Intellectual Property Protection and the Promotion of the Global Value Chain Position of Countries along the "Belt and Road"

Nuo Shi* and Liyou Fu[a]

Shanghai Dianji University, Shanghai, 200000, China

*1057582056@qq.com, [a]fuly@sdju.edu.cn

Abstract. From the perspective of intellectual property rights (IPR), the article empirically examines the impact of IPR protection on the improvement of manufacturing GVC position in the sample countries based on the panel data of manufacturing industries in 40 countries along the "Belt and Road" from 2000 to 2020 and combined with the fixed effects model. It is found that IPR protection significantly contributes to the enhancement of manufacturing GVC position, and the conclusion is still valid after the robustness test. Combined with the heterogeneity test, IPR protection significantly contributes to the enhancement of the position of manufacturing GVC in lower-middle-income countries. Further research finds that this effect is mediated by technological innovation capacity.

Keywords: intellectual property protection; global value chain position; "Belt and Road"

1 Introduction

In 2013, General Secretary Xi Jinping put forward the "Belt and Road" initiative, and as of 2023, China has signed more than 200 cooperation documents with more than 150 countries, according to the World Bank, since the implementation of the initiative, the cost of global trade can be lowered by 1.8% through infrastructure construction alone, which will lead to an increase in global income by 0.7-2.9 percent, making a significant contribution to and economic growth.

Countries along the "Belt and Road" generally have a low status in the division of labor in GVCs, and some developing countries are facing the risk of "low-end lock-in" in the global value chain division of labor system [11]. As an important institutional tool and trade barrier, intellectual property protection can realize endogenous economic growth by promoting a country's technological progress, thus leading to the rise of the positions of the global value chain.

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2 Literature Review

2.1 Related Studies on Intellectual Property Protection

The main methods of measuring the level of intellectual property protection are the survey, legislative scoring, and comprehensive scoring method. Some scholars obtained the value of the level of intellectual property through field research. Tu et al. (2019)[9] draw on Hu and Png's methodology and composite the GP index with the LSPR index to obtain the indicator of intellectual property protection level. In addition, Dai Z.Q. has studied the relationship between the intellectual property protection and export tech-nological sophistication(2014) [5].

2.2 Related Studies on the Positions of Global Value Chains

Existing studies have roughly divided the GVC position into two categories: one is to study the GVC division of labor position based on the perspective of export product composition or technology content. The other category is based on the perspective of export value-added capacity and the embedded position of the value chain to study the division of labor in GVCs. Koopman based on the value-added trade decomposition framework to determine the position of a country in the value chain by comparing the size of domestic value added in the exporting country with that of foreign value added. Additionally, Lyu Y et al. studied from artificial intelligence perspective (2020) [3].

2.3 Related Studies on Intellectual Property Protection and Global Value Chain Positions

Some scholars have discussed the role of IPR protection on the global production network layout of multinational corporations (MNCs) and the import and export trade of developed countries.

In addition, the relationship between increasing the level of IPR protection and changes in the country's position in the GVC division of labor is nonlinear, and this nonlinear relationship depends on the combined effect of spillover-enhancing and competition-exacerbating effects; Fang J.W. and Shi B.Z. has studied the impact of intellectual property protection on global value chains in developing countries (2023) [1]; Jiang Z.Y. measured the degree of participation in GVCs through the KWW extension methodology, and the results showed that IPR protection and GVC participation have a "non-linear" relationship (2022)[12]; Wan L.I et al. studied from industrial structure upgrading perspective (2020) [6]. This paper builds on the previous studies to explore the relationship between IPR protection and the positions of GVCs in greater depth. The marginal contribution of this paper is mainly in the following aspects: (1) This paper adopts the value-added-based trade accounting method to measure GVC positions, avoiding double-counting of imported intermediate goods brought about by value chain trade. (2) This paper explores the impact of the level of IPR protection on the positions of GVCs in the sample countries with different degrees of economic development and different levels of income, which increases the diversity of the research.

3 Theoretical Analysis and Research Hypotheses

Compared with traditional forms of trade, value chain trade is formed on the basis and within the framework of global value chains, and is characterized by strong knowledge and information mobility, complex trade linkages and technological and industrial dependence. Intermediate products, such as knowledge, information, etc., are easily diffused by transferring them in the external market.

Additionally, increased protection of intellectual property rights effectively safeguards the achievements of innovators. Therefore, having mature technological innovation capability is one of the indispensable conditions for deep integration into the GVC division of labor system.

Hypothesis 1: Intellectual property protection can contribute to the upgrading of the position of countries along the "Belt and Road" in GVCs.

Hypothesis 2: Intellectual property protection promotes the upgrading of the GVC positions of the "Belt and Road" countries through the enhancement of technological innovation capacity.

