

# Free Trade Zone Construction and Value Chain Upgrading: Empirical evidence from China

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**Abstract:** Under the new development pattern of dual circulation, free trade zones (FTZs), as an important carrier and platform for linking domestic and international loops, will promote China to involve and take a lead in advancing economic globalization with a higher level of opening-up, thus facilitating the upgrading in value chain of country. Using a sample of 280 prefecture-level cities in China from 2012-2017 and combining input-output table data, this paper empirically examines the impact of FTZs construction on the upgrading of China's value chain. It is found that the construction of FTZs can significantly promote the upgrading of China's value chain; the heterogeneity test results suggest that the construction of FTZs is more effective in promoting the value chain upgrading in coastal FTZs, regions with higher intellectual property protection and better marketization. Furthermore, the concentric ring effect analysis indicates that the construction of FTZs in China currently shows more of a siphon effect.

**Keywords:** free trade zone; value chain upgrading; intellectual property protection; level of marketization; concentric ring effect

**JEL Classification:** E6; L6; R5

## 1. Introduction

Under the global value chain dominated by developed countries, China mainly participates in the international division of labor with low-end elements, and has the problem of strong dependence on imports in industries with high technological complexity, and the shortcomings of core technology cannot be compensated in the short term, thus inhibiting the high-quality development of the Chinese economy (Lu et al., 2020; Yang & Fan, 2015). At a time when the world is undergoing major development, transformation and adjustment, the global economy is faced with growing uncertainties under the influence of the fourth industrial revolution and the Coronavirus Disease 2019 (COVID-19) pandemic and many other factors. Considering the changing international situation and aiming to adapt the country to the new trends of economic globalization, on September 21, 2020, the State Council issued the Overall Plans for the Beijing, Hunan and Anhui Pilot Free Trade Zones and the Plan for the Expansion of the Zhejiang Pilot Free Trade Zone. So far, China's pilot free trade zones have formed a new pattern of "1+3+7+1+6+3", demonstrating country's firm determination to promote a comprehensive opening up to the outside world. Therefore, under the new economic paradigm of dual circulation which takes domestic circulation as the mainstay with domestic and international development reinforcing each other, this paper intends to enhance the

understanding about what role do China's pilot free trade zones play against the background and how does the FTZs construction contribute to the upgrading of value chains.

The existing literature mainly focuses on the impact of FTZ construction on regional economic development. For example, the construction of FTZ not only brings about the improvement of regional location advantages, but also strengthens the synergistic and complementary relationship between regions (Ren et al., 2016), promotes regional economic growth through the "trade effect" and "investment effect" (Wang et al., 2020), and provide incentive for the development of central and peripheral cities through the institutional innovation effect (Wang, 2020). Although the construction of FTZs exerts an obvious positive influence on regional economic growth, there is a certain lag, showing obvious regional and industrial heterogeneity (Ye, 2018; Li & Liu, 2021). In addition, a small part of the research has also explored the impact of FTZ construction on trade development, for example, Xiang Houjun et al. (2016) emphasized that FTZ construction triggers a differentiated effect on the import and export of goods trade and only has a significant impact on the net import of goods trade. But some scholars have also found that FTZ construction leads to the growth of urban exports and has not changed the way of goods trade exports (Jiang Lindo et al., 2021). In summary, numerous researches have been conducted to explore the factors affecting the upgrading of value chains, however, very limited studies have provided empirical evidences from policy implementation perspective, especially the impact mechanism of China's FTZs construction on the upgrading of value chains. The continuous expansion of China's FTZs construction has advanced opening-up at a higher level, thus accelerating the pace to set up new pattern for development. It is foreseeable that the construction of FTZs will have a profound and sustained impact on the structure of China's export products, providing strong impetus for upgrading of the value chain.

## **2. Methodology**

In this paper, annual data of 280 prefecture-level cities in mainland China from 2012-2017 were selected as the research sample. The empirical data were obtained from the 2012-2017 China Statistical Yearbook, China Labor Statistical Yearbook, China Science and Technology Statistical Yearbook, and the statistical yearbooks of prefecture-level cities. In addition, data on patent infringement cases were gathered from the State Intellectual Property Office.

