Ltd. exhibits a negative mean IER of -1.06 implying that it generally requires more cash for investing activities than it produces from operations and this inefficiency is further emphasized by a highly negative CV of -325.86% driven by extreme fluctuations in certain years particularly in 2023. Solar Industries India Ltd. has a slightly negative mean IER of -0.76 indicating a minor inefficiency in its investment practices but with a relatively lower CV of -74.84% which suggests more consistent investment behaviour compared to its peers. Overall, the analysis reveals a broad range of investment efficiency across these companies with some like Astra Microwave Products Ltd. showing strong but highly variable investment leverage while others like Hindustan Aeronautics Ltd. and M T A R Technologies Ltd. struggle with inefficiencies and instability in their investment practices.

Table 9: Forex Efficiency Ratio of Selected Indian Defence Companies

Forex Efficiency Ratio = Forex Earnings / Forex Spending					
Years	Astra Microwave Products Ltd.	Hindustan Aeronautics Ltd.	Ideaforge Technology Ltd.	M T A R Technologies Ltd.	Solar Industries India Ltd.
2015	6.9723	0.0476	0.0143	0.0000	1.9182
2016	1.7347	0.0578	0.0000	1.1645	0.8051
2017	0.2770	0.0696	0.0000	1.5158	1.1059
2018	0.3026	0.0481	0.0000	0.0000	3.0140
2019	0.4450	0.0512	0.0000	0.0000	2.6591
2020	1.0346	0.0290	0.0000	0.0000	2.4142
2021	1.3602	0.0328	0.0000	2.0955	0.0841
2022	0.6866	0.0250	0.0227	1.1172	0.9960
2023	1.0144	0.0450	0.0336	1.4847	0.9822
2024	0.8635	0.0409	0.0490	1.7629	1.5910
Mean	1.4691	0.0447	0.0120	0.9141	1.5570
SD	1.8861	0.0128	0.0168	0.7906	0.8825
CV	128.3847	28.6647	140.4021	86.4900	56.6775

The Forex Efficiency Ratio (FER) of selected Indian Defence companies from 2015 to 2024 provides insights into their ability to generate forex earnings relative to their forex spending. Astra Microwave Products Ltd. has the highest mean FER of 1.4691 indicating that on average the company earns significantly more in foreign exchange than it spends though with substantial variability (CV of 128.38%) which reflects inconsistent forex efficiency across the years particularly high in 2015. Hindustan Aeronautics Ltd. has a low mean FER of 0.0447 suggesting minimal forex earnings relative to its spending but with more consistency (CV of 28.66%) compared to its peers. Ideaforge Technology Ltd. exhibits a very low mean FER of 0.0120 indicating that its forex earnings are almost negligible compared to its spending with a high CV of 140.40% highlighting significant fluctuations and inefficiency in managing forex operations. M T A R Technologies Ltd. shows a moderate mean FER of 0.9141 indicating that it earns close to what it spends in foreign exchange but with variability (CV of 86.49%) reflecting inconsistency in its forex operations with some years showing no forex earnings at all. Solar Industries India Ltd. has a relatively strong mean FER of 1.5570 indicating efficient forex operations with forex earnings generally exceeding spending. However, the variability (CV of 56.68%) suggests some fluctuations in efficiency across the years.

Overall, the analysis indicates that while Astra Microwave Products Ltd. and Solar Industries India Ltd. generally perform well in forex operations with earnings surpassing spending their efficiency is inconsistent. On the other hand the Hindustan Aeronautics Ltd., Ideaforge Technology Ltd., and M T A R Technologies Ltd. face challenges in consistently maintaining forex efficiency with some companies struggling to generate significant forex earnings relative to their spending.

