

The Impact of Bonded Zones (BZs) and Export Processing Zones (EPZs) on the Export Commodity Structures (ECSs)

Yuhan Zhang^{ORCID}, Xu Zhang*^{ORCID}

School of Economics and Management, Jiangxi Agricultural University, Nanchang, China
Email: *xuzhang@stu.jxau.edu.cn

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Abstract

Bonded zones (BZs) and export processing zones (EPZs), as key measures to promote the development of export-oriented economy, have an important impact on the export commodity structures (ECSs). Using the panel data of 30 provinces, this paper empirically tests the impact of BZ and EPZ on the ECSs and the mechanism of action through the double difference method (DID). The research results show that: from the national sample, the establishment of BZ has significantly improved the ECSs. The results of regional heterogeneity show that the BZ only improves the export commodity structure (ECS) of the inland area, while the EPZ can improve the ECS of the coastal area. The dynamic effect results show that with the passage of time, the promotion effect of the BZ on the national ECS gradually increases; in the coastal area, the promotion effect of the EPZ on the ECS gradually increases; in the inland area, the BZ promotes the ECS. The promoting effect of the structure is gradually strengthened, and the inhibitory effect of the EPZ on the ECS is gradually strengthened. The mechanism test shows that the BZ improves my country's ECS through the agglomeration effect. Based on this, this paper puts forward suggestions for optimizing industrial function positioning, adjusting industrial planning according to local conditions to adapt to comparative advantages, industrial policy aiming at upgrading the structure of long-term export commodities, and establishing supporting policies to exert agglomeration effect.

Keywords

Bonded Zone, Export Processing Zone, Export Commodity Structure, Industrial Agglomeration, Advanced Industrial Structure

1. Introduction

Optimizing the export commodity structure (ECS) is one of the key tasks for pro-

moting high-quality development of trade. The key lies in how to expand the export scale of high-quality and high-value-added high-tech products in my country (Liu & Wang, 2021). To this end, China has implemented the “innovation-driven development strategy” since the 18th National Congress of the Communist Party of China. In 2015, it proposed the “Made in China 2025” strategy. The report of the 19th National Congress of the Communist Party of China clearly proposed to achieve the transformation and upgrading of China’s foreign trade structure; in 2019, the State Council’s “Guiding Opinions on Promoting High-Quality Development of Trade” proposed to optimize the ECS and vigorously develop high-quality, high-tech and high-value-added product trade; the “14th Five-Year Plan for High-Quality Development of Foreign Trade” issued by the Ministry of Commerce in 2021 further emphasized the need to promote high-tech and high-value-added equipment companies to participate in international cooperation at a higher level and optimize the ECS.

To implement these strategies, the country has implemented various industrial policies to promote high-tech industries (HTIs), such as HTI planning, export processing zone (EPZ) policies, and high-tech industrial park policies (Han et al., 2022). Among them, the EPZ and bonded zone (BZ) industrial policies have a history of more than 30 years. Since the establishment of the Shanghai Waigaoqiao BZ in 1990 and the first batch of EPZs in 2000, the State Council has approved the establishment of two major types of special customs supervision areas (SCSAs): BZs [BZs, bonded logistics parks (BLPs), bonded port areas (BPAs) and Comprehensive Bonded Zones (CBZs)] and EPZs [(EPZs and cross-border industrial zones (CBIZs)]. The government has promoted the coordinated development of BZs, EPZs and the domestic market, and improved the technology spillover effect and industrial pull effect of foreign capital in the areas. The later policy effects of establishing SCSAs have gradually emerged in China. Since 2012, the industrial added value of China’s industrial strategic emerging industries, high-tech manufacturing and equipment manufacturing has continued to expand, and at the same time, the export structure of goods has also changed (Xue, 2018). The export of HTIs has shown “explosive growth”, with an annual growth rate of 63.39% from 1995 to 2019 (Han et al., 2022). Even though it was hit by the trade war and the COVID-19 pandemic, high-tech products accounted for 43.3% of the total export of goods in 2020. Therefore, studying the impact of the establishment of BZs and EPZs on the ECSs in terms of the proportion of high-tech products in regional exports will not only help clarify the impact of the original trade liberalization policies (EPZs, BZs) on changes in trade structure and their mechanism of action, but is also particularly important for further improving and optimizing the ECSs, promoting high-level opening up, and promoting China’s transformation from a major trading country to a strong trading country.

Existing studies mainly analyze the economic or trade effects of free trade zones (FTZs). In terms of economic effects, Jenkins and Arce (2016) analyzed the economic effects of Costa Rica’s EPZs and believed that the development of enter-

