Research on Effects of Intelligent Manufacturing Level on Embedded Position of Global Value Chain in Manufacturing Industry

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Abstract: Using the data of 14 manufacturing industries in 63 countries and regions in the input-output database of ADB from 2007 to 2022, this paper empirically examines the influence of intelligent manufacturing level on the GVC embedment location of manufacturing using a fixed-effect model. The study found that intelligent manufacturing significantly improved the position of manufacturing in the GVC; The impact of smart manufacturing varies across countries and industries. The conclusion of the study has important implications for the further promotion of China's manufacturing industry in the GVC.

***Keywords*:** manufacturing industry, global value chain,intelligent manufacturing

1. Introduction

With the deepening development of economic globalization, the GVC has profoundly changed the pattern of international division of labor. China's manufacturing industry has integrated into the GVC by virtue of its resources and labor advantages, but it has the problem of being "big but not strong" and being in the downstream of the value chain. In order to achieve transformation and upgrading, China has issued documents such as Made in China 2025 since 2015 to promote the construction of an intelligent manufacturing ecosystem. Whether intelligent manufacturing can improve the many difficulties faced by China's manufacturing industry and help the manufacturing industry break through from the current low-end value chain division of labor to climb to the high-end of the value chain has become a very key issue.

In the past, when scholars studied the relationship between intelligent manufacturing and GVC, the number of industrial robots was commonly used as an indicator of intelligent manufacturing, but this measurement method was relatively simple. Based on the input-output model, this paper analyzes how the level of intelligent manufacturing affects the embedded position of the GVC from the country-industry level, and proposes strategies to promote the upgrading of the manufacturing value chain. The research aims to provide new ideas for intelligent manufacturing and GVC research, and enrich relevant research content, while providing advice for the formulation of China's intelligent manufacturing strategy.

2. Literature Review

Related studies on the impact of smart manufacturing on manufacturing GVCs have shown that smart manufacturing has a positive impact on the embedded position of GVCs at the national and industry levels. [1]Peng Gang et al. (2021) found that smart manufacturing is overall conducive to improving the position of China's manufacturing industry in the division of labor in the GVC, but the promotion is more significant in non-technology-intensive industries and high-use-intensity industries. From the enterprise level, [2]Yi Kaigang and Sun Yi (2014) believe that intelligent manufacturing can change the causes of "low-end locking" while breaking the "low-end locking" path-dependent nature of the value chain, and put forward the path for private manufacturing enterprises to transform into manufacturing intelligence. From the viewpoint of existing research literature, scholars at home and abroad have carried out rich discussions on the level of intelligent manufacturing and the embedded position of the GVC, but when exploring the impact of the level of intelligent manufacturing on the embedded position of the value chain from the country-industry level, there is a single selection of indicators to measure the level of intelligent manufacturing, and this paper carries out a discussion on the basis of this, with reference to the Wang Yuanyuan and Zhang Huarong (2020), [3]who measured the level of intelligent manufacturing from the input-output model. smart manufacturing level, under the accounting framework of Wang et al. [4](2017), to study the impact of smart manufacturing level on the embedded position of manufacturing GVC.

3. Empirical Results and Analysis

3.1 Model Construction

This paper uses a fixed effect regression model for analysis, and the measurement model is set as follows:

$$GVC\_POS_{ijt} = \beta_0 + \beta_1 IM_{ijt} + \beta_2 control_{ijt} + \theta_{ij} + \varphi_t + \varepsilon_{ijt} \quad (1)$$

In formula (1), i represents 63 countries or regions, j represents 14 manufacturing segments, and t represents time. GVC_POS_{ijt} represents GVC position index. IM_{ijt} indicates intelligence index. $control_{ijt}$ Represents a control variable. β_0 is a constant term. β_1 is the explanatory variable coefficien. β_2 represents the coefficient of each control variable. θ_{ij} is country-industry fixed effect. φ_t is the time fixed effect. ε_{ijt} is the random disturbance term.

3.2 Accuracy of strain gauge

Explained variable: Manufacturing GVC location (GVC_POS). Based on the WWYZ decomposition framework, this paper selects the ratio of production length based on forward industry correlation to production length based on backward industry correlation to represent the embedded position of GVC.

