

Japanese Foreign Direct Investment in China and Technology Spillovers: An Innovation Network Perspective

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Abstract: Japan is an important source of foreign direct investment (FDI) in China. Based on an innovation network framework, this study combines data on Japanese investment in China from 2016 to 2021 with relevant patent data to systematically examine the technology spillover effects of intermediate technologies embodied in Japanese FDI in China and the underlying mechanisms. The results show that Japanese FDI in China generates significant technology spillover effects overall. However, absorptive capacity exerts a significant negative moderating effect on the technology spillovers of Japanese FDI, indicating that technological fields with stronger absorptive capacity are relatively less dependent on technology spillovers from Japanese FDI. From the perspectives of technological fields and innovation networks, this study provides new empirical evidence for understanding the mechanisms of technology diffusion through Japanese FDI in China and for further optimizing China's FDI structure.

Keywords: Intermediate Technologies Embodied in Japanese FDI in China; Innovation Network; Technology Spillovers; Absorptive Capacity

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1. Introduction

Japan is an important source of foreign direct investment (FDI) in China. Although Japanese FDI in China has declined in recent years, with its share of total FDI inflows into China falling from 6.07% in 2012 to 1.83% in 2024 (Table 1), Japan remains one of the major sources of FDI in China. In 2023, Japan ranked fifth among all countries and regions investing in China in terms of actual investment, and second among Asian countries and regions. In 2024, Japan ranked seventh among all countries and regions investing in China and third among Asian countries and regions in terms of actual investment.

Japan is also an important source of technology for China. In 2023, China imported 1,426 technology items from Japan, the highest number among all source countries for the fifth consecutive year. The value of these technology imports reached US\$6.62 billion, ranking second only to the United States. In 2023, among Chinese enterprises that used foreign patented technologies, 31.1% reported that their patented technologies originated from Japan (Figure 1).

A review of the literature reveals that early studies on technology spillovers from Japan to China focused extensively on spillovers through trade channels^{[1][2][3]}; In recent years, as increasing attention has been devoted to foreign direct investment, research on the technology spillover effects of Japanese FDI in China has gradually surpassed that on international trade channels^{[4][5][6][7]}. Moreover, previous studies on technology spillovers have predominantly used indicators such as total

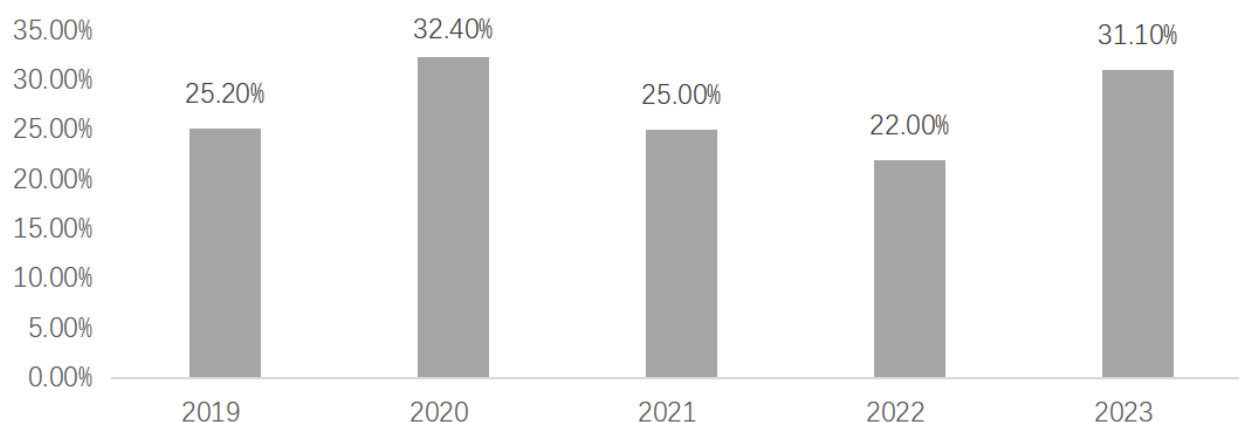
factor productivity (TFP) and GDP to measure spillover effects^{[8][9][10][11]}, while the pathways and mechanisms of technology spillovers, particularly those involving intermediate technologies, remain insufficiently explored.