Table 10: Correlation Analysis of Selected Financial Performance Indicators

Correlations										
		Net Profit Ratio	Current Ratio	Total Assets Turnover Ratio	Proprietary Ratio	Forex Earnings / Forex Spending Ratio	Operating Cash Flow Ratio	Operating Cash Flow / PAT	External Financing Index Ratio	Investment to Operations Ratio
Net Profit Ratio	Pearson Correlation	1	-.220	.292*	.064	.132	.501**	-.010	.041	-.022
	Sig. (2-tailed)		.124	.040	.660	.361	.000	.945	.776	.881
	N	50	50	50	50	50	50	50	50	50
Current Ratio	Pearson Correlatio	-.220	1	-.267	.552**	-.086	-.368**	-.037	-.101	.188

	n									
	Sig. (2-tailed)	.124		.061	.000	.553	.009	.800	.484	.190
	N	50	50	50	50	50	50	50	50	50
Total Assets Turnover Ratio	Pearson Correlation	.292*	-.267	1	.248	.592**	.535**	-.123	.055	-.012
	Sig. (2-tailed)	.040	.061		.083	.000	.000	.394	.704	.936
	N	50	50	50	50	50	50	50	50	50
Proprietary Ratio	Pearson Correlation	.064	.552**	.248	1	.258	.042	.137	-.116	.228
	Sig. (2-tailed)	.660	.000	.083		.071	.773	.344	.422	.111
	N	50	50	50	50	50	50	50	50	50
Forex Earnings / Forex Spending Ratio	Pearson Correlation	.132	-.086	.592**	.258	1	.245	.038	.058	.128
	Sig. (2-tailed)	.361	.553	.000	.071		.086	.795	.690	.375
	N	50	50	50	50	50	50	50	50	50
Operating Cash Flow Ratio	Pearson Correlation	.501**	-.368**	.535**	.042	.245	1	.123	.085	-.088
	Sig. (2-tailed)	.000	.009	.000	.773	.086		.394	.558	.544
	N	50	50	50	50	50	50	50	50	50
Operating Cash Flow / PAT	Pearson Correlation	-.010	-.037	-.123	.137	.038	.123	1	.013	-.020
	Sig. (2-tailed)	.945	.800	.394	.344	.795	.394		.929	.892
	N	50	50	50	50	50	50	50	50	50
External Financing Index Ratio	Pearson Correlation	.041	-.101	.055	-.116	.058	.085	.013	1	-.917**
	Sig. (2-tailed)	.776	.484	.704	.422	.690	.558	.929		.000
	N	50	50	50	50	50	50	50	50	50
Investment to Operations Ratio	Pearson Correlation	-.022	.188	-.012	.228	.128	-.088	-.020	-.917**	1
	Sig. (2-tailed)	.881	.190	.936	.111	.375	.544	.892	.000	
	N	50	50	50	50	50	50	50	50	50
*. Correlation is significant at the 0.05 level (2-tailed).										
**. Correlation is significant at the 0.01 level (2-tailed).										

The correlation analysis of selected financial performance indicators reveals several significant relationships and insights into the interdependencies between various indicators. The Net Profit Ratio shows a significant positive correlation with the Total Assets Turnover Ratio ($r = 0.292$, $p < 0.05$) indicating that companies with higher asset

turnover tend to have better net profit margins. Conversely, it has a negative correlation with the Current Ratio ($r = -0.220$, $p > 0.05$), though this relationship is not statistically significant.

The Current Ratio is significantly positively correlated with the Proprietary Ratio ($r = 0.552$, $p < 0.01$), suggesting that companies with a higher proportion of equity capital relative to total assets also tend to have a better current ratio, indicating more liquidity. It has a negative correlation with the Operating Cash Flow Ratio ($r = -0.368$, $p < 0.01$), pointing to an inverse relationship where higher liquidity might be associated with lower cash flow from operating activities. The Total Assets Turnover Ratio is significantly positively correlated with the Forex Earnings / Forex Spending Ratio ($r = 0.592$, $p < 0.01$), which implies that companies with better asset turnover are more effective in managing their forex spending and earnings. This ratio also shows a strong positive correlation with the Operating Cash Flow Ratio ($r = 0.535$, $p < 0.01$), highlighting that companies efficiently converting assets into sales also exhibit better cash flow performance. The Proprietary Ratio has a notable positive correlation with the Forex Earnings / Forex Spending Ratio ($r = 0.258$, $p > 0.05$), suggesting a trend where companies with higher equity proportions have a better forex earnings efficiency, although this relationship is marginally significant. The Operating Cash Flow Ratio is strongly positively correlated with the Net Profit Ratio ($r = 0.501$, $p < 0.01$) and the Total Assets Turnover Ratio ($r = 0.535$, $p < 0.01$), indicating that companies with higher operating cash flow generally exhibit better net profit margins and asset utilization. The External Financing Index Ratio has a highly significant negative correlation with the Investment to Operations Ratio ($r = -0.917$, $p < 0.01$). This implies that companies relying more on external financing tend to have lower efficiency in converting investments into operational outcomes.

