Journal of Finance and Business Digital (JFBD)
Vol. 4, No. 4 2025: 1095-1108

Internet and Manufacturing Value Added

Omas Bulan Samosir[1]*, Wilson Rajagukguk[2], Perak Samosir[3], Josia Rajagukguk[4], Hasiana Emanuel Rajagukguk[5]
[1,4,5]Universitas Indonesia
[2]Universitas Kristen Indonesia
[3]Institut Teknologi Indonesia
Corresponding Author: Omas Bulan Samosir omas.bulan@ui.ac.id

A R T I C L E I N F O

Keywords: Manufacturing Value Added, Internet, ICT Import, World Bank, World

Received : 25, Oktober
Revised : 27, November
Accepted: 29, Desember

A B S T R A C T

Manufacturing value added (MVA) is a crucial indicator of a country's economic health and growth potential, and as a sector generating significant global and domestic value, supportive policies are vital for overall economic development. This study analyzed the impact of the internet and several policy-relevant variables on MVA (as a percentage of GDP) using global World Bank data from 2025 via Multinomial Linear Regression. The analysis found that three independent variables Individuals using the Internet (% of population), Employers, female (% of female employment), and ICT goods imports (% of total goods imports) were all significantly and positively associated with MVA. Specifically, each unit increase in Internet use corresponded to a 0.001% increase in MVA, while a 1% increase in female employers resulted in a 0.289% increase, and a 1% rise in ICT goods imports led to a 0.338% increase in GDP manufacturing value added.

DOI prefik: https://doi.org/10.55927/jfbd.v4i4.530
ISSN-E: 2964-8688
https://srhformosapublisher.org/index.php/jfbd

INTRODUCTION

The relationship between the internet and manufacturing value-added is increasingly significant, as evidenced by various studies (Nguyen, 2023; Zhi, 2021; Dai, 2021). Research on how the internet increases value added has not been widely conducted in Indonesia. Thus, this research has the novelty of strengthening the internalization of the internet in increasing value added in the manufacturing sector. The internet enhances the industrialization process through, among other things, improved communication, coordination, and market access. This collectively contributes to increased efficiency and productivity in manufacturing. This transformation is evident in regions such as Southeast Asia and China. In these regions, internet penetration and initiatives have positively impacted manufacturing and value-added growth.

The internet facilitates smooth coordination in industrial processes, driving increased productivity (Nguyen, 2023). Businesses can reach global markets. The internet encourages international trade. The internet has a positive impact on supply chain value and industrial value-added (Nguyen, 2023). The internet has a positive impact on the evolution of manufacturing value. The internet enables new forms of value creation for goods and services beyond traditional models (Zhi, 2021).

Nguyen (2023) conducted a study covering eight Southeast Asian countries from 1991 to 2021 and found a positive correlation between internet growth and industrial value-added. This study also examined the role of the internet in economic restructuring (Nguyen, 2023). Dai (2021) conducted research on the Chinese manufacturing industry and found that the implementation of "Internet plus" significantly correlated with manufacturing growth. This demonstrates the transformative impact of the internet on this sector (Dai, 2021).

Figure 1 presents Individuals using the Internet (% of population) in low-income, lower-middle-income, upper-middle-income, high-income, and global countries in the period 2005 - 2024. It can be seen that internet penetration across all income groups is increasing. The highest internet penetration is in the high-income country group (53% in 2005 and becomes 93.4% in 20240 and the lowest is in the low-income country group (0.8% in 2005 and only becomes 26.5% in 2024).