Table 1. Share of Japanese FDI in China's Total FDI Inflows from Asia and the Wo

Year	Japanese FDI in China (US\$10,000)	Japan's Share of FDI from Asia (%)	Japan's Share of Global FDI (%)
2012	735,156	8.48	6.07
2013	705,817	7.46	5.7
2014	432,530	4.38	3.37
2015	319,496	3.07	2.36
2016	309,585	3.13	2.32
2017	326,100	2.99	2.39
2018	379,780	3.55	2.75
2019	372,093	3.18	2.63
2020	337,448	2.72	2.26
2021	391,325	2.55	2.16
2022	460,508	2.82	2.43
2023	388,932	2.93	2.38
2024	212,583	2.32	1.83

Compiled by the authors based on data from various editions of the China Statistical Yearbook.

Figure 1. Share of Japanese Patented Technologies as a Source of Technology for Chinese Enterprises



Compiled by the authors based on data from various editions of the China Statistical Yearbook on Science and Technology.

An innovation network represents the knowledge relationships among different technological fields. Compared with macro-level indicators such as TFP and GDP, an innovation network can provide deeper insights into the pathways and transmission mechanisms of intermediate technology spillovers^{[12][13][14][15]}. From the perspective of technological innovation networks, this study uses data from Japan's Ministry of Finance and the incoPat patent database, among other sources, to investigate the spillover effects of intermediate technology embodied in Japanese FDI in China, their moderating mechanisms, and their heterogeneous effects across technological fields.

The marginal contributions of this study are twofold. First, a key challenge in research on technology spillover mechanisms lies in accurately measuring the pathways of knowledge flows^[16]. Drawing on the technological innovation network approach of Liu Canlei et al.^[12], this study constructs a patent citation network^[12] to characterize the technology spillover effects of Japanese FDI in China at the technological-field level, thereby extending the literature on technology spillovers

from Japanese FDI in China, particularly intermediate technology spillovers. Second, by examining the moderating role of absorptive capacity, this study provides a deeper understanding of the characteristics of technology diffusion through Japanese FDI in China.

The remainder of this paper is organized as follows. Section 2 presents the theoretical analysis and research hypotheses. Section 3 describes the econometric model and presents the empirical results. The final section concludes the paper and offers policy recommendations.

2. Theoretical Analysis and Research Hypotheses

Japanese FDI in China generates significant technology spillover effects. Tian Zheng^[16] argues that Japanese FDI in China promotes industrial upgrading and transformation through three channels: technological imitation, industry demonstration, and labor spillovers. For example, Japanese firms establish production bases or R&D centers in China, introducing advanced technologies through a “produce locally and sell locally” model. In fields such as semiconductors and new energy vehicles, the technological advantages of Japanese firms are transmitted directly to China’s industrial chains through FDI, thereby promoting domestic technological innovation. Wang Baidong^[3] finds that the R&D capital spillover effects of Japanese FDI in China are greater than those of FDI from the United States and the European Union.

Overall, foreign direct investment (FDI) is an important source of technological progress and innovation output in China, and its technology spillover effects have been extensively documented in the literature. Existing studies show that multinational enterprises (MNEs) facilitate technology transfer and knowledge diffusion by introducing advanced technologies and management expertise from their parent companies, providing employee training and promoting human capital accumulation, and engaging in collaborative R&D and industrial linkages with local firms and research institutions. These activities generate horizontal and vertical spillovers through channels such as labor mobility, industrial linkages, and demonstration effects^[17]. In particular, during the operations of Japanese firms in China, Chinese employees can acquire advanced technologies and management practices through “learning by doing” and subsequently move to domestic firms or establish their own businesses, thereby further disseminating technology spillovers^{[18][19]}.

Empirical studies focusing on China further support the mechanisms discussed above. For example, Zhao^[10] finds that foreign direct investment significantly promotes the growth of the total output of Chinese high-tech enterprises. From the perspective of production efficiency, Zhang^[8] and others show that FDI has a significant positive effect on firms’ total factor productivity (TFP) and technological innovation capabilities. Based on the above analysis, this study proposes the following hypothesis:

Hypothesis 1: Intermediate technologies embodied in Japanese FDI in China significantly promote technological innovation in China.

