International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

An Analysis on the Transformative Growth of Machine Tool Industry in India

Dr V. Sumathi[1], Mr M. Lakshmanan[2]

[1]Assistant Professor, Department of Economics, PSG College of Arts & Science, Coimbatore
[2]PhD Research Scholar, Department of Economics, PSG College of Arts & Science, Coimbatore

Abstract

This study examines the evolution and performance of India's metalworking machine tool industry, focusing on both Computer Numerical Control (CNC) and Conventional Lathe sectors from 2006–07 to 2022–23. Using secondary data from the Indian Machine Tool Manufacturers' Association (IMTMA) and the Reserve Bank of India (RBI), the research applies statistical tools like Annual Growth Rate (AGR) and Compound Annual Growth Rate (CAGR) to analyse trends in production and exports. The study situates the industry's development within the theoretical frameworks of Arthur Lewis and Maurice Dobb, highlighting structural transformation, capital accumulation, and labour dynamics in a developing economy. Findings reveal significant volatility in the early years, with CNC production and exports showing strong, sustained growth post-2014, while Conventional Lathe production declined. Technological advancements, particularly the adoption of CNC and Industry 4.0 innovations, along with government initiatives like 'Make in India,' have played a pivotal role in enhancing competitiveness. The study concludes that India's machine tool industry holds substantial potential as a global export powerhouse, provided challenges like cost disadvantages, skill gaps, and limited R&D investment are effectively addressed.

Keywords: Metalworking Machine Tools, production trends, export performance, Computer Numerical Control (CNC), Conventional Lathes and Cost Disadvantages.

Introduction

Developing countries need capital formation to foster economic growth so it is essential to evolve a suitable strategy for capital formation. These countries are characterised by scarcity of capital and surplus labour. Hence, the development strategies suggested are using surplus labour in an effective manner and giving importance to heavy industries.

Machine Tool Industry

The machine tool industry is not nearly an economic lever, it is a catalyst for industrial growth in an inclusive way (NITI Aayog, April 2025). Among the heavy industries sector machine tools, encompassing both metal cutting and forming technologies, serve as the backbone of precision manufacturing, catering to industries such as automotive, aerospace, electronics, and defence. This industrial sector witnessed

substantial advancements in production capabilities, technological integration, and export performance in the recent years. This helped India to become a formidable player in the global machine tool area.

Theoretical Issues

Arthur Lewis's model (1954) provides a foundational understanding of structural economic transformation in developing countries. It posits that economies consist of two sectors:

- Traditional Sector: Characterized by low productivity, surplus labour, and subsistence agriculture.
- Modern Sector: Comprising industrial and manufacturing activities with higher productivity and capital accumulation.

Lewis argued that surplus labour from the traditional sector could be absorbed into the modern sector without affecting agricultural output, thereby facilitating industrial growth. This labour transfer, coupled with reinvestment of profits from the modern sector, would lead to capital accumulation and economic development. However, the model assumes that wages in the modern sector remain constant and that capitalists reinvest profits to expand employment. The process continues until surplus labour is exhausted, at which point wage rates rise, signalling the end of the development phase.

Maurice Dobb (1946) challenged Lewis's assumptions, particularly the notion of unlimited labour supply and the automatic transfer of labour to the modern sector. Dobb emphasized the importance of capital accumulation and the role of profits in driving economic growth. He argued that the capitalist class's ability to reinvest profits is crucial for industrial expansion and that without sufficient capital formation, economic development would be hindered. Dobb's perspective highlights the dynamic nature of economic development, where the accumulation of capital and the distribution of income play pivotal roles.

Technology and Innovation

Technological advancements have been central to the growth of any industry. The adoption of Computer Numerical Control (CNC) machines and integration of Industry 4.0 technologies have enhanced precision, efficiency, and scalability in manufacturing processes of machine tool industry. These innovations have not only improved product quality but also enabled Indian manufacturers to meet international standards and cater to diverse global markets.

Machine Tool Industry in India

Government initiatives, notably the 'Make in India' program launched in 2014, have played a crucial role in fostering a favourable environment to the machine tool industry. By promoting infrastructure development, easing foreign direct investment norms, and encouraging domestic manufacturing, these policies have stimulated growth and attracted investments into the sector.