prises in the zones has driven the development of local supplier enterprises through backward linkages; the economic effect of the development of offshore manufacturing in the Dominican EPZs is reflected in the promotion of regional employment and technological level (Schrank, 2008); Sun (2011) used time series data from 1993 to 2009 to empirically test the role of Shanghai Waigaoqiao BZ in promoting the economy of Pudong New Area; research on trade effects focuses on the impact of free trade zones on export trade and trade competitiveness. The empirical test results of Vicens & Miguel (2013) on the US foreign trade zones showed that the construction of foreign trade zones has a significant promoting effect on the export intensity of the states and metropolitan areas where they are located; the empirical results of Cling et al. (2005) confirmed the significant positive impact of EPZs on Madagascar's export trade; the empirical results of Ye (2017) showed that the trade effects of BZs and EPZs were significant and promoted the development of processing trade. From the perspective of the impact on corporate exports, the empirical results of Hu (2018) show that EPZs promote corporate exports, but are not conducive to improving productivity; Chen and Xiong (2015) believe that the dominant industry support policy of EPZs can significantly increase the export volume of enterprises in the industry, but the support effect on the export of dominant industry enterprises with comparative advantages is higher. Chen et al. (2017) also found that the establishment of EPZs is more conducive to the export of enterprises in industries with comparative advantages; but some studies have found that the introduction of foreign capital and advanced technology into BZs and EPZs may also lead to the low-end lock-in of the technological innovation capabilities of enterprises in the zone (Zhao, 2008); in terms of the impact on trade competitiveness, Lin and Gao (2000) believe that BZs have significantly reduced the production costs of enterprises in the zone and improved the international competitiveness of the export products of enterprises in the zone; Seyoum & Ramirez (2012)'s study on US foreign trade zones also found that enterprises moving into the zones can reduce production costs, thereby improving the export competitiveness of medium- and low-tech intensive industries; Wang (2003) pointed out that EPZs make up for the overall low efficiency of my country's trade system and high trade barriers, thereby improving trade competitiveness.

Research on the ECSs mainly focuses on the different measurements and influencing factors of the upgrading or optimization of the ECSs. Tello (2009) believes that the ECSs is one of the main aspects of export changes besides price and quantity, which refers to the proportion of a certain category or several categories of export commodities in the total export commodities of a country or region over a period of time. At present, there are four main methods in academia to measure the degree of optimization of the ECSs, namely, based on the classification of the International Trade Standards (SITC) (Wei et al., 2014), based on the Harmonized Commodity Name and Coding System (HS) (Yang, 2016), and based on the trade competitiveness index or the explicit comparative advantage index (Liu et al.,

2001). Existing studies have found that the main factors affecting the upgrading or optimization of the ECS include RMB exchange rate (Zhang, 2015), foreign direct investment (Wang & Zhang, 2011), trade openness (Lin et al., 2011), and industrial structure (Chen, 2017); some scholars have also studied the impact of specific factors on the ECS, including population aging and human capital investment (Gao & Li, 2017), environmental regulation (Shao, 2017), intellectual property protection (Li et al., 2018), market and consumption structure upgrading (Xie & Fu, 2018), and agglomeration of productive services (Zhang et al., 2020).

In summary, the existing literature focuses on the impact of BZs and EPZs on regional export trade, industry, and micro-enterprise exports. The impact of FTZs on the ECSs centered on high-tech product exports and its mechanism are relatively scarce and still need to be further studied. Therefore, based on 30 provincial panel data from mainland China from 2003 to 2017, this paper uses the double difference method to empirically analyze the impact of the establishment of BZs and EPZs on the optimization of ECS, and explores its mechanism of action, which is an inevitable requirement for promoting high-quality economic development with the help of high-level opening up.

2. Theoretical Framework

The theory of goose-shaped industrial development believes that a country's trade structure and industrial structure can interact effectively. A country can achieve the upgrading of its industrial structure through the dynamic evolution of deepening division of labor, capital accumulation and technological progress, and promote the sophistication of the technological ECSs. Technological progress is the result of acquired specialized learning and experience accumulation. The path of goose-shaped industrial development is a virtuous cycle mechanism among trade structure, technological progress and industrial structure upgrading.

Schumpeter's endogenous growth theory points out that technological innovation is the most fundamental driving force for economic and social structural changes and endogenous economic growth (Aghion & Howitt, 1992). Capello (2015) further pointed out that one of the important mechanisms for promoting regional economic transformation and development through the externality of agglomeration economy is to reduce the uncertainty of innovation activities. Therefore, industrial agglomeration will promote regional R&D and technological innovation processes by exerting its economies of scale and technological spillover effects. Combining agglomeration economies and Schumpeter's endogenous growth theory, industrial agglomeration improves regional innovation R&D efficiency and technological innovation levels through mechanisms such as economies of scale and knowledge spillover effects of intermediate inputs, thereby promoting the upgrading of regional manufacturing structure (Han & Yang, 2020), promoting regional high-tech product exports, and optimizing the regional ECS.

BZs and EPZs promote the gathering of wholly foreign-owned enterprises in specific areas by implementing preferential tax policies and special regulatory sys-

tems. A large number of foreign-funded processing trade enterprises and supporting bonded logistics, international trade and trade exhibition and other productive service enterprises gather in the park, promoting the formation of export-oriented industrial clusters by foreign-funded enterprises (Ren, 2004), and promoting the integration of my country's economy into the global division of labor system; the preferential policies and trade facilitation system in BZs and EPZs have created a good investment environment for local investment attraction, attracting a large number of multinational companies to settle in the park, and relying on the openness of the park to achieve vertical integration of global professional division of labor within the enterprise. It can be seen that as the spatial carrier of open industrial policies, BZs and EPZs use preferential policies and trade facilitation system advantages to attract foreign-funded export processing enterprises and supporting enterprises to gather in the area, promote my country's economy into the global division of labor system, and promote the industrial agglomeration in the area, and promote the upgrading of regional industrial structure by attracting foreign investment, accumulating capital and deepening international division of labor.