According to absorptive capacity theory, the ability of firms or industries to absorb and utilize external technological knowledge depends on their existing R&D capabilities, accumulated human capital, and the development of internal knowledge systems^[20]. Existing studies suggest that high-tech fields generally possess stronger capabilities to identify, integrate, and recombine external knowledge, owing to their relatively high R&D intensity, greater technological complexity, and long-term accumulation of well-developed indigenous innovation systems^{[21][22][23]}. Against this background, innovation activities in fields with stronger absorptive capacity are more likely to rely on accumulated internal R&D capabilities and diverse global sources of knowledge, rather than on technology spillovers from FDI originating from a single source.

Meanwhile, technology diffusion by Japanese firms is characterized by a relatively high degree of internalization, with knowledge transfer relying more heavily on on-the-job training (OJT), learning through production experience, and the transfer of tacit knowledge than on open patent diffusion^[24]. Therefore, in technological fields with stronger absorptive capacity, firms are more likely to achieve innovation through indigenous R&D and the accumulation of internal knowledge, resulting in a relatively lower marginal dependence on intermediate technologies embodied in Japanese FDI. By contrast, traditional technological fields, which generally have more limited indigenous R&D capabilities, are more likely to acquire technological knowledge through the intermediate technologies, production experience, and process know-how associated with Japanese FDI. Consequently, the technology spillover effects of Japanese FDI are more likely to materialize in these fields. As industry-level absorptive capacity increases, the marginal contribution of intermediate technologies embodied in

Japanese FDI to innovation output may gradually diminish, giving rise to a substitution effect whereby internal R&D replaces reliance on external technology spillovers. Based on this reasoning, this study proposes the following hypothesis:

Hypothesis 2: The stronger the absorptive capacity of a technological field, the weaker the technology spillover effects of intermediate technologies embodied in Japanese FDI in China.

3. Econometric Model Specification and Empirical Results

3.1 Econometric Model and Variable Description

3.1.1 Model Specification

Following Liu Canlei et al. ^[12], who employ an innovation network approach to examine the effects of intermediate technologies embodied in imports on technological innovation in China, this study constructs the following econometric model to identify the impact of intermediate technologies embodied in Japanese FDI in China on China's innovation output:

$$\ln Patn_{it} = \alpha + \beta \ln Ftech_{i,t-1} + control + \lambda_i + \gamma_t + \varepsilon_{it} \quad (1)$$

In the model, the dependent variable is the number of invention patent applications in Chinese technological field i in year t ($Patn_{it}$), which is used to measure China's innovation output and is expressed in logarithmic form. The key explanatory variable is the one-period lagged intermediate technology embodied in Japanese FDI in China ($Ftech_{i,t-1}$), which represents the effective technological conditions under which Japanese FDI in China generates technology spillovers to Chinese technological field i in year t , also expressed in logarithmic form. $control$ denotes the set of control variables. The model incorporates two-way fixed effects. Specifically, λ_i denotes technological-field fixed effects at the four-digit IPC classification level, which control for the time-invariant effects of inherent technological characteristics, such as the rate of technological iteration and the propensity for patent commercialization. γ_t denotes year fixed effects, which absorb the effects of time-varying common factors, such as macroeconomic fluctuations. ε_{it} is the random error term, which satisfies the classical assumptions.

3.1.2 Variable Definitions

(1) Key explanatory variable

Intermediate technology embodied in Japanese FDI in China. The key explanatory variable is constructed in the following three steps:

First, following the approaches of Acemoglu et al. (2016), Liu and Ma (2023), and Liu Canlei (2024), this study uses U.S. patent citation data from 1996 to 2016 to calculate, for each pair of technological fields i and j at the four-digit IPC level, the share of citations from patents in field i to patents in field j relative to the total backward citations made by field i to patents across all technological fields. This measure captures the degree of backward-citation dependence between any two technological fields and is subsequently used to construct a knowledge-flow network across technological fields. The formula is as follows:

$$w_{ij} = \frac{cite_{ij}}{\sum_k cite_{ik}} \quad (2)$$

In this equation, w_{ij} represents the degree of knowledge dependence of technological field i on technological field j , while $cite_{ij}$ denotes the number of backward citations from patents in technological field i to patents in technological field j . Here, k represents any technological field, and $\sum_k cite_{ik}$ denotes the total number of backward citations from technological field i to patents across all technological fields.