Application to the Indian Machine Tool Industry

The Indian machine tool industry serves as a pertinent case study to examine these theoretical frameworks. Between 2006 and 2023, the industry experienced significant growth, driven by factors such as technological advancements, government initiatives like 'Make in India,' and increased demand from sectors like automotive and aerospace. However, challenges such as labour skill gaps, capital constraints,

and competition from global players persisted. Analysing the evolution of machine tool industry through the lens of Lewis's and Dobb's theories provides insights into the complexities of capital accumulation, labour dynamics, and industrialization in a developing economy.

Review of Literature

Patel et al. (2024) focused on enhancing production capabilities in a small-scale manufacturing company that specializes in clamp block production. The research utilized work study techniques to optimize production workflows by identifying and addressing bottlenecks in production time, process count, and rate. The methodology included systematic observations, flow process analysis, and stopwatch time studies. Additionally, SolidWorks model software was employed for model testing and development. Key process improvements were achieved by eliminating redundant steps and consolidating processes, leading to reduced production time, better space utilization, and more streamlined operations. This study highlights the effectiveness of work study techniques in boosting productivity and efficiency within small-scale manufacturing industries.

Mourtzis (2020) explored the impact of digital technologies within the context of Industry 4.0, emphasizing the need for machine tools to evolve into intelligent systems to enable a fully connected network of machines, which forms the backbone of the Industrial Internet of Things (IIoT). The paper highlights the challenges engineers face in integrating these advanced technologies into production systems, despite their potential to enhance the functionality of manufacturing equipment. Based on a systematic literature review, the study discusses both horizontal and vertical integration of digital technologies and identifies opportunities and practical implications for their implementation in manufacturing environments.

Konnully et al. (2016) conducted a case study focusing on the productivity index of a machine tool company, emphasizing the critical role of productivity in driving economic growth, especially in developing countries like India. The study outlined various productivity measurement techniques and delves into the underlying causes of low productivity within organizations. It highlights how increased productivity contributes to prosperity and, in turn, fuels further productivity. Through organizational background, problem identification, and analysis, the study concludes with strategic recommendations to boost productivity within the company.

Nallusamy and Saravanan (2016) explored the application of lean tools to reduce lead time and enhance productivity in a small-scale automotive component manufacturing unit, all without incurring capital investment. The study utilized value stream mapping and line balancing to identify inefficiencies, drawing insights from historical production data. Techniques such as Single Minute Exchange of Dies (SMED) and Kaizen were implemented across workstations, along with balanced operator loading to ensure consistent output. As a result, setup and idle times were significantly reduced, leading to a drop-in lead time from 6.9 to 3.6 days and improvements in overall cycle time.

Brinken (2012) discussed the shift in global machine tool consumption towards emerging markets, with projections indicating that by 2014, 60% of machine tool consumption would be in Asia. The article presents statistical data and examines the growth dynamics driving this change. This shift not only demands a revised economic and marketing strategy but also calls for a reassessment of machine tool design performance. Key factors such as thermal, ergonomic, and electrical design considerations are

explored, emphasizing the need for product designs that are better suited to these new market requirements.

Scranton (2009) examines the historical evolution of the machine tool industry in the United States, particularly focusing on its Cold War-era transformation. The essay presents two main theses. First, it highlights how the machine tool sector, once characterized by specialized enterprises, shifted towards clusters of firms catering to automotive automation, aerospace precision, and specialized components, including instrumentation and controls. Second, it discusses how the advent of new industrial materials and processes, such as the substitution of plastics for metals, altered the technical and market foundations of the industry. These changes contributed to the decline of U.S. machine tool enterprises as the Cold War ended, though not primarily due to technological shifts linked to military contracts.

Statement of the Problem

One of the important sectors in the machinery industries is the machine tools industry. In India, machine tool production has been undertaken both in the private and public sectors. As a result of it, many large and medium machine tools industries in India are set up. The performance of this industry in terms of growth, production and exports required to be analysed in order to gauge the trends that are taking place in this sector.

Objectives

1. To analyse the trends in the production of metalworking machine tool by Computer Numerical Control (CNC) and Conventional Lathe in India.
2. To know the export performance of metalworking machine tool by Computer Numerical Control (CNC) and Conventional Lathe in India.