4 Model Construction, Variable Selection, and Data Sources

4.1 Model Construction

Based on the above analysis, this paper draws on Tu et al. (2019)[9] to construct a benchmark regression model that affects the position of the manufacturing global value chain. The model is shown as follows.

$$\mathrm{GVC}p_{ct} = \alpha + \beta_1 IPR_{ct} + \beta_2 lnUR_{ct} + \beta_3 InUPG_{ct} + \beta_4 InCAP_{ct} + \beta_5 InHUM_{ct} + \beta_6 EDU_{ct} + \beta_7 FDI_{ct} + \varepsilon_{ct} \quad (1)$$

In Equation 1, c denotes the country, and t denotes the year. The term $\mathrm{GVC}p_{ct}$ represents the GVC positions index of country c in year t, and IPR_{ct} denotes the intellectual property rights protection indicator of country c in year t.

4.2 Variable Selection and Data Sources

1) Explained Variable.

Global value chain position ($\mathrm{GVC}p_{cit}$). This paper adopts the value-added trade accounting method proposed by Koopman to measure a country's position in the GVC, as shown in the following equation:

$$\mathrm{GVC}p_{cit} = Ln\left(1 + \frac{IV_{cit}}{E_{cit}}\right) - Ln\left(1 + \frac{FV_{cit}}{E_{cit}}\right) \quad (2)$$

In Equation 2, $\mathrm{GVC}p_{cit}$ denotes the GVC position, IV_{cit} denotes the indirect domestic value added included in the total exports, FV_{cit} denotes the foreign value added included in the total exports, E_{cit} denotes the total exports accounted for by value added. Data from OECD-WTO (TiVA) database.

2) Core Explanatory Variable.
The core explanatory variable is Intellectual Property Protection (IPP_{ct}), which denotes the level of domestic intellectual property protection. This paper adopts the Legal System & Property Rights indicator in the Global Economic Freedom Index.

3) Control Variables.
(1) Urbanization level (UR). This paper uses the proportion of a country's urban population to its total population to measure the level of urbanization.
(2) Industrial upgrading (UPG). Referring to Zhang et al. (2023)[7], this paper utilizes the share of industrial value added in GDP to measure industrial upgrading.
(3) Fixed capital stock (CAP). This paper draws on the approach of Yang et al. (2021)[10], using a country's gross fixed capital formation as a share of GDP to measure fixed capital stock.
(4) Human capital level (HUM). This paper adopting the enrollment rate of tertiary education in each country to measure this indicator.
(5) Investment in education (EDU). This paper utilizes the ratio of a country's education expenditure to its gross national income (GNI) to measure the strength of education investment.
(6) Foreign Direct Investment (FDI). Referring to Huang et al. (2017)[2], this index is measured using the share of net FDI inflows in GDP in country c in period t.

4) Mediating Variable.
Technological innovation capacity (INNV). This paper refers to the number of patent applications by residents to measure a country's technological innovation capacity.

5 Empirical Results and Analysis

5.1 Descriptive Statistics

This paper limits the sample period of empirical research to the period of 2000-2020, and selects the panel data of manufacturing industries in 40 countries along the "Belt and Road" for analysis. The descriptive statistics results are shown in Table 1 below.

Table 1. The descriptive statistics results

Variable	Observations	Mean	Std. Dev.	Min	Max
GVCp	840	-0.012	0.17	-0.332	0.329
IPR	840	6.286	1.308	2.812	9.288
lnUR	840	4.147	0.293	3.161	4.605
lnUPG	840	3.299	0.316	2.301	4.197
lnCAP	840	3.105	0.24	2.369	3.796
lnHUM	840	3.736	0.698	-.606	4.965
EDU	840	4.21	1.381	1.25	7.86
FDI	840	8.672	33.229	-117.375	449.083

5.2 Benchmark Regression Analysis

This paper introduces different control variables for regression sequentially based on regression on the core explanatory variables, and the relevant results are shown in Table 2. Among them, column (1) is the result of regression on core explanatory variables only, and it can be found that the coefficient of the impact of intellectual property protection is positive at the significance level of 5%, and columns (2)-(7) are the results of regression based on column (1) by gradually adding the indicators of Control Variables, the coefficients of the core explanatory variables are still significantly positive, which verifies Hypothesis 1.