Accordingly, w_{ij} takes values in the interval $[0, 1]$, and the matrix Ω composed of w_{ij} represents the backward citation network among all technological fields, namely, the technological innovation network.

The backward citation network is adopted because patents are direct outputs of technological innovation, and backward citations reflect the external knowledge inputs absorbed during the innovation process ^[25]. This network effectively captures knowledge flows across technological fields during the R&D and innovation process and reveals the underlying technological linkages among different technological fields.

Second, to effectively characterize the “intermediate technology” conditions through which Japanese FDI in different technological fields affects innovation across Chinese technological fields, the industry-level data on Japanese FDI in China need to be converted into FDI data classified by technological field. Specifically, following the approach of Li Ying ^[26], this

study matches industry-level data on Japanese FDI in China for 2016–2020, provided by Japan’s Ministry of Finance, with the two-digit International Standard Industrial Classification (ISIC) codes (Rev. 4). Subsequently, based on the probabilistic product-to-technology concordance developed by Lybbert and Zolas (2014), the ISIC industry classifications are further converted into FDI by technological field at the IPC level.

Third, this study combines the technological innovation network constructed in the first step, the FDI data converted in the second step, and the number of Japanese patents in each technological field at the four-digit IPC level, and constructs the following measure of “intermediate technologies embodied in FDI ($Ftech_{it}$)” by aggregating these three components.

$$Ftech_{it} = \sum_j w_{ij} Patn_{jt} F_{jt} \quad (3)$$

Here, $Ftech_{it}$ denotes intermediate technologies embodied in FDI; i represents technological field i ; j denotes the cited technological field j ; w_{ij} represents the degree of dependence of technological field i on technological field j ; $Patn_{jt}$ denotes Japan’s level of technological knowledge in technological field j in year t , measured by the number of invention patent applications granted to Japanese applicants at the four-digit IPC level in the incoPat patent database; and F_{jt} denotes the amount of Japanese FDI in China in technological field j in year t .

The rationale for constructing the measure of “intermediate technologies embodied in FDI” is as follows. In constructing the technological innovation network, this study draws on the input–output analytical framework and regards the cited technological field j as an “intermediate technology input” into the innovation production of technological field i . Accordingly, the technologies from other technological fields j cited in the innovation output of technological field i are defined as the “intermediate technologies” of that field ^[12]. Furthermore, the effective knowledge content embodied in all intermediate technological fields associated with Japanese FDI in China determines the conditions under which such investment can exert an impact on technological innovation in Chinese technological field i . Therefore, this study defines the effective knowledge content constructed through the three steps described above as “intermediate technologies embodied in Japanese FDI in China” and uses it as the key explanatory variable.

In addition, this study employs a one-period lagged specification for the explanatory variable. This specification is motivated by two main considerations. First, there may be a time lag between the realization of technology spillovers and the response of local innovation. Second, using a one-period lag helps mitigate potential endogeneity arising from reverse causality between technological innovation and foreign direct investment.

(2) Dependent variable: Number of invention patent applications

To avoid potential upward bias arising from patents that have not yet been granted, this study follows the standard practice of Autor et al. ^[27] and uses only granted invention patents as a proxy for technological innovation. Given that the examination process for invention patents typically takes approximately four years, the sample period is defined as follows: the dependent variable is measured using data on granted invention patents from 2016 to 2021, while the explanatory variables are correspondingly constructed using foreign investment data from 2015 to 2020.