Sources of Data

Secondary data were collected from the Annual Reports of Indian Machine Tool Manufacturers' Association (IMTMA) and RBI Bulletin.

Period of Study

The study covered a period of 17 years i.e., from 2006-2007 to 2022-2023.

Statistical Tools Used

The collected data were analysed with the help of Annual Growth Rate (AGR) and Compound Annual Growth Rate (CAGR).

Scope of the Study

The present study will be useful to know the growth of production of the Machine Tools industry in India. Further, it will help to understand the export performance of both Computer Numerical Control (CNC) machines and Conventional Lathe.

Limitation of the Study

The study is based on secondary data for a period of 17 years and covered only the production and export of Metalworking Machine Tools, like Computer Numerical Control (CNC) and Conventional Lathe Machine.

Analysis of Data and Discussion of the Results

To examine the growth of production metal working machine tool sector the data were taken for CNC and Conventional Lathe separately. The data with respect to CNC combines the Farming and Cutting production as well as its value.

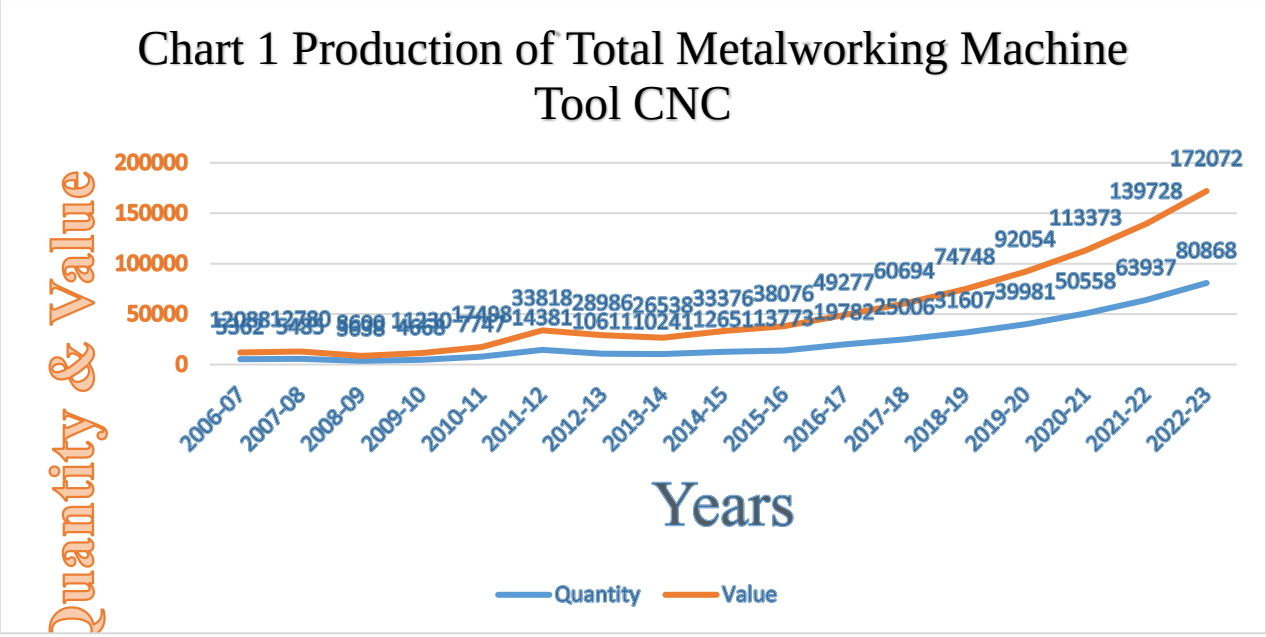
Table 1 Production of Metalworking Machine Tool by CNC (US $ million)