Table 2. Benchmark model regression results

	(1) GVCp	(2) GVCp	(3) GVCp	(4) GVCp	(5) GVCp	(6) GVCp	(7) GVCp
IPR	0.021**	0.024***	0.026***	0.015*	0.021**	0.020**	0.020**
	(2.29)	(2.62)	(2.84)	(1.70)	(2.21)	(2.17)	(2.12)
lnUR		0.103***	0.127***	0.093***	0.124***	0.124***	0.123***
		(3.12)	(3.81)	(2.80)	(3.48)	(3.47)	(3.45)
lnUPG			-0.073***	-0.100***	-0.103***	-0.102***	-0.101***
			(-3.96)	(-5.34)	(-5.48)	(-5.41)	(-5.36)
lnCAP				0.073***	0.076***	0.076***	0.076***
				(5.70)	(5.94)	(5.90)	(5.90)
lnHUM					-0.020**	-0.020**	-0.020**
					(-2.31)	(-2.37)	(-2.37)
EDU						-0.002	-0.002
						(-0.54)	(-0.59)
FDI							0.000
							(0.45)
Constant	-0.143**	-0.588***	-0.456***	-0.389**	-0.479***	-0.468***	-0.465***
	(-2.49)	(-3.82)	(-2.93)	(-2.54)	(-3.04)	(-2.93)	(-2.92)
Individual FE	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES
Observations	840	840	840	840	840	840	840
R^2	0.931	0.932	0.933	0.936	0.936	0.936	0.936

Note. T-Statistics are in parentheses. *p<0.05, **p<0.01, ***p<0.001. The same below.

5.3 Robustness Test

1) Differential Sample Test.

Considering the impact of outliers on the results, this paper re-regresses the selected sample data after shrinking the tail treatment. In addition, considering the impact of the

China-United States trade war on GVCs in 2018, this paper excludes the samples of that year and the year afterward and then re-regresses. The results are shown in columns (1)(2) of Table 3. After updating the sample data and sample years, the coefficient of the impact of IPR protection on the positions of GVCs is still significantly positive. In summary, from the regression results of the differentiated samples, the conclusions are robust.

Table 3. Robustness test results

	Selection of different sample data		Endogenous problem-solving		
	GVCp	GVCp	GVCp	IPR	GVCp
	(1)	(2)	(3)	(4)	(5)
IPR	0.022**	0.019*			0.113***
	(2.35)	(1.89)			(4.83)
L.IPR			0.017*		
			(1.75)		
lnUR	0.145***	0.129***	0.120***	-0.924***	0.202***
	(3.89)	(3.34)	(3.10)	(-7.56)	(4.98)
lnUPG	-0.100***	-0.092***	-0.089***	0.0172	-0.105***
	(-5.16)	(-4.70)	(-4.52)	(0.26)	(-5.48)
lnCAP	0.077***	0.072***	0.072***	0.118***	0.0549***
	(5.86)	(5.36)	(5.48)	(2.61)	(3.95)
lnHUM	-0.029***	-0.025***	-0.022**	0.191***	-0.0392***
	(-2.96)	(-2.69)	(-2.30)	(6.50)	(-4.02)
EDU	-0.002	-0.003	-0.004	-0.0290**	0.000551
	(-0.57)	(-0.73)	(-1.14)	(-2.50)	(0.16)
FDI	0.000	0.000	0.000	0.000368*	-1.95e-05
	(0.18)	(1.17)	(0.34)	(1.94)	(-0.35)
lnROL				0.771***	
				(12.42)	
Constant	-0.542***	-0.481***	-0.447***	5.307***	-0.829***
	(-3.33)	(-2.77)	(-2.64)	(9.67)	(-3.60)
Individual FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES
Observations	840	760	800	840	840
R^2	0.936	0.937	0.938	0.988	0.934

2) Endogeneity Test.

In order to solve the problem of endogeneity, this paper draws on the research method of Yu (2011)[4] and uses a lag of one period in intellectual property protection as the core explanatory variable for direct regression analysis, and the results of the regression are as shown in Column (3) of Table 3. The coefficients of the core explanatory variables are still significantly positive, and the conclusion is still valid.

In addition, this paper uses a country's level of rule of law (ROL) as an instrumental variable (IV) for the core explanatory variables, with data from the World Bank database. In this paper, the two-stage least squares method (IV-2SLS) is used to conduct the test, and the results of the first and second stages are reported in columns (4) and

(5) of Table 3. Meanwhile, this paper conducts a weak IV test for instrumental variables, the Cragg-Donald Wald F-value is 154.360, which is greater than the Stock-Yogo's 10% level critical value, and the model passes the weak instrumental variables test; and the non-identifiable test Anderson LM statistic rejects the original hypothesis at the 1% level, which satisfies the instrumental variables identifiability. After considering the endogeneity issue, the direction of the level of intellectual property protection on the improvement of the positions of manufacturing GVCs is still consistent with the results of the benchmark regression, and both are significantly positive.

5.4 Heterogeneity Analysis

1) Heterogeneity of Development Level.