(3) Control variables

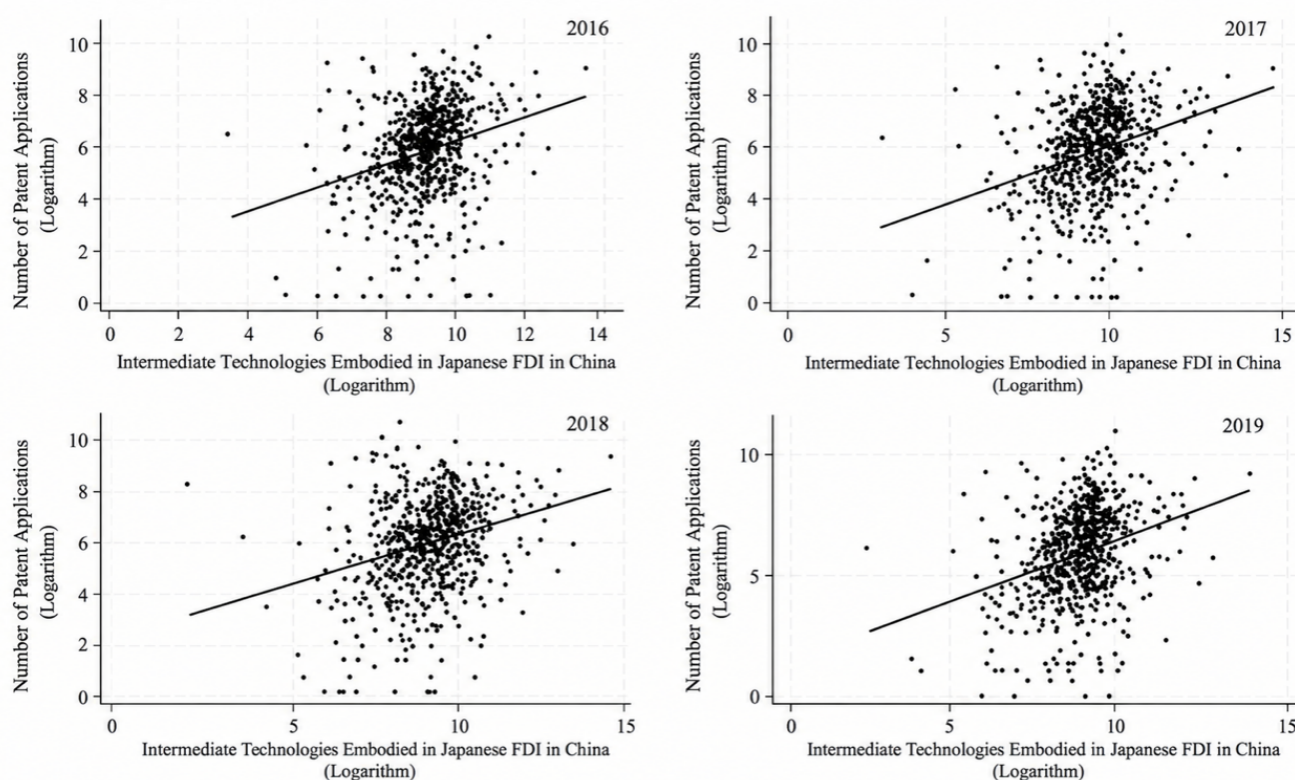
This study includes five main control variables (*control*). (1) The scale of global imports of technology products at the technological-field level, excluding Japan ($lnimpg$), measured in logarithmic form, is included to account for the potential effects of international market competition and intermediate-input supply on domestic innovation activities. (2) Global FDI technology spillovers, excluding Japan ($lnFDIspill$), measured in logarithmic form, are included to capture knowledge spillovers arising from global cross-border capital flows. (3) Production spillovers based on input–output linkages ($lniospill$), measured in logarithmic form, are included to control for the effects of import trade on technological innovation output through production input–output relationships. (4) Domestic innovation network spillovers ($lnchntech$), which control for knowledge diffusion within China’s domestic innovation system. (5) The logarithm of the total number of patent applications worldwide, excluding China and Japan ($lngpat$), which is included to account for the potential influence of global technological development trends on the results. Table 2 reports the descriptive statistics and data sources for all variables in Model (3).

Table 2. Descriptive Statistics of Variables

lnPatn	Patent applications	incoPat	4505	5.82	1.94	0	11.36
lnFtech	Intermediate technology embodied in FDI	Ministry of Finance (Japan); incoPat	3830	9.04	1.33	1.18	14.93
lnimp	Global imports	GACC	3779	19.49	2.84	0	26.17
lnFDIspill	FDI spillovers	CIED	3861	0.32	0.25	0.02	2.41
lniospill	Production-channel spillovers	incoPat; GACC	3779	29.09	0.78	27.57	29.99
lnchntech	Domestic technology diffusion	incoPat	4505	8.23	0.77	3.78	10.99
lngpat	Global patent applications	incoPat	4505	7.04	1.84	0	12.04