S.No	Year	Quantity	AGR	Value	AGR
1	2006-07	5362	-	12088	-
2	2007-08	5485	2.24	12780	5.41
3	2008-09	3638	-50.77	8600	-48.60
4	2009-10	4668	22.07	11230	23.42
5	2010-11	7747	39.74	17498	35.82
6	2011-12	14381	46.13	33818	48.26
7	2012-13	10611	-35.53	28986	-16.67
8	2013-14	10241	-3.61	26538	-9.22
9	2014-15	12651	19.05	33376	20.49
10	2015-16	13773	8.15	38076	12.34
11	2016-17	19782	30.38	49277	22.73
12	2017-18	25006	20.89	60694	18.81
13	2018-19	31607	20.88	74748	18.80
14	2019-20	39981	20.94	92054	18.80
15	2020-21	50558	20.92	113373	18.80
16	2021-22	63937	20.93	139728	18.86
17	2022-23	80868	20.94	172072	18.80
CAGR			**-11.28**		**-16.27**

Source: Annual Reports of Indian Machine Tool Manufacturers' Association (IMTMA)

The overall production trends of CNC metalworking machine tools from 2006–07 to 2022–23, including both quantity and value with their respective Annual Growth Rates (AGR) and Compound Annual Growth Rate (CAGR) revealed an initial phase of volatility, with a significant decline in 2008–09 due to external economic factors. A strong recovery occurred in the following years, especially in 2010–11 and 2011–12, when both quantity and value saw growth above 35%. After a brief slowdown in 2012–13 and 2013–14, the industry experienced consistent and robust growth from 2014–15 onwards. Notably, from 2016–17 through 2022–23, the AGR for quantity hovered around 21% and value around 18.8%, marking a phase

of sustained expansion. Despite these steady gains in the latter half of the period, the overall CAGR for quantity (-11.28) and value (-16.27) remains negative, indicating that early-year declines had a lasting impact on the long-term growth trajectory.



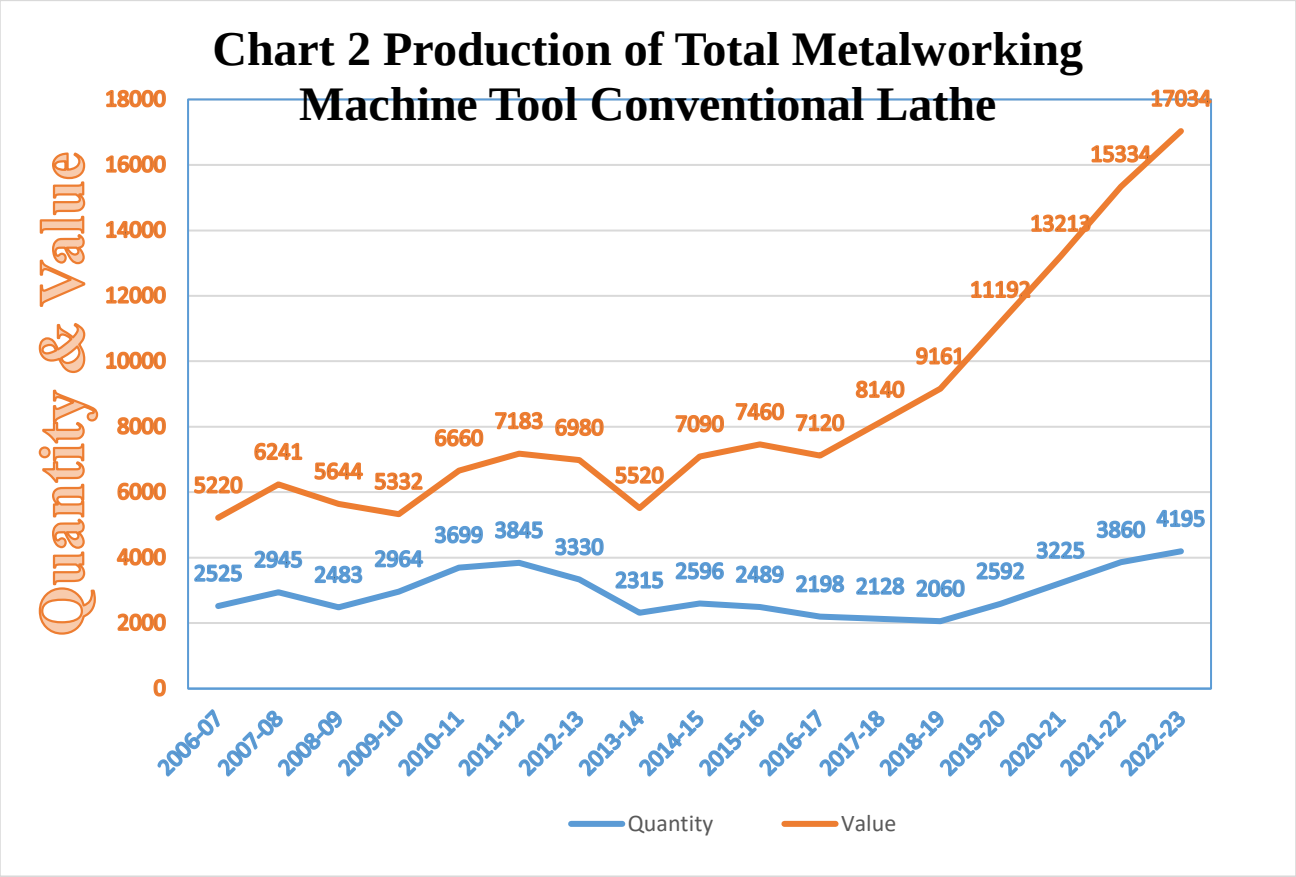
Similarly, the metalworking machine tool production by Conventional Lathe and its growth were analyzed for the period of 17 years. The early years showed a moderate growth, but from 2008–09 onwards, fluctuations became more prominent. Sharp declines were observed in 2012–13 and especially in 2013–14, when both quantity and value dropped significantly. While there were periods of recovery most notably from 2019–20 to 2022–23, with sustained positive AGR the overall performance remained inconsistent. In the report of IMTMA it was observed that despite recent improvements, the long-term outlook remains weak, as reflected in the highly negative CAGR for quantity (-90.23) and value (-80.80), underscoring a significant decline over the entire period.

