The Impact of International Trade on Regional Economic Growth Rates — An Empirical Analysis Based on Data from Prefecture-Level Cities in China

Zhang Xu *

International Business School, Brandeis University, Waltham, America

* Corresponding Author Email: 15639510295@163.com

Abstract. Accurately and comprehensively assessing the magnitude and mechanisms of the impact of international trade on China's long-term economic growth is of great significance for the government to adopt targeted policies. Using data from China's prefecture-level cities from 2004 to 2017, sourced from the China City Statistical Yearbook and the China Statistical Yearbook, this paper empirically examines the impact of international trade on regional economic growth rates in China and the corresponding mechanisms within the SYS-GMM estimation framework. The study finds that international trade has a positive effect on China's economic growth rate. Further mechanism decomposition indicates that the facilitative effect of international trade on economic growth exhibits significant heterogeneity across technological level, human capital, and employment, while its impact on industrial structure shows a U-shaped pattern, decreasing first and then increasing.

Keywords: International trade, economic growth rate, dynamic panel.

1. Introduction

The theoretical and empirical relationship between international trade and economic growth has long been a focus of mainstream economists' research. Classical economics holds that international trade can break domestic market constraints, expand market scale, further develop division of labor, and promote productivity growth, thereby driving economic growth [1,2]. According to data from the National Bureau of Statistics, China's total trade was 20 billion USD in 1977, and by the end of the 20th century, this figure had reached an astonishing 475 billion USD. Between 1978 and 2001, China began to open up to the outside world and change its inward-looking policies, with the government aiming to achieve long-term growth by joining the multilateral trading system of the WTO at the expense of short-term interests. Therefore, before joining the WTO, China significantly reduced tariffs and non-tariff barriers while increasing trade rights for foreign and domestic enterprises. After decades of development, China's total trade had reached 4.623 trillion USD by 2018, making it the world's largest exporter and the second-largest importer.

Although the academic community has a relatively unified understanding of the role of international trade in promoting economic growth, some scholars have raised doubts about research methods during empirical studies, particularly regarding the selection and measurement of trade (openness) indicators. Research conclusions can vary depending on how indicators are measured, and differences in the selection of sample spaces can also lead to divergent findings [3]. Therefore, this study empirically examines the impact of international trade on China's economic growth rate using different trade indicators, especially in the context of trade conflicts between China and the United States, providing a reference for accurately quantifying the impact of trade wars on China's long-term economic growth and the corresponding mechanisms. Testing different trade indicators within the same econometric model can not only provide a more robust and reliable analysis of the impact of international trade on China's economic growth rate but also help compare coefficient differences between different measurement methods. Additionally, this study employs the generalized method of moments (GMM) estimation for dynamic panel data to further examine the impact of trade on regional economic growth and explores the mechanisms of influence from the perspectives of technology level, human capital, industrial structure, and employment.

2. Methodology

2.1. Measurement Model and Estimation Method

This study refers to the economic growth models, and constructs a panel data model at the prefecture-level city level, linking per capita GDP growth rate with per capita income, trade variables, and control variables. The baseline model is designed as follows:

$$growth_{rt} = \alpha + \beta\, trade_{rt} + \gamma\, X_{rt} + f_r + u_t + \varepsilon_{rt} \quad (1)$$

Where the subscript r denotes the prefecture-level city, t denotes year, $growth_{rt}$ represents the GDP growth rate of city r in year t, and X_{rt} is a series of control variables that may affect economic growth, f_r and u_t represent city and time fixed effects, respectively, and ε_{rt} is the error term.

This study applies the System Generalized Method of Moments (SYS-GMM) method for empirical testing. This method uses the moment conditions of the level equation based on the first-differenced GMM, treating the first differences of lagged variables as instruments for the corresponding level variables in the level equation, thereby enhancing the validity of the instruments. The advantage of the system GMM method is that it controls for unobserved time and individual effects through differencing, while addressing endogeneity by incorporating lagged dependent variables and lagged exogenous variables as instruments within the model.

2.2. Data Description

The data used in this analysis mainly come from the China Urban Statistical Yearbook, the China Regional Statistical Yearbook, the CEIC database, the Zhongjing Network statistical database, and the National Bureau of Statistics. The observation period analyzed in this paper is from 2004 to 2017.

2.3. Key Indicators

The dependent variable $growth_{rt}$ is the actual GDP growth rate at the prefecture-level city in China. The core variable $trade_{rt}$ draws on the commonly used trade dependency measure in domestic literature:

$$trade_{rt} = (import_{rt}+export_{rt})/GDP_{rt} \quad (2)$$

Where $import_{rt}$, $export_{rt}$, *and* GDP_{rt} are the import, export, and total regional output of city r in year t, respectively. This reflects the degree of economic connection between a country and other countries or the extent of participation in international division of labor. The most commonly used measures are trade dependency or export dependency, i.e., the ratio of the total import and export value to the GDP in a given year, or the ratio of export value to GDP. However, including import and export shares separately in the regression equation is an important step in understanding the relationship between international trade and growth. Imports and exports are equally important; they are complementary rather than substitutes. Through imports, technological levels can be improved, and industrial structure optimized. Moreover, imported intermediate goods are crucial for cost control in international trade production and processing enterprises. Therefore, this study also constructs the import dependency $trade\_import_{rt}$, which is the ratio of imports to GDP that year and corresponds to the export dependency $trade\_export_{rt}$.