To provide a preliminary examination of the relationship between intermediate technologies embodied in Japanese FDI in China and China's innovation output, this study plots annual scatter diagrams for 2016–2019 (Figure 2) and fits a bivariate linear regression between the key explanatory variable and the dependent variable. As shown in the figure, the observations in each year exhibit a clear upward trend, and all fitted lines have positive slopes. This indicates a stable positive correlation between intermediate technologies embodied in Japanese FDI in China and the number of invention patent applications in China. A comparison across years shows that the scatter points are relatively concentrated from 2016 to 2019 and that the fitted lines have broadly similar slopes, suggesting that this positive relationship remains relatively stable over time. In addition, the simple regression results are statistically significant at the 1% level in all four years, providing further evidence that intermediate technologies embodied in Japanese FDI in China are positively associated with China's innovation output. These findings provide preliminary visual evidence and empirical support for subsequently examining the impact of intermediate technologies embodied in FDI on innovation output within a two-way fixed-effects framework.

Figure 2. Intermediate Technologies Embodied in Japanese FDI in China and China's Innovation Output (2016–2019)



3.2 Econometric Analysis

3.2.1 Baseline Regression and Robustness Test Results

Columns (1)–(3) of Table 3 report the OLS estimation results for Model (3). Column (1) presents the baseline regression. In addition to controlling for technological-field and year fixed effects, it includes all control variables that may affect knowledge spillovers: the scale of global technology-product imports (*lnimpg*), global FDI technology spillovers (*lnFDIspill*), production-linkage spillovers (*lniospill*), domestic technology spillovers (*lnchnotech*), and the global volume of patent applications (*lngpat*). To assess the robustness of the model, column (2) excludes the production-linkage spillover variable (*lniospill*) from the baseline specification, while column (3) excludes the global technological trend variable (*lngpat*).

To further assess the robustness of the baseline results, this study replaces the Japanese FDI flow data used in the original key explanatory variable with FDI stock data and re-estimates the model. As shown in column (4) of Table 3, the coefficient of the key explanatory variable image remains positive and statistically significant (0.2156**) after the variable is replaced. Both its sign and level of statistical significance are consistent with the baseline results. Moreover, the estimated coefficients of the other control variables remain highly consistent in terms of both sign and statistical significance, indicating that the regression results are robust.

Overall, the results indicate that intermediate technology embodied in Japanese FDI in China (*lnFtech*) has a significant positive effect on technological innovation in China. A 1% increase in intermediate technology embodied in FDI is associated with an approximately 0.045% increase in invention patent applications at the technological-field level.

Table 3. Baseline Regression Results for Technology Spillovers from Intermediate Technologies Embodied in Japanese FDI in

	China			
	(1)	(2)	(3)	(4)
	lnPatn	lnPatn	lnPatn	lnPatn
lnFtech	0.0445** (2.572)	0.0467*** (2.675)	0.0468*** (2.728)	0.2156** (2.439)
lnimpg	-0.0150 (-0.584)	-0.0177 (-0.694)	-0.0149 (-0.580)	-0.0158 (-0.621)
lnFDIspill	-0.0175 (-0.481)	-0.0465 (-1.284)	-0.0222 (-0.610)	-0.0221 (-0.592)
lniospill	-1.0944*** (-4.097)		-1.1098*** (-4.123)	-1.1149*** (-4.151)
lnchnotech	0.4372*** (5.075)	0.4721*** (5.462)	0.4888*** (5.745)	0.4168*** (4.476)
lngpat	0.0771** (2.472)	0.0791** (2.487)		0.0727*** (2.403)
_cons	33.4782*** (4.306)	1.3777* (1.653)	34.0330*** (4.346)	32.1587*** (4.089)
IPC4-field fixed	Yes	Yes	Yes	Yes
Year fixed	Yes	Yes	Yes	Yes
N	3741	3741	3741	3746
adj. R ²	0.984	0.984	0.984	0.984

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

3.2.3 Testing the Moderating Effect of Absorptive Capacity

Existing studies generally recognize absorptive capacity as an important factor influencing the technology spillover effects of foreign direct investment (FDI) ^[20]. To further investigate the mechanisms through which intermediate technologies embodied in Japanese FDI in China operate, this study measures absorptive capacity using changes in the number of R&D personnel across Chinese industries and constructs an interaction term between this measure and intermediate technologies embodied in Japanese FDI to test the moderating effect.