Value chain upgrading refers to the gradual transformation of the industrial chain from manufacturing-centered to service-centered. From the perspective of the "smile curve", the servitization of manufacturing can extend the industrial chain to the downstream with higher added value by improving the R&D and innovation system, exerting economies of scale and scope, and adopting product differentiation strategies (Liu et al., 2016). In this paper, we chose the degree of servitization in manufacturing as an estimator to measure industrial chain upgrading (vcu), which can be obtained through calculating the direct consumption coefficient matrix and complete consumption coefficient matrix based on the input-output tables for each Chinese province in 2012, 2015 and 2017, as shown in equation (1).

$$vcu_{ij} = a_{ij} + \sum_{k=1}^n a_{ik}a_{kj} + \sum_{s=1}^n \sum_{k=1}^n a_{is}a_{sk}a_{kj} + \dots \quad (1)$$

where  $vcu_{ij}$  indicates the servitization level of the manufacturing sector  $j$ ,  $a_{ij}$  represents the complete consumption coefficient of the manufacturing sector  $j$  to the sector  $i$ ,  $\sum_{k=1}^n a_{ik}a_{kj}$  and  $\sum_{s=1}^n \sum_{k=1}^n a_{is}a_{sk}a_{kj}$  denotes the first and second round of indirect consumption respectively.

Further, this paper applied the method of mean and interpolation for filling the missing data in 2013, 2014 and 2016. Considering that the higher the ratio of tertiary industry to secondary industry, the higher the impact on value chain upgrading correspondingly, therefore, we selected the ratio of tertiary industry to secondary industry in prefecture-level cities and interpolate with the value chain upgrading index at the provincial level to obtain the value chain upgrading data reflecting the prefecture-level city level.

In addition, the control variables selected in this paper are the level of economic development (gdp): expressed by using GDP per capita; the level of human capital investment (edu): expressed by using the ratio of education expenditure to fiscal expenditure; the degree of foreign trade dependence (trade): expressed by using the proportion of total import and export to regional GDP of each prefecture-level city; the level of fixed asset investment (fixinv): expressed by using the proportion of fixed asset investment to regional GDP of each prefecture-level city; government intervention (gov): expressed by the proportion of government financial expenditure to GDP; R&D level (rd): expressed by the proportion of R&D expenditure to GDP of each prefecture-level city.

**Table 1.** Descriptive statistics of variables

Variable	N	Mean	St.d	Min	Max
ftz	1,680	0.0238095	0.1525007	0	1
vcu	1,680	0.1898697	0.1607246	0	3.271856
gdp	1,680	33.44872	560.3687	0.01534	11492.17
edu	1,680	18.16449	3.954222	4.362782	35.62073
trade	1,680	1.121153	6.277398	0	97.63366
fixinv	1,680	0.9067985	2.368057	0	74.24695
gov	1,680	19.57282	9.074226	0.0001946	70.09467
rd	1,680	1.597342	1.465738	0.0658214	12.64753
mkt	1,680	6.827304	1.564273	2.53	10

### 3. Results

#### 3.1. Construction of the Economic Model

During the study period over 2012-2017, there were 25 prefecture-level FTZs established in China, located in Shanghai, Guangzhou, Shenzhen, Zhuhai, Tianjin, Xiamen, Fuzhou, Dalian, Shenyang, Yingkou, Zhoushan, Hangzhou, Ningbo, Jinhua, Zhengzhou, Kaifeng, Luoyang, Wuhan, Xiangyang, Yichang, Chongqing, Chengdu, Luzhou, Xi'an and Xianyang. Aiming to examine whether FTZs can promote the value chain upgrading, this paper draws on the study of Bertrand and Mullainathan (2003) to run regressions by employing a multi-period DID model, a model that describes the situation where individuals are not perfectly

aligned at the point in time of treatment. In this paper, the interaction term ( $Treat \times Post$ , replaced by  $ftz$  in this paper) between the treatment group dummy variable and the treatment time dummy variable is incorporated directly into the regression model. Among them, the magnitude and significance of the coefficient  $\beta$  is the main focus of this paper. The coefficient reflects the impact of the FTZ construction on the upgrading of the value chain before and after the implementation of the FTZ, and if  $\beta$  is significantly positive, it means the FTZ construction helps to promote the upgrading of the regional value chain. The specific regression model is presented as follows.