To sum up, according to the theory of goose-shaped industrial development, agglomeration economies and Schumpeter's endogenous growth theory, under the influence of the "economy of scale effect" and "knowledge and technology spillover effect" brought about by industrial agglomeration, as well as the industrial and technological support provided by changes in industrial structure, enterprises in BZs and EPZs can achieve a leap in commodity production efficiency and technological innovation, improve the technological content of export commodities in the zone, and continuously optimize the ECS.

3. Data and Experimental Methods

3.1. Empirical Methodology

The establishment of SCSAs such as BZs and EPZs requires application from local governments and approval from the State Council for construction, and they can be sealed and operated after passing national acceptance. Since the establishment of the Waigaoqiao BZ in 1990, a total of 168 SCSAs have been approved by the end of 2021. This method of application and establishment in batches meets the properties of a quasi-natural experiment. In order to avoid interference from unobserved factors caused by the different time periods when the parks are affected by policies, this article refers to the research of Ye et al. (2021) and uses the double difference method (DID) to study the impact and mechanism of the establishment of BZs and EPZs on the ECSs, and constructs the econometric model as follows:

$$ECS_{it} = \alpha + \beta BZ_{it} + \gamma EPZ_{it} + \delta \sum \text{Control}_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (1)$$

In formula (1), subscript i indicates region; subscript t indicates year; ECS_{it} indicates ECS; BZ_{it} and EPZ_{it} are dummy variables of BZ and EPZ respectively; Control_{it} is a set of control variables, including foreign trade dependence

(ycd), logarithm of invention patents (lnfm), R&D investment (rd), labor cost (wage), factor structure (es), and government intervention (gov); μ_i and ν_t are unobservable region and time fixed effects respectively; ε_{it} is a random error term. In the model, when coefficient β or γ is significantly positive, it means that the establishment of BZ or EPZ improves the ECSs.

3.2. Data Introduction

Based on data availability (data for the Tibet Autonomous Region are seriously missing), this paper uses provincial panel data from 30 provinces (autonomous regions, municipalities) in mainland China except the Tibet Autonomous Region from 2003 to 2017 as the research sample. Unless otherwise specified, the data are all from the China Statistical Yearbook and the statistical yearbooks of various provinces (autonomous regions, municipalities).

3.3. Description of Variables

Dependent variable: ECS. There is no unified standard in the academic community for measuring the ECS, mainly including the proportion of capital-intensive and technology-intensive products, the proportion of industrial manufactured products, and high-tech products (Lin et al., 2011). Since the increase in the proportion of high-tech product exports means the optimization of the ECS, this paper measures the ECS of a province (autonomous region, municipality) by the proportion of the total export value of high-tech products in the total export value.

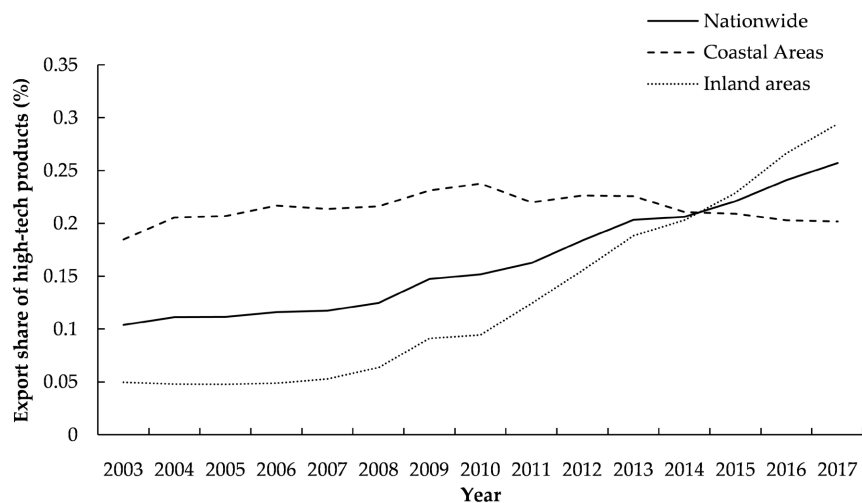


Figure 1. ECS change trend chart.

In order to illustrate the trend of changes in the ECSs and regional heterogeneity, this paper refers to the method of Teng et al. (2022) and divides the sample into coastal areas (including Liaoning Province, Beijing, Tianjin, Hebei Province, Shandong Province, Jiangsu Province, Shanghai, Zhejiang Province, Fujian Province, Guangdong Province, Guangxi Zhuang Autonomous Region, Hainan Province) and inland areas (Heilongjiang Province, Jilin Province, Inner Mongolia Au-

tonomous Region, Shanxi Province, Henan Province, Anhui Province, Hunan Province, Hubei Province, Jiangxi Province, Shaanxi Province, Ningxia Hui Autonomous Region, Gansu Province, Xinjiang Uygur Autonomous Region, Sichuan Province, Chongqing City, Guizhou Province, Yunnan Province, Qinghai Province). The trend of changes in the ECSs in different regions and their differences are shown in **Figure 1**. From 2003 to 2017, the national ECS showed an upward trend; the ECS of coastal areas fluctuated and increased before 2010, fluctuated and decreased after 2010, and was lower than the national average after 2014; the ECS of inland areas showed a substantial increase after 2007, and exceeded the national and coastal levels after 2014.