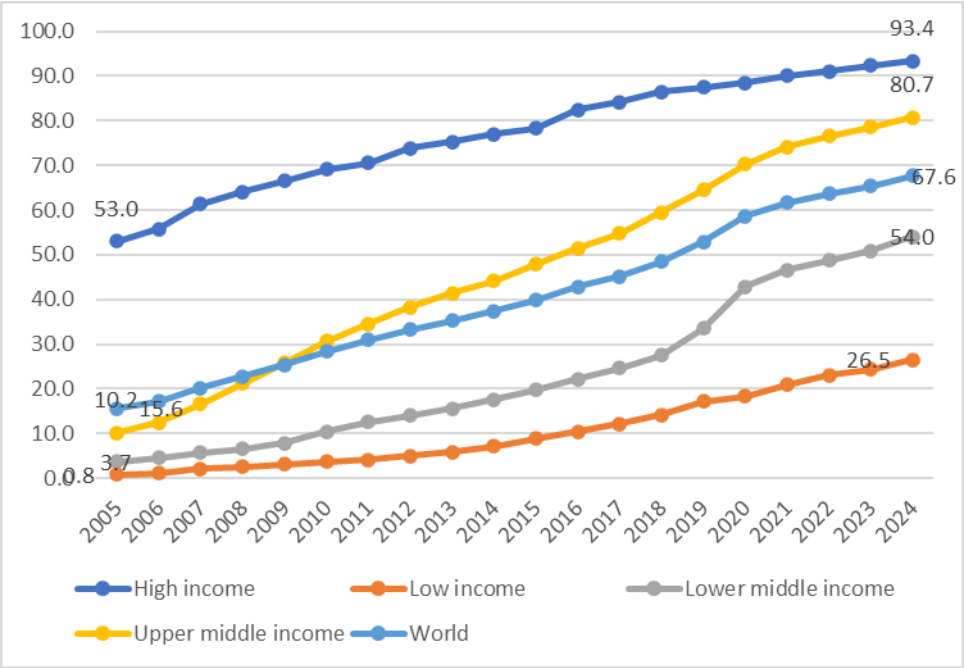

Figure 1. Individuals using the Internet (% of population), Country Groups by Income, 2005 – 2024 (World Bank, 2025)

Figure 2 shows internet penetration among individuals using the internet (% of population) in several ASEAN countries. In general, there has been an increase in internet penetration in ASEAN. However, there is still a gap between Singapore and Brunei Darussalam compared to Vietnam, Indonesia, and Timor Leste. In 2005, internet penetration among individuals using the internet was 61.0% in Singapore and became 94.3% in 2024. Meanwhile, there was a higher increase in Brunei Darussalam (36.5% in 2005 to 99% in 2024). In 2024, Brunei Darussalam had a percentage of the population with individuals who had internet access. East Timor has an increase in internet penetration from 0.1% in 2005 to 34% in 2024. Meanwhile, Indonesia and Vietnam respectively had this figure of 3.6% and 12.7% in 2005 and will increase to 78.1% and 59.2% respectively in 2024.

Figure 3 shows Manufacturing value added (% of GDP) for the period 2004-2024. Generally, this economic variable shows a slow decline. Globally, it tends to remain constant. The most significant decline occurs in high-income countries. Upper-middle-income countries have significantly higher Manufacturing value added (% of GDP) compared to the rest of the world and other income groups.