Accordingly, this study extends the baseline model by incorporating the absorptive capacity variable and its interaction term with the key explanatory variable. The resulting econometric specification is as follows:

$$\ln Patn_{it} = \alpha + \beta_1 \ln Ftech_{i,t-1} + \beta_2 \ln RD_{it} + \beta_3 (\ln Ftech_{i,t-1} \times \ln RD_{it}) + Control + \lambda_i + \gamma_t + \varepsilon_{it} \quad (4)$$

Here, RD_{it} denotes industry-level absorptive capacity, measured by changes in the number of R&D personnel across industries. The data are obtained from the National Bureau of Statistics of China's statistics on R&D personnel in industrial enterprises above designated size, disaggregated by industry. $\ln Ftech_{i,t-1} \times \ln RD_{it}$ is the interaction term, which captures the moderating effect of absorptive capacity on FDI-related technology spillovers. All other variables are defined in the same way as in the baseline model.

Table 4. Testing the Moderating Effect of Absorptive Capacity

	(1)	(2)	(3)
	Moderating Effect	High-Tech Fields	Traditional Fields
$\ln Ftech$	0.0206 (1.178)	0.0287 (0.937)	0.0414** (2.193)
$\ln RD$	-0.0513 (-0.703)		
$\ln Ftech \times \ln RD$	-0.0044*** (-3.093)		
$\ln gpat$	0.0551* (1.688)	0.0836 (1.336)	0.0695* (1.952)
$\ln impg$	0.0271 (0.830)	-0.0456 (-1.121)	-0.0080 (-0.247)
$\ln FDIspill$	-0.0088 (-0.172)	0.1834** (2.592)	-0.0613 (-1.416)
$\ln iospill$	-0.4626 (-1.400)	-1.2778** (-2.600)	-1.0995*** (-3.749)
$\ln chntech$	0.3815*** (3.445)	0.3884*** (2.919)	0.5018*** (4.497)
_cons	15.1741 (1.584)	40.3669*** (2.792)	32.8863*** (3.857)
N	1913	1109	2632
adj. R ²	0.988	0.983	0.984

t statistics in parentheses

* p<0.1, ** p<0.05, *** p<0.01

The regression results in column (1) of Table 4 show that the coefficient on the interaction term β_3 is negative and statistically significant, indicating that the positive effect of intermediate technologies embodied in Japanese FDI on innovation weakens

as absorptive capacity increases. Meanwhile, the coefficient on intermediate technologies embodied in Japanese FDI is not statistically significant on its own, suggesting that the technology spillover effects of Japanese FDI are substantially moderated by absorptive capacity. Building on these findings, this study further classifies four-digit IPC technological fields into high-tech and traditional fields according to the OECD classification of technological intensity and conducts heterogeneity regression analyses. The results are reported in columns (2) and (3) of Table 4.

Further heterogeneity analysis provides additional support for the above findings. The results show that the technology spillover effects of intermediate technologies embodied in Japanese FDI are statistically significant only in traditional technological fields, with no significant effects observed in high-tech fields. This suggests that traditional manufacturing industries, owing to their relatively limited absorptive capacity, remain more dependent on specific intermediate technologies brought by Japanese FDI and are therefore more likely to experience significant technology spillover effects. By contrast, firms in high-tech fields have developed stronger capabilities in indigenous R&D and knowledge integration, making them relatively less dependent on technology spillovers from FDI originating from a single source, such as Japan.

In addition, the variable capturing global FDI spillovers exhibits a statistically significant positive effect only in high-tech fields, while its effect is not statistically significant in traditional fields. This suggests that high-tech firms with strong absorptive capacity no longer rely primarily on the specific intermediate technologies embodied in Japanese FDI, but are instead able to integrate knowledge spillovers from FDI originating from a broader range of countries. By contrast, firms in traditional technological fields, owing to their relatively limited technological absorptive capacity, are more likely to absorb specific technologies that are closely aligned with their existing production systems. Consequently, they remain more dependent on the intermediate technology channel associated with Japanese FDI.

Meanwhile, the domestic R&D variable exhibits a statistically significant positive effect in both groups of technological fields, indicating that the primary driver of firms' patent innovation remains the accumulation of indigenous R&D capabilities. In this context, technology spillovers from intermediate technologies embodied in Japanese FDI primarily complement existing innovation capabilities in traditional fields with weaker absorptive capacity, whereas in high-tech fields, their contribution is partly substituted by firms' internal R&D capabilities.