Table 2 Production of Metalworking Machine Tool by Conventional Lathe (US $ million)

S.No	Year	Quantity	AGR	Value	AGR
1	2006-07	2525	-	5220	-
2	2007-08	2945	14.26	6241	16.36
3	2008-09	2483	-18.61	5644	-10.58
4	2009-10	2964	16.23	5332	-5.85
5	2010-11	3699	19.87	6660	19.94
6	2011-12	3845	3.80	7183	7.28
7	2012-13	3330	-15.47	6980	-2.91

8	2013-14	2315	-43.84	5520	-26.45
9	2014-15	2596	10.82	7090	22.14
10	2015-16	2489	-4.30	7460	4.96
11	2016-17	2198	-13.24	7120	-4.78
12	2017-18	2128	-3.29	8140	12.53
13	2018-19	2060	-3.30	9161	11.15
14	2019-20	2592	20.52	11192	18.15
15	2020-21	3225	19.63	13213	15.30
16	2021-22	3860	16.45	15334	13.83
17	2022-23	4195	7.99	17034	9.98
CAGR			**-90.23**		**-80.80**

Source: Annual Reports of Indian Machine Tool Manufacturers' Association (IMTMA)



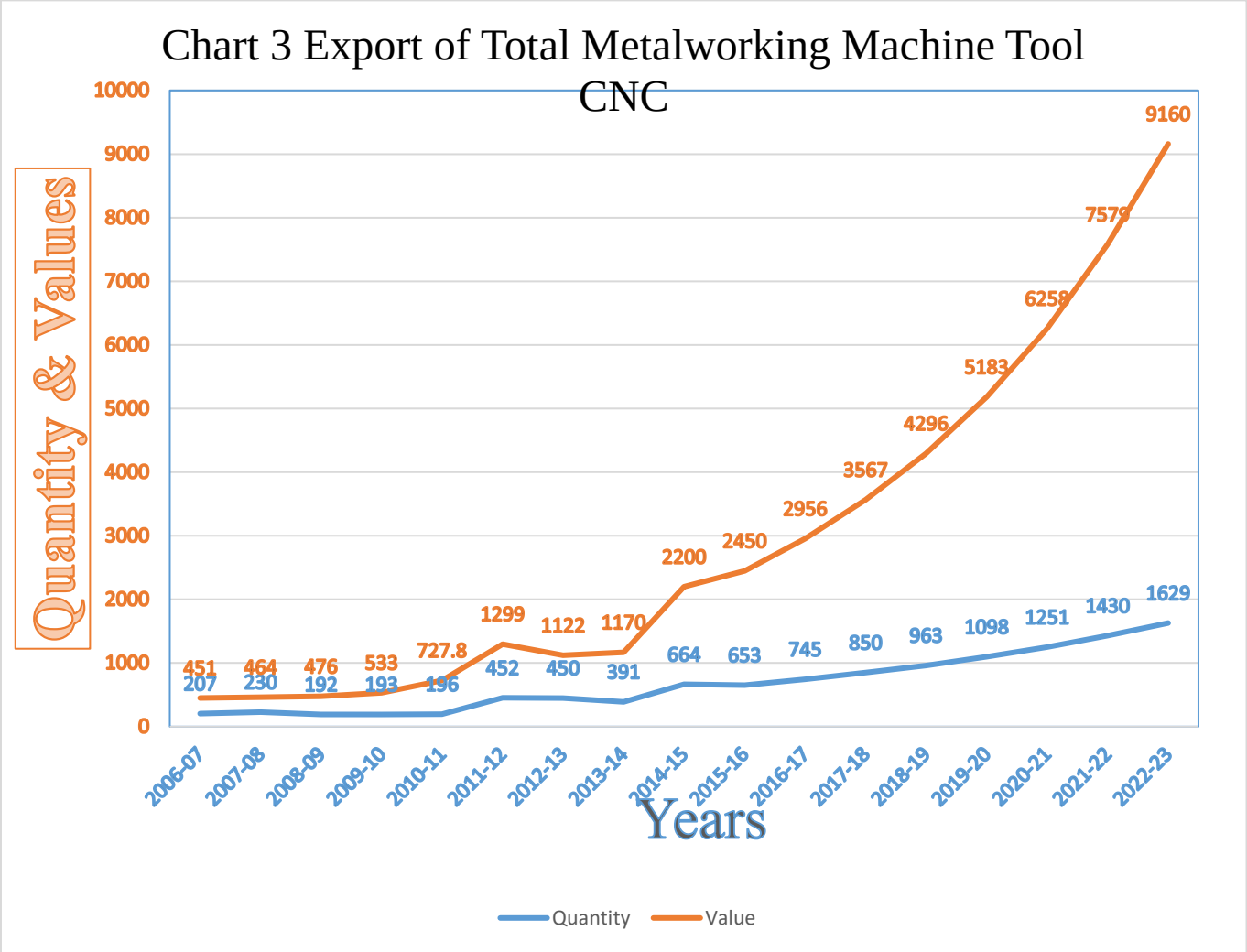
Export Performance of Metalworking Machine Tool

Classified data were obtained to analyses the export performance of both CNC and Conventional Lathe sectors. The early years reflect moderate growth in both dimensions, with a notable uptick in 2011–12 when quantity and value nearly tripled. However, occasional dips followed—such as in 2012–13 and 2013–14 indicating market corrections or external trade factors. From 2014–15 onwards, the data shows a consistent upward trend in both quantity and value, suggesting steady demand