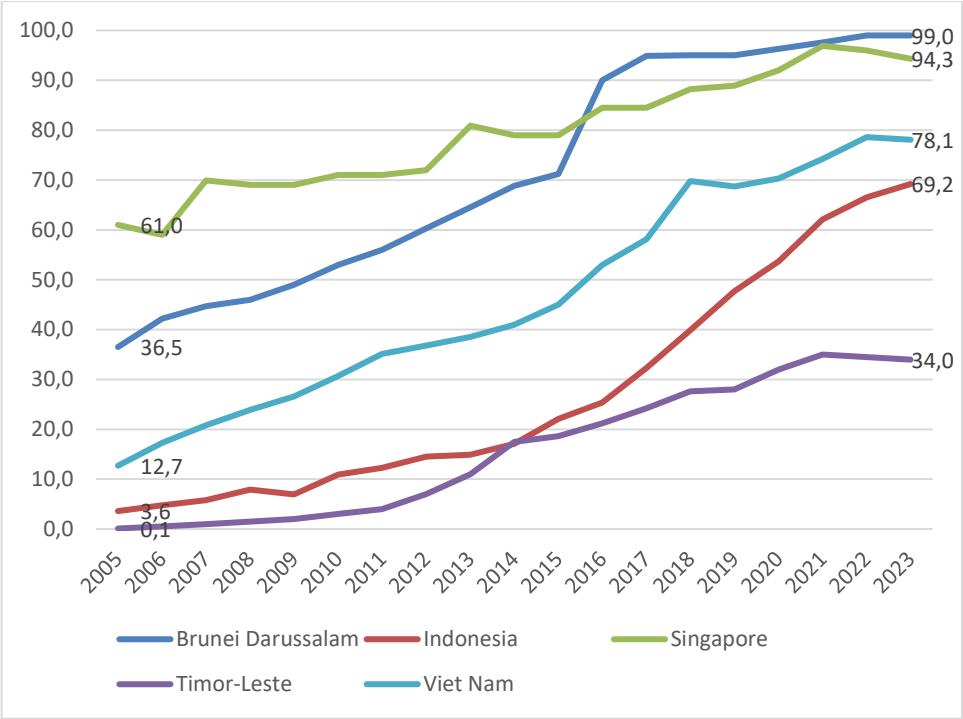

Figure 2. Individuals Using the Internet (% of Population), Asean Selected Country, 2005 – 2024 (World Bank, 2025)

The relationship between value added in the manufacturing sector and national economic growth demonstrates both direct and indirect links. The manufacturing sector is considered a "growth engine" as a key driver of economic growth, due to its potential to stimulate productivity, employment, and technological advancement. Therefore, this research is necessary and important to examine the determinants of value added in the manufacturing sector.

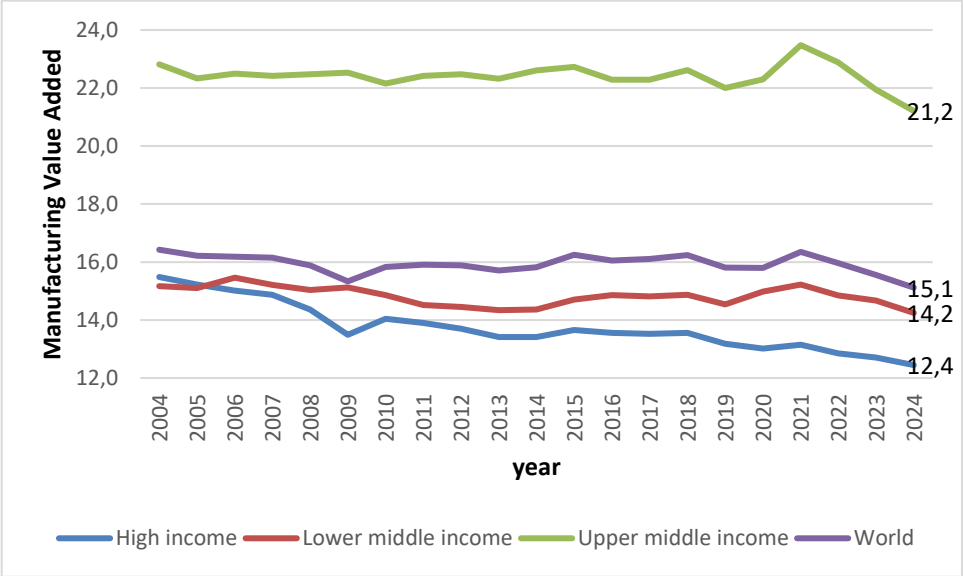

Figure 3. Manufacturing, Value Added (% of GDP), Country Groups by Income, 2004 – 2024 (World Bank, 2025)

Figure 4 presents the Manufacturing value added (% of GDP) of selected ASEAN countries compared to the world for the period 2004-2024. Despite fluctuations, Singapore, Indonesia, Brunei Darussalam, and Vietnam tended to experience an increase in this variable. Meanwhile, Vietnam, like the world, tended to experience a decline.