$$vcu_{it} = \alpha + \beta FTZ_{it} + \lambda X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (2)$$

where,  $vcu_{it}$  is the independent variable measuring the level of the value chain in region  $t$  at time  $i$ .  $FTZ_{it}$  is the core dependent variable indicating whether region  $i$  has established an FTZ at time  $t$  and is a dummy variable which equals 0 for every year before the establishment of the FTZ and equals 1 for every year after the establishment of the FTZ.  $X_{it}$  is the set of control variables,  $\mu_i$  is the region fixed effect,  $\delta_t$  is the time fixed effect, and  $\varepsilon_{it}$  is the random error term.

### 3.2. Results of the Benchmark Model

Table 2 shows the results of the benchmark regression of the establishment of the FTZs on value chain upgrading, where model (1) only controls the core explanatory variables, model (2) controls the core explanatory variables and the control variables, model (3) further controls regional fixed effects based on model (2), and in model (4) a double fixed effects test is performed. The findings in Table 2 reveal that the coefficients of the core explanatory variables  $ftz$  are all significantly positive at the 1% statistical level.

**Table 2.** The impact of FTZ on value chain upgrading

	(1)	(2)	(3)	(4)
	<b>vcu</b>	<b>vcu</b>	<b>vcu</b>	<b>vcu</b>
$ftz$	0.0962	0.0752	0.0988	0.0657
	(0.0003)	(0.0037)	(0.0000)	(0.0000)
Control	YES	YES	YES	YES
$_{-}cons$	0.1882	0.1996	0.7042	0.5980
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\mu_i$	NO	NO	NO	YES
$\delta_t$	NO	NO	YES	YES
N	1,680	1,680	1,680	1,680
R2	0.0079	0.1285	0.3690	0.4402

### 3.3. Results of the Heterogeneity Test

Initially, the total 25 FTZs in China has been assigned with different tasks according to their own geographic benefits, thus there may exists regional differences in the impact of FTZs construction on promoting value chain upgrading. Therefore, in order to test regional heterogeneity, this paper divides the sample into coastal FTZs and inland FTZs two groups based on the criterion of whether the location of FTZs are on China's coastline or not, then conducts a partition test, with the results shown in columns (1) and (2) of Table 3.

Moreover, stronger IPR protection contributes to protect the legitimate rights and interests of innovators, reduce the risk of enterprises' high-tech investments, optimize technology investments returns, and motivate enterprises to increase their innovation R&D investment, which in turn improves the quality of export products (Li & Miao, 2018) and promotes the upgrading of regional value chains. Therefore, this paper seeks to further validate the heterogeneity analysis of IPR intensity. Regarding the measurement of the strength of IPR protection, we draw on the sub-index of IPR protection in the Fan Gang Marketization Index (Fan et al., 2011). Regions are divided into two categories according to the median, those below the median are regions with poor IPR protection, and those above the median are regions with better IPR protection, and the test results are shown in columns (3) and (4) of Table 3.

Ultimately, market integration can ensure the smooth flow of factors between regions, which creates the favorable conditions for regional value chain upgrading. Therefore, we can reasonably expect that the effect of China's FTZs construction on value chain upgrading is more significant in regions whose market is better integrated. To further verify the heterogeneous impact of market integration, this paper selects the marketization index proposed by Fan Gang and Wang et al. (2011) as an estimator of market integration level, then divide the sample into regions with lower marketization and regions with higher marketization two kinds based on the median value, and the regression results are shown in columns (5) and (6) of Table 3.