and improving global competitiveness. Particularly between 2016–17 and 2022–23, the exports exhibited robust and stable growth, averaging around 12%–17% AGR annually. Despite the negative CAGR in quantity (-53.71), which might indicate earlier high volatility or data anomalies, the positive CAGR of 19.47% in value highlights a significant improvement in unit value or high-value product exports over time, pointing to qualitative growth in the CNC export segment.

Table 3 Export of Metalworking Machine Tool by CNC (US $ million)

S.No	Year	Quantity	AGR	Value	AGR
1	2006-07	207	-	451	-
2	2007-08	230	10.00	464	2.80
3	2008-09	192	-19.79	476	2.52
4	2009-10	193	0.52	533	10.69
5	2010-11	196	1.53	727.8	26.77
6	2011-12	452	56.64	1299	43.97
7	2012-13	450	-0.44	1122	-15.78
8	2013-14	391	-15.09	1170	4.10
9	2014-15	664	41.11	2200	46.82
10	2015-16	653	-1.68	2450	10.20
11	2016-17	745	12.35	2956	17.12
12	2017-18	850	12.35	3567	17.13
13	2018-19	963	11.73	4296	16.97
14	2019-20	1098	12.30	5183	17.11
15	2020-21	1251	12.23	6258	17.18
16	2021-22	1430	12.52	7579	17.43
17	2022-23	1629	12.22	9160	17.26
CAGR			**-53.71**		**19.47**

Source: Annual Reports of Indian Machine Tool Manufacturers' Association (IMTMA)



The export performance of Conventional Lathe metalworking manufacturing sector revealed a mixed performance during the period under the study.