Core independent variables: BZ, EPZ dummy variables. Referring to the classification method of **Ye and Guo (2018)**, BZs, CBZs, BPAs, and BLPs are listed as BZs, and CBIZs and EPZs are listed as EPZs. The list is based on the public announcement of the “China Development Zone Network”. The specific assignment method is: determine the establishment year of each BZ and EPZ, and assign the year of establishment or establishment to BZ = 1 (or EPZ = 1), and assign the year before establishment to BZ = 0 (or EPZ = 0).

Control variables: (1) Foreign trade dependence (*ycd*), expressed as the ratio of the total import and export volume of a province (autonomous region, municipality) in a certain year to GDP; (2) Invention patents (*lnfm*), expressed as the natural logarithm of the actual number of invention patents; (3) R&D investment intensity (*rd*), referring to the approach of **Wang and Zhang (2020)**, expressed as the natural logarithm of the ratio of R&D expenditure to GDP; (4) Labor cost (*wage*), referring to the approach of **Ye and Guo (2018)**, expressed as the ratio of the average wage of urban employees to per capita GDP; (5) Factor structure (*es*), referring to the approach of **Chen (2016)**, expressed as the ratio of fixed asset stock to the total number of employees; (6) Government intervention (*gov*), expressed as the ratio of the total fiscal general budget expenditure of a province (autonomous region, municipality) in a certain year to GDP. The descriptive statistics of the main variables in this paper are shown in **Table 1**.

Table 1. Descriptive statistics of main variables.

Variable Types	Variable Name	Observations	Mean	Standard Deviation	Maximum	Minimum
Dependent Variable	ECS	450	0.164	0.166	0.776	0.000
Explanatory variables	BZ	450	0.527	0.500	1	0
	EPZ	450	0.753	0.432	1	0
Control variables	<i>ycd</i>	450	0.307	0.353	1.668	0.013
	<i>lnfm</i>	450	6.991	1.670	10.738	2.833
	<i>rd</i>	450	14.206	1.335	17.565	10.516
	<i>wage</i>	450	1.227	1.277	3.063	0.544
	<i>es</i>	450	0.683	0.683	1.635	0.049
	<i>gov</i>	450	0.208	0.208	0.627	0.079

4. Results

4.1. Basic Regression Results Analysis

The direct impact of BZs and EPZs on the ECSs is shown in **Table 2**. (1) and (2) are the regression results of the national sample. Before adding control variables, the regression coefficients of BZ and EPZ are positive and significant at the 1% and 5% levels. After adding control variables, the regression coefficient of BZs is still significant and positive at the 1% level, but the regression coefficient of EPZs is no longer significant. This shows that at the national level, the establishment of BZs is conducive to the upgrading of the ECS, but the establishment of EPZs has no effect on the ECS. The possible reason is that the functional development of EPZs is too single and they enjoy too much policy dividends, resulting in a large number of processing enterprises that enjoy land, financing benefits and financial subsidies in the parks, using cheap production factors to process labor-intensive products. These enterprises are almost at the bottom of the global value chain, resulting in the low-end lock-in of technological innovation capabilities in the parks (Ye et al., 2021). At the same time, enterprises outside the zone can apply for export tax refund (exemption) when providing raw materials or spare parts to the zone. Although this is beneficial to local supporting enterprises to a certain extent, it also leads to the low-end locking of the regional industrial structure and is not helpful in improving the ECS.

Among the control variables, the coefficient of foreign trade dependence (*y*cd) is significantly positive, indicating that increasing foreign trade dependence, that is, expanding the scale of imports and exports, is conducive to improving the ECSs. This is because the demand for advanced products in overseas markets is conducive to the technological upgrading and innovation of domestic enterprises (Deng, 2018); the coefficient of R&D input intensity (*rd*) is significantly negative, indicating that excessive R&D costs inhibit the enthusiasm of enterprises to seek technological upgrading and have an adverse impact on the upgrading of ECSs; the coefficient of labor cost (*wage*) is significantly negative, indicating that increased labor costs are not conducive to improving the ECSs; the coefficient of government intervention (*gov*) is significantly negative, indicating that excessive government intervention is not conducive to improving the ECSs, which verifies the research results of Zheng et al. (2008). However, the impact of invention patents (*lnfm*) and factor structure (*es*) on the ECSs has not yet emerged.

China's gradual opening-up path from east to west has led to differences in economic development levels and industrial structures between coastal and inland areas, which has had a certain impact on the implementation effects of BZs and EPZs. This paper divides the sample into coastal and inland areas, and the regional heterogeneity results of the impact of BZs and EPZs on the ECSs are shown in **Table 2** (3) and (4). The establishment of BZs has no significant impact on the ECSs in coastal areas, but has a significant positive impact on the ECSs in inland areas; the establishment of EPZs has a significant positive impact on the ECSs in coastal areas, but has no significant impact on the ECSs in inland areas.