Explanatory variable: Intelligent manufacturing level (IM). In this paper, intelligent index is constructed to characterize the level of intelligent manufacturing. First of all, the direct consumption coefficient is calculated. On this basis, the full consumption coefficient is calculated, and the full consumption coefficient is multiplied with the added value rate of manufacturing sub-industries in various countries to obtain the effective input value of intelligent products contained in a unit, namely the intelligent index of manufacturing sub-industries.

Control variable: (1) Research and development expenditure (R&D). (2) Tariff level (Tariff-l). (3) Foreign Trade dependence (trade-d). (4) Fixed broadband penetration. (5) The proportion of Education expenditure. (6) Government efficiency (government-e). (7) GDP.

3.3 Data sources

Based on the scientificity and accessibility of the data, the panel data of 14 industries in 63 countries and regions from 2007 to 2022 are selected as research samples. The data sources involved in the paper are all from ADB-MRIO database, UIBEGVC database, UNCTAD database and World Bank database.

3.4 Measurement results and data analysis

Column (1) and (2) of table 1 reports the regression results of intelligent manufacturing on GVC position index. It can be seen that intelligent manufacturing significantly improves GVC position at the level of 5%. Column (3) and (4) conduct robustness tests by replacing the core explanatory variable (replacing the manufacturing value added rate from the previous section with the relative manufacturing value added rate across countries) and the explanatory variable (replacing it with the average length of production), respectively. Column (5) shows the results of endogeneity testing the model using the average of the digitization levels of subindustry inputs from other countries as an instrumental variable and using 2SLS. Columns (6) and (7) report the results of the heterogeneity regressions for countries at different levels of development (developed and developing countries) and for different industries (low-technology manufacturing and medium- and high-technology manufacturing).

Table 1. Results of baseline regression

Variable: GVC_POS	(1)	(2)	(3)	(4)	(5)		(6)		(7)	
IM	0.213**	0.172**		1.021***		0.841***	0.290*	0.052	0.226**	0.160
	(2.55)	(2.02)		(7.28)			(1.74)	(0.56)	(1.98)	(1.30)
IV					0.878***					
					(22.11)					
IM’			0.017**							
			(2.03)							
control variables		control	control	control	control	control	control	control	control	control
Durbin-Wu-Hausman					p=0.000					
Cragg-Donald Wald F					F=787.46 p=0.000					
Constant	0.939***	0.561***	0.565***	0.283**	-0.038***	1.109***	0.459***	-0.185	0.642***	0.487***
	(330.11)	(5.83)	(5.85)	(1.98)	(-3.49)	(62.00)	(3.40)	(-1.07)	(5.10)	(3.33)
fixed effect	control	control	control	control	control	control	control	control	control	control

Variable: GVC_POS	(1)	(2)	(3)	(4)	(5)		(6)		(7)	
N	13,222	13,222	13,222	13,222	13,222	13,222	6,092	7,130	6,637	6,585
R-squared	0.858	0.858	0.858	0.886			0.843	0.884	0.857	0.854

Note: ***, ** and * represent significance levels of 1%, 5% and 10% respectively.

4. Conclusion

Based on the data of 14 manufacturing industries in 63 countries and regions from 2007 to 2022, this paper empirically examines the impact of intelligent manufacturing on the embedded position of the GVC of the manufacturing industry by using a fixed-effect model. The study found that intelligent manufacturing significantly improved the position of manufacturing in the GVC, and this conclusion was still valid after the robustness test and the endogeneity problem.Further analysis shows that the impact of smart manufacturing is more significant in developed countries and low-tech manufacturing.

Based on the above research conclusions, this paper puts forward the following two suggestions: First, strengthen core technology research and development, and promote the intelligent transformation of enterprises. Promote the networked synergy of the industrial chain and supply chain, promote the deep integration of information technology and the manufacturing process. Second, cultivate intelligent manufacturing talents, improve the innovation network and promote the construction of intelligent manufacturing standard system to provide a strong guarantee for the long-term development of intelligent manufacturing.

References

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