The early years saw a strong surge, particularly in export value, which more than tripled. However, this momentum was short-lived, as 2008–09 and 2009–10 recorded substantial declines in both quantity and value. After a strong rebound in 2010–11, the following years continued to show fluctuating growth patterns, with some years experiencing sharp downturns, notably in 2012–13. From 2016–17 onwards, the export figures began to stabilize, reflecting more consistent growth in both quantity and value. Notable improvements occurred between 2017–18 and 2022–23, where both dimensions grew steadily. Despite these recent positive trends, the overall CAGR remains significantly negative for quantity (-91.82) and value (-65.92), suggesting a long-term downward trend, possibly due to declining global demand for conventional technology in favour of CNC alternatives.

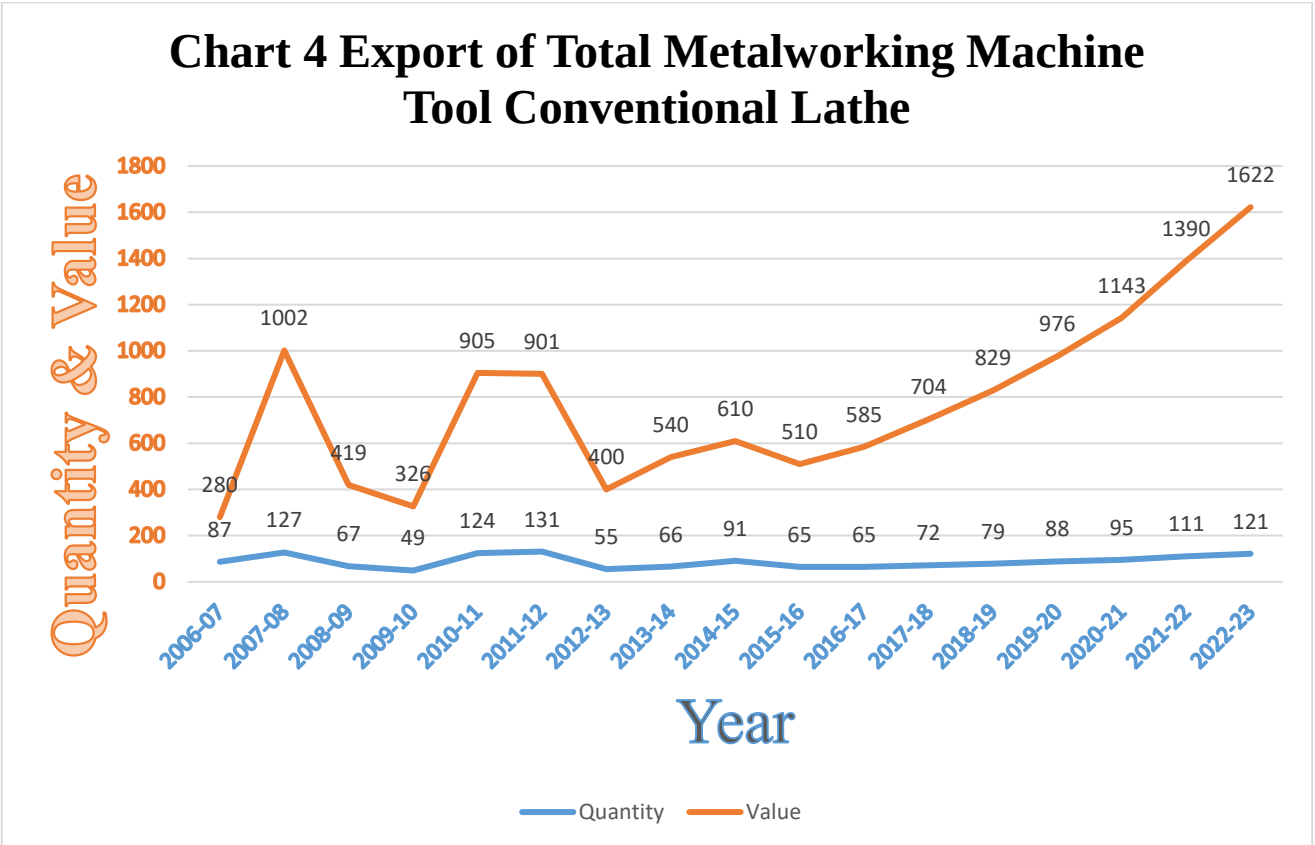
Table 4 Export of Metalworking Machine Tool by Conventional Lathe (US $ million)