Control variables include government expenditure scale (*govscal*), population (*pop*) representing the size of prefecture-level cities, the proportion of fixed asset investment to GDP (*inv*), labor force growth rate (*employ*), and a dummy variable for city rank (*rank*), where sub-provincial cities are coded as 1, non-sub-provincial provincial capitals as 2, and ordinary prefecture-level cities as 3. In all regressions in this paper, except for the city rank variable, all control variables are lagged by one period to mitigate endogeneity [4, 5].

3. Empirical Results

This paper uses the System Generalized Method of Moments (SYS-GMM), employing the lagged terms of the explanatory variables themselves as instrumental variables to estimate Equation (1). The regression results reported in column (1) of Table 1 indicate that the coefficient of the impact of international trade on GDP growth rate is positive at the 1% level, with the magnitude of the effect on GDP growth being 0.058, which is consistent with most studies.

An alternative indicator for economic growth rate is expressed as the natural logarithm of per capita real GDP at the prefecture-level city. However, since the China City Statistical Yearbook does not provide a per capita real GDP index, the GDP deflator for each province was first calculated and then combined with nominal per capita GDP to obtain the real value. The results in column (2) of Table 1 show that trade has a significantly positive effect on economic growth, and the results are robust.

The regression results for export dependence are shown in columns (3) and (4) of Table 1. The results indicate that export trade dependence has a significantly positive impact on economic growth. The coefficient for import trade dependence is also positive. Based on the consistent results from multiple indicators, it can be preliminarily concluded that foreign trade has a robust positive effect on China's economic growth rate.

This paper considers the full outbreak of the global financial crisis in September 2008 as a key point and uses the SYS-GMM estimation method to examine the different effects of international trade on China's economic growth rate during the two periods before and after. The results show that during both periods, although trade openness had a positive impact on China's economic growth, the coefficient was not significant in the 2004-2008 period, possibly because even before the full outbreak of the financial crisis in September 2008, the subprime crisis had already erupted. China's major trading partners were facing the impact on the real economy, rising unemployment, and a significant decrease in market consumption capacity, and had already begun adjusting relevant trade policies. From 2009 to 2017, China's foreign trade began to show a significant positive impact on economic growth, with the effect coefficient greater than that of 2004-2008, reflecting the series of policies implemented in China after the financial crisis to stimulate domestic export enterprises and stabilize the global economy.

Table 1. Basic Regression Results

	(1)	(2)	(3)	(4)
trade	0.058*** (0.015)	0.133*** (0.017)		
trade_export			0.156*** (0.031)	
trade_import				0.004 (0.018)
inv	-0.150*** (0.009)	0. 153*** (0.006)	-0.153*** (0.009)	-0. 160*** (0.009)
govscal	-0.391*** (0.047)	0.575*** (0.021)	-0.362*** (0.046)	-0.383*** (0.045)
employ	-0.086*** (0.007)	-0.069*** (0.009)	-0.087*** (0.007)	-0.085*** (0.006)
pop	0.017*** (0.005)	0.020*** (0.002)	0.017*** (0.005)	0.016*** (0.004)
rank	0.037 (0.033)	-0.367*** (0.105)	0.035 (0.035)	0.056* (0.030)
cons	0.496*** (0.073)	1.856*** (0.129)	0.488*** (0.075)	0.499*** (0.069)
Obs.	3498	3499	3501	3545

Note: (1) Numbers in parentheses are standard errors; (2) * indicates significance level, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4. Further Discussion

This paper examines the effects of trade on China's technological level, human capital, and industrial structure separately.

4.1. Variable selection in the impact mechanism

Due to data limitations, it is difficult to directly measure the technological level at the prefecture-level city scale, so the paper uses the average GDP per worker in each prefecture-level city as a proxy for technological level, calculated as the city's per capita GDP divided by the number of employed individuals in that area.

The indicator for human capital stock is measured by the number of full-time faculty in regular higher education institutions per 10000 people. Specifically, the higher the level of the school, the more full-time teachers it has, thus training more labor with high human capital, indicating a higher human capital content in the corresponding region.

The industrial structure is measured by the ratio of employees in the tertiary sector to the total employed population. The larger this ratio, the more labor is being transferred to the tertiary sector, indicating better development. As an important driver of economic growth, industrial upgrading is reflected not only in the output and tax revenue of the service sector but also in the direction of labor transfer across the primary, secondary, and tertiary sectors. An alternative indicator for industrial structure is the ratio of value added by the tertiary sector to GDP. To reduce model endogeneity, the regressions in Table 2 include lagged values of investment, population, employment, and government size as well as city-level variables.