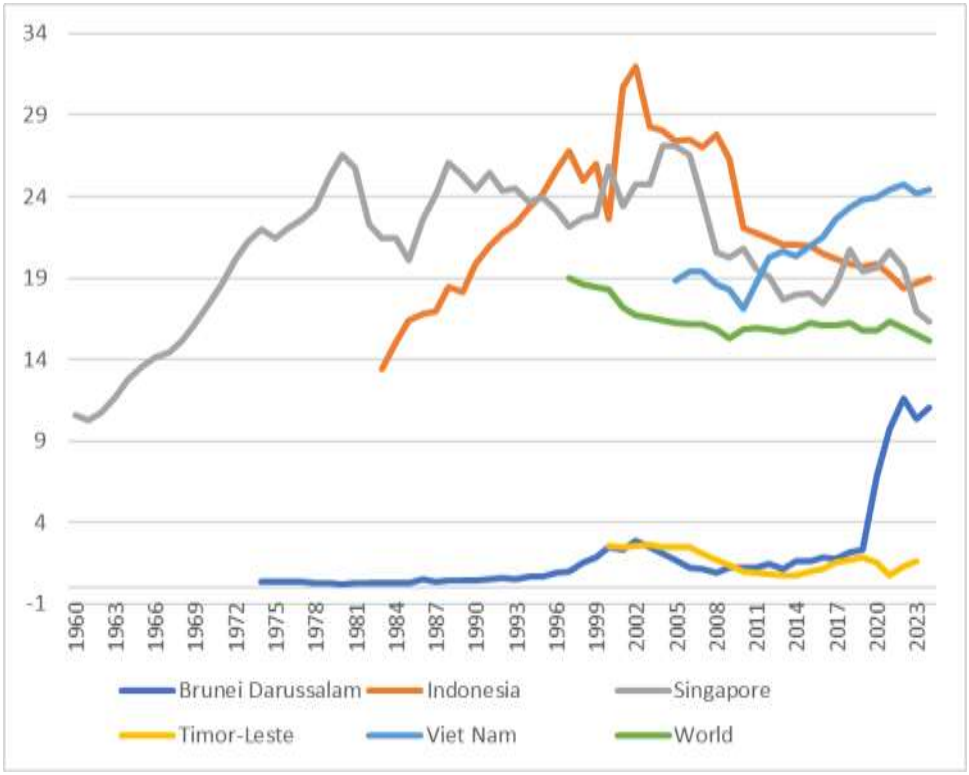

Figure 4. Manufacturing, Value Added (% of GDP) of Selected ASEAN Countries, 2004 – 2024 (World Bank, 2025)

Manufacturing can have both direct and indirect impacts on economic growth. The manufacturing sector has a significant positive impact on GDP growth in Nigeria (Wang, 2022). The manufacturing sector is the primary driver of the economy, followed by labour and capital inputs. Ferraz (2024) conducted research in Portugal. The results showed that since the 1950s, manufacturing production has been positively correlated with economic growth, particularly in the basic metallurgy industry. A study by Chatterjee & Chatterjee (2021) covering 25 major economies found that manufacturing output has a significant impact on GDP growth, although the strength of this relationship can vary across countries. In developing countries, the manufacturing sector has demonstrated a positive impact on economic growth, particularly from 1970 to 1990 (Szirmai et al., 2011).

LITERATURE REVIEW

The internet has indeed presented numerous opportunities for increasing manufacturing value. Despite its complexity, development and research are needed to address a number of remaining challenges, including the need for businesses to adapt to rapidly changing technology and market dynamics. Internet penetration has improved welfare and economic growth (Rajagukguk, 2022) through increased value-added manufacturing.

The internet has contributed significantly to increasing the added value of the manufacturing sector by improving connectivity, efficiency, and global market access. The internet has been shown to successfully facilitate the integration of digital technology into manufacturing processes. This integration results in increased productivity and competitiveness. The internet's role in manufacturing transformation impacts various aspects such as supply chain management, trade, and technological innovation. (Nguyen, 2023; Blecker, 2006; Bojnec & Fertö, 2015; Bojnec & Fertö, n.d.; Zhong & Ge, 2018; Fauadi et al., 2020; Li, 2005; Wen & Deng, 2023)

The internet enables real-time communication and collaboration, leading to improved coordination in industrial processes. This connectivity has been shown to increase efficiency and productivity throughout the production chain. A study conducted by Nguyen (2023) in Southeast Asian countries demonstrated and demonstrated that internet growth has a positive impact on industrial added value.