S.No	Year	Quantity	AGR	Value	AGR
1	2006-07	87	-	280	-

2	2007-08	127	31.50	1002	72.06
3	2008-09	67	-89.55	419	-139.14
4	2009-10	49	-36.73	326	-28.53
5	2010-11	124	60.48	905	63.98
6	2011-12	131	5.34	901	-0.44
7	2012-13	55	-138.18	400	-125.25
8	2013-14	66	16.67	540	25.93
9	2014-15	91	27.47	610	11.48
10	2015-16	65	-40.00	510	-19.61
11	2016-17	65	0.00	585	12.82
12	2017-18	72	9.72	704	16.90
13	2018-19	79	8.86	829	15.08
14	2019-20	88	10.23	976	15.06
15	2020-21	95	7.37	1143	14.61
16	2021-22	111	14.41	1390	17.77
17	2022-23	121	8.26	1622	14.30
CAGR			**-91.82**		**-65.92**

Source: Annual Reports of Indian Machine Tool Manufacturers' Association (IMTMA)

Chart 4 Export of Total Metalworking Machine Tool Conventional Lathe



Technological Transformation

When the production trends observed in this sector it became clear that it has to overcome the challenges like cost competitiveness (14 – 17% cost disadvantages), technical know-how (low R&D investment constraining innovation and quality improvements and lack of organisational support (like world class metalworking tool clusters). Given the global dynamics in terms of export opportunities India has to focus on

- Creation of advanced metalworking tool clusters
- Addressing structural cost disadvantages by way of effective reforms
- An inclusive development of SMEs.

Conclusion

The fact has been well established that only by addressing cost disadvantages, scaling operations through world – class clusters and implementing market reforms, India can transform its metalworking machine tool industry into an export power house. At the same time, this transformation will not come easily as it requires bold policy actions and commitment to overcome structural barriers.

References

1. Lewis, W. A. (1954). Economic development with unlimited supplies of labour. *The Manchester School*, 22(2), 139–191. https://doi.org/10.1111/j.1467-9957.1954.tb00021.x
2. Keirstead, B. S. (1947). Marxist economic thought. *Canadian Journal of Economics and Political Science/Revue Canadienne de economies et science politique*, 13(2), 222–224. https://doi.org/10.2307/137465
3. Patel, H., Vaghela, S., & Singh, M. D. (2024). Enhancing productivity in small-scale manufacturing industry through work study approach: A case study. *International Journal of Research in Engineering and Science*, 12(1), 150–157. https://www.ijres.org/papers/Volume-12/Issue-1/150-157.pdf
4. Mourtzis, D. (2020). Machine tool 4.0 in the era of digital manufacturing. *Proceedings of the 2020 International Conference on Industrial Engineering and Operations Management*, 1–6. https://www.cal-tek.eu/proceedings/i3m/2020/emss/060/
5. Nallusamy, S., & Saravanan, V. (2016). Lean tools execution in a small-scale manufacturing industry for productivity improvement: A case study. *Indian Journal of Science and Technology*, 9(35), 1–7. https://doi.org/10.17485/ijst/2016/v9i35/100162
6. Brinken, M. (2012). The shift in global machine tool consumption towards emerging markets. *Machine Tool Technology*, 12, 34–39.
7. Scranton, P. (2009). The machine tool industry and the Cold War: A historical perspective. *Technology and Culture*, 50(2), 345–367. https://doi.org/10.1353/tech.0.0162
8. Unlocking $25+ billion export potential – India's hand & power tools sector. *NITI Aayog* 2025, April 15.