Table 2. Mechanism Test

	(1)	(2)	(3)
	Technological Level	Human Capital	Industrial Structure
trade	0.022*** (0.002)	0.160*** (0.010)	-0.086*** (0.017)
Trade2			0.021*** (0.007)
cons	0.488*** (0.027)	-1.166*** (0.081)	-0.503*** (0.078)
Obs.	3215	3123	2872

4.2. The Impact of International Trade on Technological Level and Human Capital

According to the regression results in column (1), the impact of trade on China's technological level is 0.022, which is significant at the 1% level. This indicates that through international trade, China can improve its technological level, which in turn can promote economic growth. In column (2), the coefficient of human capital is positive and significant at the 1% level, indicating that international trade actively promotes the accumulation of human capital across China's regions. In the process of trading with developed countries, enterprises not only obtain information on new products but also update their understanding of domestic and foreign market demands in a timely manner, thereby forcing themselves to engage in imitation, training, and innovation in management, organization, and technology, leading to the accumulation of human capital. Meanwhile, as connections with countries around the world become closer, economic, cultural, and talent exchanges occur more frequently, talent mobility becomes more rational, social resource allocation is optimized, technological levels are enhanced, and economic growth is further stimulated [6,7].

4.3. The impact of international trade on industrial structure

Industrial structure is an important pillar of the economic structure. The proportionate changes in the structure of the three major industries and the optimization of internal structure within each industry are greatly influenced by trade liberalization. Generally speaking, international trade can provide market incentives to industries with comparative advantages through international

competitiveness, stimulating greater investment in those industries, adjusting and establishing the direction of industry development. Moreover, these comparative advantages and the demand in international markets are constantly changing. Industries that first experience international competitive pressure will also be the first to adjust their export structures in a competitive environment, which will undoubtedly guide economic development. In column (3), the coefficient of the linear term of trade on industrial structure is significantly negative, while the coefficient of the quadratic term is significantly positive, indicating that the impact of international trade on China's industrial structure follows a U-shaped curve. The underlying reason is that since joining the WTO, China has continuously expanded its openness to foreign trade. However, in the early stage, China's foreign trade was mainly concentrated in labor-intensive industries with relatively low technological levels, so an increase in trade openness suppressed the upgrading of China's industrial structure. As the main sectors of foreign trade gradually shifted to capital- and technology-intensive industries, trade liberalization began to promote the upgrading of China's industrial structure. On the other hand, the foreign value-added ratio of China's exports of capital-intensive products, such as communication equipment and computers, is relatively high, even reaching up to 80%. This causes the substantial growth in trade to appear somewhat illusory, as the technological progress represented by the export of capital-intensive products does not correspond to a simultaneous increase in domestic value-added, resulting in a slow pace of industrial structure upgrading [8].

5. Summary

Since the reform and opening-up, China's economy has grown rapidly, once creating the myth of the China Miracle. Alongside economic development, China has continuously reformed its trade policies, achieving remarkable success in foreign trade. Trade liberalization has increasingly become an entry point for explaining economic development internationally. As China's economy enters a new stage, transitioning from high-speed growth to medium-high-speed growth, it faces a more severe international environment and intensifying Sino-US trade conflicts. Accurately identifying and quantifying the role and mechanism of international trade in China's long-term economic growth is of significant theoretical and practical importance.

This paper empirically examines the impact of international trade on China's economic growth, finding that international trade has a significantly positive effect on overall economic growth, approximately at a level of 5.8%. After the 2008 financial crisis, the promotion effect of international trade on economic growth gradually strengthened and became more pronounced compared to before the crisis. Further mechanism test indicates that international trade significantly promotes technological advancement and employment in China. Additionally, this study confirms that international trade's effect on China's industrial structure follows a U-shaped curve rather than a single-directional influence.

The results of this paper indicate that besides trade, there are numerous factors affecting economic growth, such as government expenditure, domestic fixed asset investment, population, labor force, and industrial structure. Therefore, in designing trade policies in the context of the Sino-US trade war, trade should not be treated as an isolated policy variable but considered in coordination with other fiscal and monetary policies. Secondly, in the era of global economic knowledge and information, the competition between countries ultimately comes down to the competition for talent. Therefore, in the process of deepening opening-up to the outside world, China should promote the capacity building of human resources through various means such as education development, personnel training, and international exchanges and cooperation, so as to transform its population advantage into a human capital advantage in foreign trade. Thirdly, according to the U-shaped impact of trade on industrial structure, under the background of entering a new period of economic development, China should pay more attention to the export of capital-intensive products, increase investment in research and development, actively attract international talent, and enhance the ratio of domestic value-added in exported goods, rather than merely engaging in assembly production.

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