Referring to the classification method of UNCTAD, the economies in the sample are divided into developed economies and developing economies, and then heterogeneity analysis for different types of economies. The results are shown in columns (1) and (2) of Table 4.

The regression results show that IPR protection contributes to the upgrading of manufacturing value chains in both developing and developed economies.

Table 4. Heterogeneity analysis results

	(1) Developing countries	(2) Developed countries	(3) Lower middle-income countries	(4) High-income countries
IPR	0.056***	0.019*	0.057***	0.019
	(4.18)	(1.77)	(4.05)	(1.50)
lnUR	-0.012	-0.108	0.098**	0.046
	(-0.27)	(-1.20)	(2.09)	(0.45)
lnUPG	-0.102***	-0.172***	-0.089***	-0.128***
	(-3.49)	(-8.08)	(-2.81)	(-5.67)
lnCAP	-0.019	0.087***	0.004	0.111***
	(-0.86)	(6.09)	(0.20)	(7.18)
lnHUM	-0.023**	-0.067***	-0.046***	0.009
	(-2.13)	(-5.11)	(-3.95)	(0.69)
EDU	0.016***	-0.013***	0.016***	-0.013***
	(3.26)	(-3.71)	(3.22)	(-3.11)
FDI	-0.004***	0.000	-0.003***	0.000
	(-4.72)	(1.00)	(-3.08)	(1.52)
Constant	0.219	0.861**	-0.253	-0.317
	(1.03)	(2.12)	(-1.07)	(-0.70)
Individual FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Observations	420	420	420	420
R^2	0.934	0.956	0.929	0.946

2) Heterogeneity of Income Level.

This paper classifies the countries into lower-middle-income countries and high-income countries according to the World Bank database, in order to verify the impact of income differences, and the results are shown in columns (3) and (4) in Table 4.

The results show that the estimated coefficients are significantly positive for lower middle-income countries and insignificant for high-income countries, which may be due to the fact that the manufacturing industries of latter may be at the high end of the GVCs, and their competitive advantages mainly come from branding, marketing and services rather than mere IPR protection.

5.5 Mechanism Test

According to Jiang (2022)[8], this paper conducts the test according to the following steps: (1) arguing the influence of the mediating variables on the explained variables; (2) identifying the influence of the explanatory variables on the mediating variables.

$$lnINNV_{ct} = \alpha + \beta_1 IPR_{ct} + \beta_2 lnUR_{ct} + \beta_3 InUPG_{ct} + \beta_4 InCAP_{ct} + \beta_5 InHUM_{ct} + \beta_6 EDU_{ct} + \beta_7 FDI_{ct} + \mu_c + \mu_t + \varepsilon_{ct} \quad (3)$$

Among them, $lnINNV_{ct}$ is the mediator variable, i.e., technological innovation capability, IPR_{ct} is the core explanatory variable.

Table 5. Mediation effect regression results

	(1) GVCp	(2) lnINNV
IPR	0.020**	0.357***
	(2.12)	(3.62)
lnUR	0.123***	3.052***
	(3.45)	(8.13)
lnUPG	-0.101***	0.342*
	(-5.36)	(1.73)
lnCAP	0.076***	0.162
	(5.90)	(1.20)
lnHUM	-0.020**	0.409***
	(-2.37)	(4.53)
EDU	-0.002	0.106***
	(-0.59)	(3.03)
FDI	0.000	-0.000
	(0.45)	(-0.54)
Constant	-0.465***	-12.516***
	(-2.92)	(-7.46)
Individual FE	YES	YES
Time FE	YES	YES
Observations	840	840
R^2	0.936	0.958

The results are shown in Table 5. Column (2) takes technological innovation as the explained variable, and the results show that the estimated coefficient of intellectual property protection is significantly positive at the 1% level, indicating that the improvement of intellectual property protection can promote the improvement of a country's manufacturing technological innovation capacity, thus promoting the position of the manufacturing industry's GVC in the countries along the “Belt and Road”, which is in line with hypothesis 2.

6 Conclusions and Policy Recommendations

This paper analyzes the panel data of the manufacturing industry in 40 countries along the Belt and Road from 2000 to 2020, and empirically examines the impact of intellectual property protection on the improvement of the global value chain status of the manufacturing industry in countries along the Belt and Road by using a fixed-effect model. The results are as follows:

First, intellectual property protection has significantly promoted the promotion of the GVC positions of the manufacturing industry in the "Belt and Road" countries. Second, the impact of intellectual property protection on the GVC is heterogeneous. Third, the promotion of intellectual property protection to the GVC positions can be achieved through the mechanism of enhancing technological innovation capacity.

The “Belt and Road” countries need to take the enhancement of intellectual property protection as an important part of the improvement of the institutional system, and to realize high-quality development through more integration into the GVC system.

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