Table 2. Estimated results of the impact of BZ and EPZ on the ECSs.

variable	Nationwide		Coastal Areas	Inland areas
	(1)	(2)	(3)	(4)
BZ	0.153*** (0.011)	0.067*** (0.015)	0.017 (0.012)	0.044** (0.022)
EPZ	0.045** (0.023)	-0.022 (0.022)	0.046** (0.028)	-0.045 (0.027)
yed		0.400*** (0.050)	0.081*** (0.028)	1.378*** (0.177)
lnfm		0.010 (0.015)	0.018* (0.010)	0.016 (0.023)
rd		-0.009** (0.004)	0.000 (0.002)	-0.010* (0.006)
wage		-0.086*** (0.031)	0.063** (0.031)	-0.049 (0.041)
es		0.033 (0.047)	0.099* (0.051)	0.117* (0.060)
gov		-0.795*** (0.153)	0.357** (0.032)	-0.948*** (0.190)
Constant term	0.049*** (0.017)	0.271** (0.126)	-0.194** (0.094)	0.134 (0.183)
Regional Effect	controlled	controlled	controlled	controlled
Time Effect	controlled	controlled	controlled	controlled
Observations	450	450	180	270
R ² -Within	0.341	0.484	0.364	0.645

a. *, **, and *** indicate significant at the 10%, 5%, and 1% levels, respectively, with robust standard errors in parentheses.

The possible reason is that the coastal areas were opened earlier and have a mature export processing trade system. The policy dividends of the BZs have low marginal benefits for local enterprises. At the same time, the export structure of coastal areas has shifted to high-tech and high value-added products. The traditional functions of the BZs are difficult to further promote structural upgrading. Enterprises rely more on technological innovation or global supply chain integration rather than the low-cost advantages of the bonded areas. Due to high transportation costs and low international logistics efficiency, inland areas have traditionally been dominated by resource-based products or primary processed products. The BZs reduce trade costs through the “domestic and foreign customs” function, significantly improve export competitiveness, and promote the development of processing trade. In addition, with the transfer of manufacturing, foreign-

funded enterprises undertaken by BZs have brought relatively advanced technology and management methods, which have a positive effect on the industrial development of inland areas and improve the export commodity structure of the region. The functions of EPZs are relatively single, and the impact on the regional export commodity structure mainly depends on the positioning of the leading industry functions (Chen & Xiong, 2015). The coastal areas themselves have a mature manufacturing base. The establishment of EPZs has further strengthened the scale effect and specialized division of labor, attracted foreign investment and high-efficiency enterprises to settle in, and promoted the upgrading of export structure to high value-added manufactured products. In addition, the coastal areas have obvious port advantages. EPZs are superimposed with bonded logistics, fast customs clearance and other policies, which greatly reduce trade costs, making it easier for enterprises to integrate into the global value chain and export more technology-intensive products. Inland areas are far away from ports and have high international logistics costs. Even if EPZs provide tariff preferences, transportation time and costs still weaken competitiveness. Foreign investment and enterprises are more inclined to layout in coastal processing zones, and inland processing zones are difficult to attract high-end industries. In addition, inland areas lack mature industrial chain clusters. Processing zone enterprises rely more on coastal areas to supply raw materials or core components. The local value-added rate is low, and the export commodity structure is still dominated by primary processed products. Therefore, the establishment of EPZs has no obvious effect on improving the export commodity structure of inland areas.

4.2. Robustness Test

In order to test whether the results of the benchmark regression are reliable, this paper will use the following two methods to perform robustness tests. The results are shown in **Table 3**.

First, counterfactual test. In order to exclude the impact of other policies and random factors on the ECSs, this paper draws on the method of Teng et al. (2022) to conduct counterfactual tests by changing the establishment time of industrial policies. If the establishment time of BZs and EPZs is advanced by 1 or 2 years, and the regression results are not significant or reversely significant, it means that the conclusions of the previous study are established. The results in **Table 3** (1) and (2) show that the regression results of advancing industrial policies by 1 year and 2 years are not significant or reversely significant, indicating that the research conclusions are robust.

Second, delete abnormal samples. As the center of regional politics, economy and culture, municipalities directly under the Central Government have obvious advantages over other regions in terms of openness, policy support, tax incentives, etc. (Dai et al., 2020), which may lead to bias in the overall estimation results. Therefore, drawing on the robustness test method of Ye (2017), the samples of Beijing, Shanghai, Tianjin and Chongqing were deleted, and the samples of the

remaining 26 provinces were reanalyzed. The regression results show that the regression coefficient of the BZ is still significantly positive, and the regression coefficient of the EPZ is still not significant, which is not significantly different from the conclusions of the previous study.

Table 3. Robustness test results.

variable	Counterfactual Testing		(3) Delete abnormal samples
	(1)	(2)	
L1BZ	-0.009 (0.015)		
L1EPZ	-0.018 (0.024)		
L2BZ		-0.022* (0.013)	
L2EPZ		-0.005 (0.022)	
BZ			0.067*** (0.015)
EPZ			-0.022 (0.022)
Constant term	0.249* (0.128)	0.255** (0.128)	0.272** (0.126)
Control variables	controlled	controlled	controlled
Regional Effect	controlled	controlled	controlled
Time Effect	controlled	controlled	controlled
Observations	450	450	450

b. *, **, and *** indicate significant at the 10%, 5%, and 1% levels, respectively, with robust standard errors in parentheses.