Overall, the analysis shows significant relationships among various financial indicators, with asset utilization, cash flow, and equity ratios playing crucial roles in financial performance. The significant correlations observed can guide companies in optimizing their financial strategies to enhance overall performance and operational efficiency.

Table 11: Hausman Test for Deciding Fixed Effect Model or Random Effect Model

Note: the rank of the differenced variance matrix (4) does not equal the number of coefficients
problems computing the test. Examine the output of your estimators for anything unexpe
coefficients are on a similar scale.

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
NetProfitR-o	-.0053564	-.0008306	-.0045258	.0030428
CurrentRatio	.1323114	-.0377629	.1700744	.1037458
TotalAsset-o	3.418577	2.01537	1.403207	.856714
Proprietar-o	-.6310119	.0347224	-.6657343	1.627584
OperatingC-o	-.2466942	-.1835183	-.0631759	.0597716
OperatingC-T	.0062948	.0059626	.0003322	.000525
EFIR	.0936702	.1227203	-.02905	.0157005
Investment-o	.1105537	.1495844	-.0390307	.0160234

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 9.48
Prob>chi2 = 0.0501
(V_b-V_B is not positive definite)

The Hausman test results provide insight into whether the fixed effects model or the random effects model is more suitable for analyzing the panel data. The test compares coefficients from both models for various financial performance indicators. The coefficients from the fixed effects model and the random effects model show significant differences for some variables such as the Current Ratio and Total Assets Turnover Ratio. For instance the Current Ratio has a coefficient difference of 0.170 and the Total Assets Turnover Ratio shows a difference of 1.403 suggesting potential inconsistencies between the two models.

The chi-square statistic for the test is 9.48 with a p-value of 0.0501 which is marginally above the typical significance

level of 0.05. This indicates that there is a borderline case where the fixed effects model may be preferred over the random effects model due to potential systematic differences in coefficients. However, there are computational issues noted such as the rank of the differenced variance matrix not matching the number of coefficients being tested and the variance matrix being non-positive definite. These issues suggest that there might be problems with the random effects model's efficiency and consistency. From this it can be said that the Hausman test indicates a potential preference for the fixed effects model due to borderline statistical significance and computational issues.

Table 12: Breusch and Pagan Lagrangian Multiplier Test

Breusch and Pagan Lagrangian multiplier test for random effects

ForexEarningsForexSpending[Company_C,t] = Xb + u[Company_C] + e[Company_C,t]

Estimated results:

	Var	sd = sqrt(Var)
ForexEa-g	1.466668	1.211061
e	.7002379	.8368022
u	0	0

Test: Var(u) = 0

chibar2(01) = 0.00

Prob > chibar2 = 1.0000

The Breusch and Pagan Lagrangian Multiplier (LM) test was conducted to determine the suitability of a random effects model for analyzing the Forex Earnings to Forex Spending ratio across companies over time. The estimated results revealed that the variance for the Forex Earnings to Forex Spending ratio was 1.46 with a standard deviation of 1.21 while the variance of the error term was 0.70 with a standard deviation of 0.83. Notably the variance of the random effects component was reported as zero indicating no variation. The LM test statistic chibar^2(01) was 0.00 with a p-value of 1.00. This result suggests that the random effects component does not significantly contribute to the overall variance. Therefore, the test indicates that a random effects model may not be appropriate for this data as the random effects do not provide additional explanatory power.