Internet technology has been integrated with factory automation (Blecker, 2006). This technology has successfully increased productivity through intra-organizational applications. Such policies include the use of internet technology in assembly line automation and quality control. Internet technology improves manufacturing efficiency (Blecker, 2006).

The number of internet users in the population and industries significantly influences manufacturing export growth (Bojnec & Fertö, 2015). Internet users, through increasing information availability, reducing trade costs, and increasing competition, are associated with export growth, particularly in OECD countries. The internet mitigates the impact of distance on manufacturing exports (Bojnec & Fertö, n.d.).

The relationship between female workers and added value in the manufacturing sector can involve aspects of gender roles in management, economic empowerment, and productivity. Female workers can increase the added value of the manufacturing sector. Female leadership in the manufacturing sector can positively influence employment dynamics, company value, and productivity. (Gisela et al., 2024; Castiglione et al., 2020; Bui & Long, 2021; Gozen et al., 2024; Jena, 2012; Bertay et al., 2020)

Female leadership can be associated with and positively influence firm value (Gisela et al., 2024). Female audit committees have been shown to significantly increase the value of manufacturing companies. Gisela et al. (2024) found that this is due to women's unique perspectives and decision-making approaches. This uniqueness can improve corporate governance and financial performance.

Castiglione et al. (2020) conducted research in Italy and found that in manufacturing companies, the presence of female managers increases productivity. This study suggests that female leadership can positively impact company performance. Female leadership has the potential to generate higher added value in the manufacturing sector.

Women-led manufacturing SMEs in the formal sector tend to have higher value-added and labour productivity compared to male-led SMEs, according to a study conducted by Bui & Long (2021) in Vietnam. A study by Gozen et al. (2024) using historical data in the United States showed that women-owned manufacturing firms, although smaller and less capital-intensive, tend to employ more women and pay higher wages. This study's results suggest a potential cyclical increase in women's business ownership and labour market participation. This potential cyclical increase in women's business ownership can contribute to economic value-added and improve welfare.

Despite their positive impacts, it is important to note that women-led enterprises often face constraints such as limited access to financial resources and lower productivity levels in certain contexts (Jena, 2012). It is a matter of concern and policy considerations from stakeholders that the unorganized manufacturing sector and women-owned enterprises tend to operate at lower productivity levels compared to men-owned enterprises. Gender inequality remains a significant barrier to maximizing the potential of women's workforce in the manufacturing sector (Bertay et al., 2020). Reducing gender inequality can facilitate a better allocation of women's labour. Reducing gender inequality can lead to faster growth in industries with higher market share and female employment.

Policy is needed because gender inequality remains a significant barrier to maximizing the potential of the female workforce in the manufacturing sector. Policy interventions that promote gender equality are needed to further enhance the contribution of female entrepreneurs to manufacturing value-added. Furthermore, it is important to note that women's leadership can vary across cultural and economic contexts. Therefore, policymakers need to develop specific strategies to support women's empowerment in the manufacturing sector.

ICT import policies can significantly impact domestic value-added in manufacturing by providing essential components and technologies that can boost productivity and innovation. This link is particularly evident in countries like China (Yuan et al., 2024). Imports of Chinese digital products have been shown to increase the value-added level of domestic goods exports through a number of mechanisms, such as cost markups and relative price adjustments (Yuan et al., 2024). The role of ICT imports in economic growth varies across countries with income levels (Yoon, 2019). Low-income countries benefit more significantly from ICT imports on growth

Lin et al., (2016) found that in the context of Taiwan and Korea, decomposing gross exports into value-added components successfully demonstrated that ICT exports declined significantly when measured by value added. This substantially indicates a dependence on imports. Imports of ICT goods are positively associated with economic growth, particularly in low-income countries (LICs) in the Asia-Pacific region (Yoon, 2019). This finding supports the "leapfrogging" hypothesis, which posits that low-income countries will benefit more from ICT import policies than high-income countries (HICs) (Yoon, 2019).

China's successful experience in the ICT industry demonstrates the success of industrial upgrading through imports (Amighini, 2005). China's positive experience in the ICT industry demonstrates the success of industrial development through imports. China transitioned from simply assembling imported inputs to becoming a high-tech manufacturing country for intermediate goods. This economic shift has increased the domestic value-added of exports and subsequently reduced China's dependence on imports.