**Table 3.** Heterogeneity test of FTZs for value chain upgrading

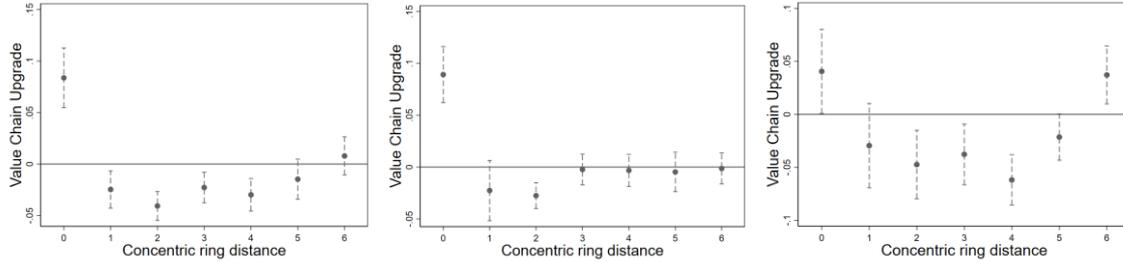
	(1)	(2)	(3)	(4)	(5)	(6)
	Coastal	Inland	Low level of IPR	High level of IPR	Less market-oriented	Highly market-oriented
ftz	0.0777 (0.0161)	0.0169 (0.0197)	0.0036 (0.0413)	0.0854 (0.0160)	0.0383 (0.0418)	0.0896 (0.0144)
Control	YES	YES	YES	YES	YES	YES
_cons	-0.1110 (0.0537)	0.6147 (0.0530)	-0.0383 (0.0318)	0.6817 (0.0800)	-0.0100 (0.0549)	0.6173 (0.0657)
$\mu_i$	YES	YES	YES	YES	YES	YES
$\delta_i$	YES	YES	YES	YES	YES	YES
N	678	1,002	815	865	850	830
R2	0.362	0.504	0.591	0.598	0.424	0.549

### 3.4. Analysis of Concentric Ring Effects

In order to further explore the spatial effect of the FTZ construction, this paper draws on the study of Lu et al. (2019) to calculate the spatial distance of each city. Firstly, using Amap to obtain the latitude and longitude information of all prefecture-level cities, and measuring the spatial distance between two of cities. Secondly, exploring the spatial effect of FTZs by examining the cities whose geographical location is within a 50 km radius of the FTZs, and then gradually extending to 300 km. Compared with the traditional spatial measurement model, this method can not only examine the existence of the spatial effect of FTZs establishment, but also detect the direction of this effect and the scope of influence. The specific model is constructed as follows.

$$vcu_{it} = \gamma_0 + \gamma_1 FTZ_{it} + \sum_{n=1}^6 \sigma_n Ring((n-1), n)_i \times Post_t + \lambda X_{it} + \mu_i + \delta_t + \varepsilon_{it} \quad (3)$$

In equation (3),  $Ring((n-1), n)$  is a set of dummy variables that equals 1 when the city  $i$  is located within  $((n-1), n]$  of the FTZ, and 0 otherwise, where  $n = 1, 2, \dots, 6$ . For example, when  $n=1$  means that the city is located within 50 km of the FTZ, when  $n=2$  means that the city is located within 50-100 km of the FTZ, and so on. Figure 3 plots the estimated coefficients  $\sigma_n$  in 95% confidence intervals as the location of the concentric ring changes.