Notably, the variable capturing production-network technology spillovers arising from input–output linkages exhibits a statistically significant negative effect in both groups of technological fields. This suggests that deep integration into supply chain networks does not necessarily promote firms' patent innovation and may instead constrain innovative activities. This finding differs to some extent from the conventional view that production linkages facilitate technology diffusion and suggests substantial differences in the quality of technology spillovers across channels. Compared with active learning through R&D and knowledge absorption, passive technological embeddedness through production linkages may encourage greater reliance on existing technologies, weakening firms' incentives for indigenous innovation and generating a potential substitution effect associated with “free-riding.” Furthermore, spillovers through supply chains may primarily lead to process improvements and greater production efficiency, rather than original innovations that can be directly translated into patentable outcomes. Meanwhile, prolonged and deep integration into existing production networks may give rise to technological lock-in, constraining firms to established technological trajectories and thereby hindering the emergence of breakthrough innovations. The above results indicate that the technology spillover effects of intermediate technologies embodied in Japanese FDI exhibit significant heterogeneity to absorptive capacity. In traditional technological fields with relatively weak absorptive capacity, intermediate technologies embodied in Japanese FDI continue to provide an effective complement to firms' innovation activities. By contrast, in high-tech fields with stronger absorptive capacity, firms' innovation activities rely more heavily on accumulated internal R&D capabilities and diverse global sources of knowledge, resulting in a substantially lower dependence on technology spillovers from FDI originating from Japan alone.

4. Conclusions and Policy Recommendations

Based on a technological innovation network framework and data on Japanese FDI in China from 2016 to 2021, this study constructs a key explanatory variable measuring the intermediate technologies embodied in Japanese FDI in China at the patent technological-field level. This approach provides a more systematic and in-depth examination of cross-border technology

spillovers associated with Japanese FDI in China from a technological-field perspective. The main findings are as follows:

First, intermediate technologies embodied in Japanese FDI in China significantly promote China's technological innovation. Specifically, a higher level of intermediate technologies embodied in Japanese FDI within a given technological field is associated with a greater number of Chinese patent applications in that field. This finding remains robust after a series of robustness checks and the use of an instrumental variable approach to address potential endogeneity.

Second, absorptive capacity, measured by changes in the number of R&D personnel across technological fields, exerts a significant negative moderating effect on technology spillovers from intermediate technologies embodied in Japanese FDI in China. In other words, the technology spillover effects of intermediate technologies embodied in Japanese FDI in China are weaker in technological fields with stronger absorptive capacity.

Based on the above findings, this study proposes the following policy recommendations.

First, given the significant technology spillover effects of foreign direct investment (FDI), China should continue to improve its foreign investment environment. In recent years, Japan and many other countries have adopted "China+1" strategies to diversify their supply chains and reconfigure their investment locations. This trend is partly associated with changes in foreign investors' labor costs as China's economic environment continues to improve and per capita income rises. At the same time, it poses structural challenges to China's ability to attract foreign investment. Against this background, as China transitions from a major manufacturing country to a manufacturing powerhouse, it should place greater emphasis on systematically strengthening its indigenous innovation capabilities and developing its competitive industries. By consolidating its industrial foundations and enhancing its technological capabilities, China can strengthen its long-term attractiveness to foreign investors, thereby creating more favorable conditions for higher-level international R&D cooperation and contributing to the building of a community with a shared future for humanity.

Second, the empirical results show that industries with stronger absorptive capacity are less reliant on technology spillovers from Japanese FDI, with firms' innovation drawing more heavily on accumulated internal R&D capabilities and knowledge spillovers from FDI originating from a broader range of countries. Accordingly, China should further strengthen support for R&D investment and improve policies such as tax deductions for eligible R&D expenses and the training of highly skilled R&D personnel. These measures should encourage firms to establish long-term, stable R&D systems and enhance domestic firms' capabilities to absorb, integrate, and further develop external technologies. In addition, China should further promote the international expansion of its high-tech industries and encourage firms to participate actively in global R&D collaboration, international patent cooperation, and cross-border technology alliances, thereby strengthening their ability to integrate knowledge from diverse technological sources.

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No

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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