4.3. Parallel Trend and Dynamic Effect Analysis

The use of the double difference method requires that there is no systematic difference in the trend of changes in the ECS between the experimental group and the control group before the establishment of the BZ or EPZ, or even if there is a difference before the establishment, the development trend remains consistent, so that the estimated results can be considered reasonable. In order to verify the parallel trend hypothesis, this paper draws on the research of Dai et al. (2020) and constructs the econometric model as follows:

$$ECS_{it} = \alpha + \sum_{n=-2}^5 \beta_n d_{it}^n \times BZ_{it} + \sum_{n=-2}^5 \gamma_n d_{it}^n \times EPZ_{it} + \delta \sum \text{Control}_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (2)$$

In formula (2), when $t - sltime = n$, d_{it}^n takes the value of 1, otherwise it takes

the value of 0; *stime* represents the establishment time of the BZ or EPZ in region *i*; *n* takes the value of $-2, -1, \dots, 5$, where the samples after 5 years are merged into 5 years. From the regression results in **Table 4**, it can be seen that there is no significant difference in the ECS between the experimental group and the control group before the policy was established, indicating that the data conforms to the parallel trend hypothesis.

Table 4. Parallel trend and dynamic effect test results.

variable	Nationwide		Coastal Areas		Inland areas	
	BZ	EPZ	BZ	EPZ	BZ	EPZ
2nd year before establishment	-0.001 (0.021)	0.025 (0.041)	0.033 (0.024)	-0.010 (0.064)	-0.008 (0.024)	-0.004 (0.048)
established in the year	0.062*** (0.020)	0.005 (0.029)	0.003 (0.020)	0.033 (0.053)	0.034 (0.027)	-0.031 (0.034)
1st year after establishment	0.067*** (0.022)	0.001 (0.031)	-0.004 (0.020)	0.049 (0.039)	0.037 (0.029)	-0.039 (0.037)
2nd year after establishment	0.076*** (0.023)	-0.006 (0.033)	-0.005 (0.020)	0.036 (0.053)	0.050 (0.032)	-0.054 (0.039)
3rd year after establishment	0.111*** (0.025)	-0.015 (0.035)	0.003 (0.021)	0.054 (0.049)	0.102*** (0.036)	-0.060 (0.041)
4th year after establishment	0.119*** (0.027)	-0.027 (0.036)	0.003 (0.023)	0.034 (0.055)	0.120*** (0.042)	-0.077* (0.042)
5th year after establishment	0.114*** (0.030)	-0.037 (0.035)	-0.012 (0.024)	0.109** (0.054)	0.120** (0.048)	-0.125*** (0.042)
Constant term	0.306** (0.130)		-0.254** (0.108)		0.032 (0.184)	
Control variables	controlled		controlled		controlled	
Individual Effect	controlled		controlled		controlled	
Time Effect	controlled		controlled		controlled	
Observations	450		180		270	
R ² -Within	0.501		0.409		0.680	

c. *, **, and *** indicate significant at the 10%, 5%, and 1% levels, respectively, with robust standard errors in parentheses.

The dynamic effect test results show that in the national sample, the coefficient of the BZ on the ECS is positive and significant in the year when the policy is established, and the coefficient continues to increase over time. This shows that the BZ promotes the improvement of the ECS, and the promotion effect gradually increases with the passage of time. Although the coefficient of the EPZ is not statistically significant, it can be seen from the change in the coefficient that the establishment of the EPZ has a certain negative impact on the ECS, and the negative

impact gradually expands over time. The possible reason is that, over time, enterprises in the BZ have deeply embedded their institutional advantages into the global value chain, realizing the transition from cost savings to value creation. In addition, long-term competition has screened out efficient enterprises, and low value-added production capacity has been naturally eliminated. Surviving enterprises have formed barriers through accumulated implicit knowledge, making export structure upgrades feasible. For EPZ, long-term enjoyment of policy dividends may lead to inertial dependence, accustomed to low-cost competition models, and neglect of technological innovation. When the incentive effect of early policy preferences on enterprises weakens, enterprises have not yet established new competitive advantages. At this time, the EPZ have become a hotbed of low-end production capacity, dragging down the overall export structure upgrade.

The results of regional samples show that the impact of BZs in coastal areas on the ECSs is not significant in each period; the impact coefficient of EPZs on the ECSs has not changed significantly in the first four years, but is significantly positive after the fifth year of establishment, indicating that the EPZs have an obvious lag effect in improving the ECSs in coastal areas, and the improvement effect gradually increases with the passage of time. The positive impact of BZs in inland areas on the ECSs gradually increases, and the regression coefficient is significantly positive three years after the policy is established; the negative impact of EPZs on the ECSs gradually increases, and is significantly negative after four years of establishment. In summary, there are obvious regional differences in the impact of BZs and EPZs on the ECSs, and at the same time, as the policy is established, the impact effect shows a polarization trend.

5. Further Discussion: Analysis of the Mechanism of Action

Through theoretical analysis, we know that BZs and EPZs may affect the ECSs through agglomeration effect and structural effect. Therefore, this paper refers to the research of Wen and Ye (2014), uses the stepwise method to test the intermediary mechanism, and constructs the equation as follows:

$$ECS_{it} = \alpha + \beta BZ_{it} + \gamma EPZ_{it} + \delta \sum \text{Control}_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (3)$$

$$\text{effect}_{it} = \alpha + \beta BZ_{it} + \gamma EPZ_{it} + \delta \sum \text{Control}_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (4)$$

$$ECS_{it} = \alpha + \beta BZ_{it} + \gamma EPZ_{it} + \theta \text{effect}_{it} + \delta \sum \text{Control}_{it} + \mu_i + \nu_t + \varepsilon_{it} \quad (5)$$

In formulas (3), (4), and (5), effect_{it} represents the agglomeration effect and structural effect, respectively, which are measured by the tertiary industry agglomeration (scjj) and industrial structure upgrading (isg) indexes.