**Figure 1.** Concentric ring effect test results (the first figure is the overall concentric ring effect, the second figure is the coastal FTZ concentric ring effect, and the third figure is the inland FTZ concentric ring effect)

#### 4. Discussion

In order to examine the impact of the China's FTZs construction on value chain upgrading, this paper explores the correlation between the two by employing a multi-period DID model with a research sample of 280 prefecture-level cities in China. The data analysis demonstrates that the establishment of FTZs plays a positive role in upgrading of regional value chains. Moreover, the construction of FTZs has obvious regional heterogeneity and the empirical evidence indicates that coastal FTZs are better able to promote the upgrading of regional value chains, while inland FTZs' positive effect is not significant at present. The main reason for this is that due to geographical constraints, the development of inland FTZs is relatively immature, and the trade scale effect has not yet been formed for the possessed resources, however, with the continuous deepening and improvement of FTZs, the potential of factor resources may be gradually unleashed. Furthermore, this study found that only in areas with better protection of intellectual property rights and better market integration level, the positive effect of FTZs construction on value chain upgrading is more obvious, suggesting that the strength of intellectual property rights protection and a perfect market-oriented environment can provide a good external condition for value chain upgrading.

In addition, the construction of China's FTZs showed different degrees of siphoning effects on cities located in different rings of the value chain upgrading, while the positive spillover effects on cities located farther away were not significant. The siphoning effect is more pronounced in coastal FTZs than in inland FTZs, while cities outside the 5 rings of inland FTZs show positive spillover effects. The economic reason behind this phenomenon is that, according to the theory of agglomeration effect, the construction of FTZs will first produce a siphon effect on cities closer to them, and a large amount of resources will rush to

the core cities, and only when a certain distance is exceeded can they get rid of their negative siphon effect, and the positive spillover effect will appear.

The construction of China's free trade zones (FTZs) is a major carrier for exploring system-based opening-up, and has an important impact on promoting the upgrading of a country's value chain. Compared with existing studies, this paper makes an empirical contribution from the following three aspects: firstly, this paper takes the layout of FTZ construction as access point for the first time to examine the impact of China's FTZ construction on the upgrading of regional value chains, providing empirical evidence on how FTZs construction optimizes regional value chains and enriching the related research on value chain upgrading. Second, this paper examines the impact of FTZs construction on value chain upgrading using a multi-period DID approach based on data from 280 prefecture-level cities in China and input-output table data from 2012-2017. The statistical findings reveal that the construction of FTZs can significantly increase the upgrading of the value chain. Third, this paper further inspects the heterogeneous impact of FTZs construction on value chain upgrading by conducting the analysis from four perspectives: geographical location of FTZs establishment, intellectual property protection strength, market environment and concentric ring distance.

There are still some limitations in this study. This paper studies the upgrading of industrial value chain, using the data of China's input-output table. Unfortunately, the data of China's input-output table is updated every five years and only updated until 2017. Served as pioneers of country's reform and opening-up, China's FTZs strategy has been proposed and implemented for eight years, and is still in a process of continuous exploration and improvement, therefore, this article only focuses on the short-term effect brought by FTZs and the research for the long-term effect can be expected in the further study. Moreover, there are many policies on reform and opening up in China, such as The Belt and Road initiative, National New Area policy, development zone policy, etc., due to the limitation of data, this paper cannot completely divorce other policies from the FTZ policy. Additionally, this paper explores the impact of China's FTZs construction on domestic value chains, but in fact, it can be extended to global value chains for a deeper study.

## **5. Conclusions**

Following the new development vision of dual-circulation, China's FTZs, as pacesetters of opening-up in the new era, is providing important support for the new round of economic globalization. This paper examines the impact and mechanism of the establishment of China's FTZs on the upgrading of the value chain by using panel data of prefecture-level cities from 2012-2017, and the main findings are as follows: first, the construction of FTZs can significantly promote the upgrading of China's value chain and the conclusion remain robust after parallel trend tests; Second, this paper also researches the impact of China's FTZs establishment on the value chain upgrading based on heterogeneity tests, conducting sub-sample regressions based on regional heterogeneity, intellectual property protection heterogeneity and market environment heterogeneity. The test results highlight that the effect of FTZ construction on value chain upgrading is greater in coastal FTZs, regions with

higher degree of intellectual property protection and better market-oriented environment. Third, the paper further finds after concentric ring effects that the impact of China's FTZs construction on the value chain is currently more manifested as a siphon effect, whether it is located on the coast or inland.

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**Conflict of interest:** none

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