METHODOLOGY

The data used in this study were obtained from the World Bank (2025), (accessed July 2025), World Development Indicators. This data contains the dependent variable Manufacturing, value added (% of GDP) and the independent variables industrial using the internet (% of population), employers, % of female employment), and ICT goods import (% of total good import). Table 1 presents the Variable, N, Minimum, Maximum, Mean, and Std. Deviation used in this study.

Table 1. Variable, N, Minimum, Maximum, Mean, dan Std. Deviation

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Access to electricity (% of population)	1120	4.80	100.00	87.16	25.46
Individuals using the Internet (% of population)	1116	.20	98.20	41.99	28.34
Employers, female (% of female employment)	1120	.00	17.00	1.8428	1.45
ICT goods imports (% total goods imports)	1046	.70	50.30	7.3989	5.47

In this study, the analysis used is the Multinomial Linear Regression method with the following equation form:

$$\boldsymbol{Y = \alpha_0 + \alpha_1 . X_1 + \alpha_2 . X_2 + \alpha_3 . X_3} \qquad \ldots\ldots\ldots\ldots\ldots\ldots \quad \textbf{(1)}$$

Where
Y = Manufacturing, Value Added (% of GDP).
X_1 = Individuals using the Internet (% of population).
X_2 = Employers, female (% of female employment).
X_3 = ICT goods imports (% total goods imports).

RESEARCH RESULT

The results of the analysis are shown in Table 2. The three independent variables are significantly positively associated with the dependent variable (Y).

Table 2. Research Result

Variable	Coefficient	Std. Error	t	Sig.
(Constant)	10.187	.414	24.612	.000
Individuals using the Internet (% of population)	.001	.116	2.218	.027
Employers, female (% of female employment)	.289	.118	2.444	.015
ICT goods imports (% total goods imports)	.338	.031	10.743	.000

Dependent Variable: Manufacturing, Value Added (% of GDP)

1. Each increase of one unit of Individuals using the Internet (% of population) is associated with an increase in the dependent variable Manufacturing, Value Added (% of GDP) of 0.01.
2. A one-unit increase in the independent variable Employers, female (% of female employment) has an impact or is associated with a 0.289-unit increase in the dependent variable Manufacturing, Value Added (% of GDP).
3. Each increase of one unit in the independent variable ICT goods imports (% of total goods imports) is associated with an increase of 0.338 units in the dependent variable Manufacturing, Value Added (% of GDP).

DISCUSSION

The findings of this study confirm the significant role of digital and gender-related factors in enhancing manufacturing value added across countries. The positive relationship between Individuals using the Internet (% of population) and Manufacturing Value Added indicates that increased internet penetration improves communication, coordination, and access to digital technologies, which in turn strengthens production efficiency and industrial competitiveness. This result aligns with previous research (Nguyen, 2023; Zhi, 2021) that highlights the internet's capacity to transform manufacturing processes through greater automation, improved supply chain management, and broader market accessibility.

Similarly, the positive effect of female employers (% of female employment) on Manufacturing Value Added reinforces the importance of gender inclusion in economic development. Evidence from prior studies suggests that female leadership contributes to enhanced governance, innovation, and productivity in manufacturing enterprises (Gisela et al., 2024; Castiglione et al., 2020). The results of this study support the argument that empowering women in managerial and entrepreneurial roles may generate higher financial performance and value added for the manufacturing sector.

Furthermore, ICT goods imports (% of total goods imports) show the strongest positive association with manufacturing value added. This finding suggests that imported ICT components play a critical enabling role in industrial upgrading, technology absorption, and production restructuring. This is consistent with evidence from China, Taiwan, South Korea, and other developing countries, which demonstrates that ICT imports can accelerate industrial modernization and increase domestic value added (Amighini, 2005; Yuan et al., 2024; Yoon, 2019). The results imply that adopting and integrating imported technologies may help countries—especially those in low- and lower-middle-income groups—leapfrog in their industrial development.