5.1. Agglomeration Effect

Existing literature shows that the export-oriented economic functional positioning of BZs and EPZs and the industrial positioning dominated by export processing industries have a significant attraction effect on the location of productive

service enterprises such as international trade and warehousing business (Ye, 2018). The industrial agglomeration within the park is mainly based on the tertiary industry. Therefore, this paper draws on the approach of Bai et al. (2004) and uses the tertiary industry location quotient index (*i.e.* the proportion of the tertiary industry output value in the regional total output value/the proportion of the national tertiary industry output value in the national total output value) to measure the tertiary industry agglomeration (scjj). The results of the mediating effect test of industrial agglomeration are shown in **Table 5**.

Table 5. Aggregation effect test results.

variable	(1)	(2)	(3)
	ECS	scjj	ECS
BZ	0.067*** (0.015)	0.017* (0.009)	0.064*** (0.015)
EPZ	-0.022 (0.022)	-0.051*** (0.014)	-0.015 (0.023)
scjj			0.151* (0.082)
Constant term	0.272** (0.126)	0.828*** (0.077)	0.147 (0.143)
Control variables	controlled	controlled	controlled
Regional Effect	controlled	controlled	controlled
Time Effect	controlled	controlled	controlled
Observations	450	450	450
R ² -Within	0.484	0.251	0.489

d. *, **, and *** indicate significant at the 10%, 5%, and 1% levels, respectively, with robust standard errors in parentheses.

As shown in **Table 5**, the coefficient of the BZ on the industrial agglomeration effect is significantly positive, and the industrial agglomeration effect on the ECS is significantly positive, indicating that the establishment of a BZ can promote industrial agglomeration and thus improve the ECS. However, the impact of the EPZ on the ECS is not significant, so there is no intermediary effect. BZs can reduce trade costs and optimize supply chain layout. That is, BZs are exempted from tariffs and value-added tax through the “domestic customs” policy, and enterprises can import high-quality intermediate products at low cost. In addition, upstream and downstream enterprises form supply chains in BZs, reduce logistics losses, and improve production efficiency, thereby attracting enterprises to concentrate and form specialized industrial clusters. After the industrial agglomeration is formed, it can form economies of scale, technology spillover effects, and institutional innovation effects. Specifically, it can reduce the average cost of en-

terprises and release more resources for R&D and brand building; foreign-funded enterprises and local enterprises cooperate in production to promote the diffusion of implicit knowledge; the pilot policy of BZs can also drive enterprises to extend to both ends of the smile curve, thereby promoting the path of upgrading the export structure. However, the functional structure of EPZs is single, and they enjoy greater policy benefits, which leads to the gathering of inefficient processing and OEM enterprises in the parks. Excessive policy benefits become the “rent” paid by the government to these enterprises. The purpose of enterprises moving in is only to obtain “rent”. Although this investment promotion model that uses “policy rent” as a competitive weight can achieve the spatial concentration of enterprises, it is also a simple “clustering” that makes it difficult to form industrial clusters, and therefore does not have the agglomeration effect of spontaneous evolution.

5.2. Structural Effects

Existing studies have shown that BZs and EPZs attract foreign-funded enterprises, optimize the allocation of regional production resources, transfer production resources from labor-intensive processing trade industries to technology-intensive processing trade industries, and promote industrial structure upgrading (Teng et al., 2022). In order to verify the mediating effect of industrial structure upgrading, this paper draws on the method of Liu et al. (2008) to construct the calculation formula of industrial structure upgrading (ISG) as follows:

$$isg = \sum_{i=1}^3 effect_{it} \times LP_{it} \quad (i = 1, 2, 3) \quad (6)$$

In formula (6), isg represents the level of industrial structure upgrading; i represents the first, second, and third industries; $effect_{it}$ represents the proportion of industry i in GDP in a certain region; LP_{it} represents the labor productivity of industry i during t period, which is calculated by the following formula:

$$LP_{it} = \frac{VA_i}{L_i} \quad (7)$$

In formula (7), VA_i represents the added value of industry i , and L_i represents the number of employees in industry i .

The results of the mediating effect test of industrial structure upgrading (ISG) are shown in Table 6. The BZ has no significant impact on the industrial structure upgrading, and the EPZ has no significant impact on the ECS, indicating that the establishment of BZs and EPZs cannot affect the ECS through industrial structure upgrading. The possible reasons are that, on the one hand, the policy function is mismatched with the goal of industrial upgrading. The core function of BZs and EPZs is to provide trade cost benefits such as tariff reductions and customs clearance convenience, rather than directly stimulating technological innovation or industrial upgrading. In addition, due to the low technical threshold requirements for settled enterprises, it is easy to attract labor-intensive or simple processing trade enterprises, forming a “low-end lock”. On the one hand, due to the suppression of the global value chain and the bottleneck of localization, BZs and EPZs

dominated by foreign-funded enterprises usually limit local enterprises to low-skill links, and the core technology is retained by the parent company; at the same time, enterprises in the park are highly dependent on imported intermediate products, and the linkage with the local economy is weak, forming a “bonded island”. On the other hand, the distortion of corporate behavior and institutional incentives, enterprises in the park enjoy tariff reductions and low-cost advantages, and are satisfied with the OEM model, forming a “policy dependence syndrome”. At the same time, the low-end industrial structure formed in the early stage of the park solidifies over time, and it is difficult for enterprises to shift their investment in special equipment and skill structure to high value-added fields.