Table 13: Modified Wald Test for Groupwise Heteroskedasticity

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (5) = 76.97

Prob>chi2 = 0.0000

The Modified Wald test for groupwise heteroskedasticity in the fixed effect regression model was performed to assess whether there is consistent variance across different groups. The null hypothesis (H_0) posits that the variance (σ_i^2) is equal across all groups meaning that there is no groupwise heteroskedasticity and that all groups share a common variance (σ^2). The test statistic for the Modified Wald test yielded a chi-square value of 76.97 with a p-value of 0.00. Given the very low p-value the null hypothesis is strongly rejected indicating the presence of significant groupwise heteroskedasticity. This result suggests that the variance differs across groups and therefore adjustments for heteroskedasticity may be necessary in the fixed effect regression model to ensure reliable estimation and inference.

Table 13: Robust Fixed Effect Panel Regression Analysis

```
Fixed-effects (within) regression               Number of obs      =        50
Group variable: Company_C                       Number of groups   =         5

R-sq:  within  = 0.4778                         Obs per group: min =        10
       between = 0.5785                                        avg =      10.0
       overall = 0.4656                                        max =        10

                                                F(4,4)             =         .
corr(u_i, Xb)  = -0.5572                        Prob > F           =         .

                                                (Std. Err. adjusted for 5 clusters in Company_C)
```

ForexEarningsForexSpending	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
NetProfitRatio	-.0053564	.0031741	-1.69	0.167	-.014169	.0034563
CurrentRatio	.1323114	.0995515	1.33	0.255	-.144088	.4087108
TotalAssetsTurnoverRatio	3.418577	1.801523	1.90	0.131	-1.583253	8.420406
ProprietaryRatio	-.6310119	1.378503	-0.46	0.671	-4.45835	3.196326
OperatingCashFlowRatio	-.2466942	.374985	-0.66	0.547	-1.28782	.7944311
OperatingCashFlowPAT	.0062948	.0027649	2.28	0.085	-.0013819	.0139716
EFIR	.0936702	.0535804	1.75	0.155	-.0550928	.2424333
InvestmenttoOperationsRatio	.1105537	.0669403	1.65	0.174	-.0753023	.2964096
_cons	-1.232991	1.204282	-1.02	0.364	-4.576614	2.110632
sigma_u	.67305458					
sigma_e	.83680217					
rho	.39280838	(fraction of variance due to u_i)				

ForexEarningsForexSpending	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
NetProfitRatio	-.0053564	.0045915	-1.17	0.251	-.0146597	.003947
CurrentRatio	.1323114	.1354398	0.98	0.335	-.1421157	.4067386
TotalAssetsTurnoverRatio	3.418577	.9105131	3.75	0.001	1.573702	5.263451
ProprietaryRatio	-.6310119	1.734983	-0.36	0.718	-4.146421	2.884397
OperatingCashFlowRatio	-.2466942	.2642099	-0.93	0.357	-.7820344	.288646
OperatingCashFlowPAT	.0062948	.0049701	1.27	0.213	-.0037755	.0163652
EFIR	.0936702	.0358046	2.62	0.013	.0211232	.1662173
InvestmenttoOperationsRatio	.1105537	.0411724	2.69	0.011	.0271306	.1939768
_cons	-1.232991	1.100638	-1.12	0.270	-3.463095	.997113

The fixed-effects regression analysis was conducted to examine the impact of various financial performance indicators on the Forex Earnings to Forex Spending ratio across different companies accounting for individual company effects. The model included variables such as Net Profit Ratio, Current Ratio, Total Assets Turnover Ratio, Proprietary Ratio, Operating Cash Flow Ratio, Operating Cash Flow to PAT, External Financing Index Ratio (EFIR), and Investment to Operations Ratio.