Overall, the study highlights that internet penetration, gender-inclusive leadership, and ICT technology adoption jointly contribute to strengthening the manufacturing sector. Effective policies targeting digital infrastructure, gender empowerment, and strategic ICT import management may therefore help countries increase industrial productivity and competitiveness.

CONCLUSIONS AND RECOMMENDATIONS

This study concludes that internet use, the share of female employers, and ICT goods imports each play a significant and positive role in increasing manufacturing value added. Higher levels of internet penetration contribute to improved communication, coordination, and access to digital tools that enhance industrial efficiency and competitiveness. Similarly, the presence of women in employer or leadership positions supports better organizational governance, decision-making quality, and productivity, which ultimately strengthens value creation in the manufacturing sector. ICT goods imports also emerge as a crucial driver, as imported technological components provide the foundation for industrial upgrading, enabling countries to adopt more advanced production processes and integrate into global value chains.

These findings suggest several key policy directions. Strengthening digital infrastructure and ensuring broad, affordable access to the internet should be prioritized to support ongoing industrial digitalization. Empowering women in the manufacturing sector through training, financial support, and leadership opportunities can further enhance productivity and firm performance. At the same time, governments should develop strategic ICT import policies that facilitate access to high-quality technological inputs while encouraging domestic technological capability. In addition, investment in human capital—particularly digital, managerial, and technical skills—remains essential to ensure that industries can fully utilize imported technologies and the opportunities created

by widespread internet access. Collectively, these initiatives can contribute to building a more competitive, digitally ready, and inclusive manufacturing ecosystem.

ADVANCED RESEARCH

Despite providing valuable insights, this study has several limitations that open opportunities for more advanced research. The analysis relies on secondary cross-country data, which may not fully capture institutional, cultural, or regulatory variations that influence manufacturing performance in different contexts. Additionally, the use of Multinomial Linear Regression limits the ability to explore potential nonlinear relationships, interaction effects, or sector-specific dynamics that may exist between the variables. The dataset also does not include other important determinants such as innovation capacity, infrastructure quality, or trade and industrial policies, which likely play a substantial role in shaping manufacturing value added.

Future studies could expand on these findings by incorporating additional variables that provide a more comprehensive view of the factors influencing manufacturing development. Employing more sophisticated econometric techniques, such as panel data models or structural equation modeling, would allow researchers to explore deeper causal pathways and interactions. Country-specific or regional analyses may also yield richer insights into how digitalization, gender participation, and technological imports operate within particular economic or institutional environments. Furthermore, examining manufacturing subsectors—such as high-tech versus low-tech industries—could reveal differentiated impacts that are not visible in aggregate data. Such extensions would advance the understanding of how digital transformation and gender inclusion can more effectively drive manufacturing value creation in diverse economic settings.

REFERENCES

Amighini, A. (2005). China in the International Fragmentation of Production: Evidence from the ICT Industry. European Journal of Comparative Economics, 2(2), 203–219. http://eaces.liuc.it/18242979200502/182429792005020203.pdf.

Bertay, A. C., Dordevic, L., & Sever, C. (2020). Gender Inequality and Economic Growth: Evidence from Industry-Level Data. IMF Working Papers, 2020(119). https://doi.org/10.5089/9781513546278.001.A001.

Blecker, T. (2006). Internet Technologies in Factory Automation (pp. 678–683). IGI Global. https://doi.org/10.4018/978-1-59140-799-7.CH109.

Bojnec, Š., & Ferto, I. (2015). Impact of the Internet on Manufacturing Trade. Journal of Computer Information Systems, 50, 124–132. https://www.tandfonline.com/doi/abs/10.1080/08874417.2009.11645369.

Bojnec, S., & Fertö, I. (n.d.). Impact of the Internet on Manufacturing Trade. https://doi.org/10.1080/08874417.2009.11645369.

Bui, M. T. T., & Long, T. Q. (2021). Women's Economic Empowerment in Vietnam: Performance and Constraints of Female-Led Manufacturing SMEs. 14(6), 255. https://doi.org/10.3390/JRFM14060255.