Table 6. The results of the structural effect test.

variable	(1)	(2)	(3)
	ECS	isg	ECS
BZ	0.067*** (0.015)	-0.000 (0.006)	0.067*** (0.015)
EPZ	-0.021 (0.022)	-0.035*** (0.009)	-0.007 (0.022)
isg			0.400*** (0.124)
Constant term	0.333*** (0.088)	0.315*** (0.035)	0.207** (0.095)
Control variables	controlled	controlled	controlled
Regional Effect	controlled	controlled	controlled
Time Effect	controlled	controlled	controlled
Observations	450	450	450
R ² -Within	0.484	0.691	0.497

e. *, **, and *** indicate significant at the 10%, 5%, and 1% levels, respectively, with robust standard errors in parentheses.

6. Conclusion and Implications

BZs and EPZs are not only important carriers for developing an export-oriented economy, but also important measures to guide the upgrading of the ECS. However, the actual effect of the policy has not yet been confirmed. Based on the panel data of 30 provinces in mainland China from 2003 to 2017, this paper empirically tests the impact of BZs and EPZs on the ECS and their mechanism of action through the double difference method (DID). The research results show that: (1) As far as the whole country is concerned, the establishment of BZs significantly improves the ECS, but EPZs have no effect on the ECS. This result still holds after multiple robustness tests. (2) There is obvious regional heterogeneity in the impact of BZs and EPZs on the ECS. BZs only improve the ECS of inland areas, while EPZs can

improve the ECS of coastal areas. (3) The dynamic effect results show that the role of BZs in promoting the ECS of my country gradually increases with the passage of time. In terms of different regions, the impact of BZs and EPZs has obvious lag and shows a polarized trend. The promotion effect of EPZs in coastal areas on the ECSs has gradually increased, the promotion effect of BZs in inland areas on the ECSs has gradually increased, and the inhibitory effect of EPZs on the ECSs has gradually increased. (4) Mechanism tests show that BZs improve my country's ECS through agglomeration effects.

Based on the above conclusions, this paper makes the following suggestions on improving the ECS by utilizing BZs and EPZs:

First, optimize the industrial function positioning of BZs and EPZs. Change the planning ideas of BZs and EPZs. On the one hand, change the industrial positioning of processing-type BZs, adjust the development plan from focusing on "quantity" to focusing on "quality", remove the original low-value-added enterprises in the park, re-arrange the industrial chain around the regional resource advantages, introduce HTIs, improve the position of regional industries in the global value chain, and continue to play the positive impact of BZs on the ECSs; on the other hand, enrich and upgrade the functions of EPZs, improve policy support, and diversify development towards higher value-added links such as R&D, design, marketing, and branding.

Second, adjust industrial planning and comparative advantages according to local conditions. Accelerate the layout of EPZs in coastal areas, introduce policies to support the development of HTIs in the parks, and improve the structure of regional export commodities; at the same time, timely adjust the industrial functions of BZs to extend to high-end, adapt to the advantages of local economic foundations, and promote the upgrading of ECS by introducing high-value-added productive service industries with finance, commerce, logistics and research and development as the main body. In inland areas, on the one hand, continue to take advantage of policy preferences and production factor price advantages, undertake international industrial transfer, and give play to the positive role of bonded processing trade industry in ECS; on the other hand, reduce the approval of pure processing enterprises in EPZs, position advanced manufacturing as the leading industry, and improve the regional ECS by utilizing the advanced technology and management concepts of foreign-funded enterprises.

Third, industrial policies should be aimed at upgrading the ECSs in the long term. The impact of industrial policies on the ECSs is not achieved overnight. Therefore, we should take the "14th Five-Year Plan" for high-quality development of foreign trade as a guide, learn from the successful experience of active special zones such as free trade pilot zones and free ports, and promote the adjustment and upgrading of BZs and EPZs from "policy depressions" to "institutional highlands". Through institutional innovation, we will implement high-standard foreign investment rules of "pre-entry national treatment + negative list", efficient administrative efficiency and simplified customs clearance proce-

dures, and use the dividends of institutional innovation to enhance the attractiveness of high-quality foreign-funded enterprises to enter the park, and provide sustained momentum for the long-term development of the regional industrial structure.

Fourth, establish supporting policies for industrial agglomeration and give play to the agglomeration effect. Formulate supporting policies to attract high-tech foreign-funded enterprises to settle in the BZ, guide local enterprises and multinational companies to form industrial clusters through planning industrial parks, realize resource sharing and personnel flow within the region, and generate technology spillover effects, continuously improve the core technology level and international competitiveness of regional industries, and continue to give play to the positive role of the agglomeration effect in the BZ on the ECS.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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