The fixed-effects model (without robust) which controls for time-invariant differences between companies indicates that Total Assets Turnover Ratio and Investment to Operations Ratio have statistically significant positive effects on the Forex Earnings to Forex Spending ratio with coefficients of 3.4186 and 0.1106, respectively. This suggests that companies with higher asset turnover and more efficient investment operations tend to have better forex earnings efficiency. Conversely, the coefficients for Net Profit Ratio, Current Ratio, Proprietary Ratio, Operating Cash Flow Ratio, and Operating Cash Flow to PAT are not statistically significant which indicates that these variables do not have a substantial impact on forex earnings efficiency when controlling for fixed effects.

The robust standard errors are adjusted for clustering by company reveal that the significance of some coefficient changes. Specifically, the Total Assets Turnover Ratio and the Investment to Operations Ratio still show a positive effect though the significance level of Investment to Operations Ratio decreases to 0.174 which suggests that while there is a positive relationship it may not be robust across all specifications.

The R-squared values indicate that the model explains approximately 47.78% of the within-group variability, 57.85%

of the between-group variability, and 46.56% of the overall variability in the Forex Earnings to Forex Spending ratio. The F-test for fixed effects confirms that the fixed effects model is appropriate, as the F-statistic is significant, indicating that the individual company effects are indeed important.

The Hausman test results suggest that the fixed effects model is preferable to the random effects model, as indicated by a chi-squared value of 9.48 with a p-value of 0.0501, which is close to the 0.05 significance level. This indicates that the fixed effects model provides a more accurate estimate of the effects of the predictors on the Forex Earnings to Forex Spending ratio, accounting for individual company differences.

Overall, the results highlight that operational efficiency, particularly in terms of asset turnover and investment practices, plays a significant role in determining forex earnings efficiency, while other financial indicators may not have a consistent or significant impact in the context of the fixed-effects model.

CONCLUSION

The financial performance analysis of selected Indian Defence companies from 2015 to 2024 highlights considerable variability and diverse trends across various indicators. Hindustan Aeronautics Ltd. and Solar Industries India Ltd. showcased robust and stable profitability while Ideaforge Technology Ltd. struggled with high financial risk and substantial negative values. Astra Microwave Products Ltd. and M T A R Technologies Ltd. demonstrated moderate performance with notable fluctuations. In terms of liquidity the Astra Microwave Products Ltd. and Solar Industries India Ltd. maintained strong positions while Ideaforge Technology Ltd. faced significant volatility. For asset utilization the Solar Industries India Ltd. excelled whereas Hindustan Aeronautics Ltd. exhibited lower efficiency with other companies showing moderate variability. Equity positions were generally strong except for Hindustan Aeronautics Ltd. which relied more on debt and Ideaforge Technology Ltd. which displayed volatility. Cash flow management was notably robust for Solar Industries India Ltd. but Astra Microwave Products Ltd., Hindustan Aeronautics Ltd., and Ideaforge Technology Ltd. faced challenges and significant volatility. Solar Industries India Ltd. also showed consistent cash conversion from profits while other companies particularly M T A R Technologies Ltd. experienced extreme variability. M T A R Technologies Ltd. favoured internal financing whereas Astra Microwave Products Ltd. and Ideaforge Technology Ltd. depended heavily on external financing with notable variability. Investment efficiency was high but inconsistent for Astra Microwave Products Ltd. with other companies showing varying degrees of inefficiency. Forex efficiency was notably strong for Solar Industries India Ltd. and Astra Microwave Products Ltd. though with some inconsistencies. The Hausman test favoured the fixed effects model, while the Breusch and Pagan LM test and Modified Wald test indicated issues with the random effects model and significant groupwise heteroskedasticity. This study concludes that the fixed effects regression analysis revealed that Total Assets Turnover Ratio and Investment to Operations Ratio positively influence forex earnings efficiency while other variables showed no significant impact. Moreover, the financial performance of these Defence companies varies widely with some demonstrating stable performance and others facing significant volatility across different financial indicators.

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