Chatterjee, N., & Chatterjee, T. (2021). Effects of Labor Productivity and Growth of Manufacturing Sector on Overall Growth of the Nation – A Panel Data Analysis of the Major Economies. Emerald Publishing Limited. https://doi.org/10.1108/978-1-80071-094-820211002.

Castiglione, C., Infante, D., & Smirnova, J. (2020). Do female managers affect productivity? Evidence from Italian manufacturing firms. International Journal of Finance & Economics. https://doi.org/10.1002/IJFE.2268.

Dai, X. (2021). Impact of "Internet plus" on manufacturing upgrading Based on evidence from Chinese manufacturing. 235, 03045. https://doi.org/10.1051/E3SCONF/202123503045.

Fazli Md Fauadi, M. H., Muhamad Damanhuri, A. A., Hambali, R. H., Mohamed Noor, A. Z., & Anuar, N. I. (2020). Recent applications of internet of things (iot) in manufacturing sector – a review. International Journal of Scientific & Technology Research, 9(9), 334–339. https://www.ijstr.org/final-print/sep2020/Recent-Applications-Of-Internet-Of-Things-iot-In-Manufacturing-Sector-A-Review.pdf.

Ferraz, R. (2024). Manufacturing production as a source of growth: the case of Portugal. Journal of Economic Structures, 13(1). https://doi.org/10.1186/s40008-024-00339-w.

Gisela, G., Husnatarina, F., Oktavia, R., Rapel, R., Yuni, S., & Christian, I. (2024). Pengaruh Komite Audit Perempuan, Pengalaman Kerja dan Pendidikan Akuntansi & Keuangan Terhadap Nilai Perusahaan Manufaktur. Moneter. https://doi.org/10.61132/moneter.v2i4.935.

Gozen, R., Hornbeck, R., Humlum, A., & Rotemberg, M. (2024). Historical Differences in Female-Owned Manufacturing Establishments: The United States, 1850-1880.

Jena, N. (2012). Women Entrepreneurship and Employment in Micro and Small Manufacturing Enterprises. 39(4), 1–20. https://doi.org/10.1177/0970846420120401.

Li, D. (2005). E-Supply Chain Management (Vol. 16). WIT Press. https://doi.org/10.2495/978-1-85312-998-8/10.

Lin, H.-C., Hsu, S.-H., Liou, R.-W., & Chang, C.-C. (2016). A value-added analysis of trade in Taiwan and Korea's ICT industries. Journal of Korea Trade, 20(1), 47–73. https://doi.org/10.1108/JKT-03-2016-004.

Nguyen, H. M. (2023). Impact of Internet use on industrial value added: evidence from Southeast Asian countries. Journal of International Economics and Management. https://doi.org/10.38203/jiem.023.3.0073.

Rajagukguk, W., (2022). The demographic and economic features: the nexus with internet use, HELIYON, https://doi.org/10.1016/j.heliyon..e10686.

Szirmai, A., Verspagen, B., & Verspagen, B. (2011). Manufacturing and Economic Growth in Developing Countries, 1950-2005. Research Papers in Economics. https://ideas.repec.org/p/unm/unumer/2011069.html.

Wang, A. Y.-M. (2022). The Impact of Manufacturing Sector on Economic Growth in Nigeria. https://doi.org/10.21203/rs.3.rs-2203096/v1.

Wen, J., & Deng, Z. (2023). Internet development, resource allocation and total factor productivity: Empirical evidence from China's listed manufacturing enterprises. Applied Economics, 1–12. https://doi.org/10.1080/00036846.2023.2188167.

World Bank (2025). World Development Indicators.

Yoon, S.-C. (2019). The Impact of ICT Goods Imports on Economic Growth: Evidence from Asia-Pacific Countries. Journal of Korea Trade, 23(7), 1–12. https://doi.org/10.35611/JKT.2019.23.7.1

Zhi, G. (2021). Research on Internet Development and the Value-added Path of Manufacturing Value. 235, 03061. https://doi.org/10.1051/E3SCONF/202123503061.

Zhong, R. Y., & Ge, W. (2018). Internet of things enabled manufacturing: a review. *International Journal of Agile Systems and Management*, *11*(2), 126. https://doi.org/10.1504/IJASM.2018.092545.