

Does the Division of Domestic Value Chains Affect the Export Binary Margin

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Abstract: This study examines the potential heterogeneous effects of domestic value chains (DVCs) on two different paths of export expansion, namely the intensive margin and the extensive margin. Using panel data of 195 prefecture-level cities in China spanning from 2000 to 2013, this paper explores the association between DVCs and export binary margin. The results indicate that DVCs exhibit a significant positive U-shaped relationship with the export intensive margin, while it has a linear positive effect on the export extensive margin. Additionally, market integration and market competition emerge as important mechanisms through which DVCs influence the city's export binary margin. In addition, the study suggests that central and western regions' integration into DVCs more strongly promotes local export expansion compared to eastern regions. Overall, the empirical evidence presented in this paper contributes to enhancing the understanding of the development pattern of DVCs in China from the perspective of trade competitiveness.

Keywords: Domestic value chains, Intensive margin, Extensive margin, Market integration, Market competition.

1. Introduction

Upon China's accession to the World Trade Organization (WTO) in 2001, its manufacturing enterprises were integrated into global value chains (GVCs), resulting in a surge of substitute labor opportunities and division of labor tasks. This expansion of foreign trade acted as one of the three drivers behind China's economic growth. In recent times, the development of GVCs has slowed down, and the international scenario has become complex. The traditional comparative advantage of China has declined significantly, constraining the growth space of China's export trade and weakening the role of exports as an engine of economic growth. The changing internal and external environment has posed serious challenges to China's export model, requiring a move away from the past dependence on the international economic cycle to invigorate exports. This shift necessitates the adoption of the domestic value chains (DVCs) strategy, which takes advantage of the division of labor and cooperation between regions to facilitate value climbing. Liu and Zhang (2008)[1] were the first to propose this concept, which has since gained significant attention in the Chinese context. The development of DVCs has become an essential direction for China to overcome the "low-end lock" dilemma of GVCs and solve the issue of weakening traditional comparative advantages of exports.

The building of DVCs is a crucial aspect for China's economic development, enabling it to achieve industrial upgrading and growth. However, DVCs also carry the potential risk of functional homogenization locking, which needs to be considered while assessing their benefits. While domestic production linkages have the potential to lower coordination costs and foster product differentiation, they can also create higher switching costs for a country or region that wishes to expand its international value chains, thereby reinforcing the "lock-in effect" of functional linkage homogeneity. The final outcome of the DVCs creation depends on the relative magnitude of these two effects (Beverelli et al., 2015)[2]. This paper aims to evaluate the economic impact of DVCs at the city level through the export

binary margin perspective. By empirically testing the effect of DVCs construction on city's export participation, we intend to complement the existing economic literature. It is worth noting that binary marginal welfare implications differ from trade gains and studying the effect of DVCs from the binary marginal perspective can provide insights that traditional trade theory fails to capture.

2. Theoretical Mechanism and Research Hypothesis

This paper posits that the export binary margin can be impacted by DVCs through the avenues of market integration and market competition.

From a market integration perspective, the construction of DVCs is beneficial in breaking down administrative protection and market barriers between domestic regions, thereby promoting regional market integration (Beverelli et al., 2019)[3]. This integration facilitates the flow of products and factors more freely and efficiently in space, which results in scale market advantages, the integration of upstream and downstream resources in the industry, and the exploration of domestic demand potential. By reducing trade barriers and transaction costs such as logistics and transportation, market integration can lower the production costs of enterprises and make it easier for them to find domestic suppliers of intermediate goods, thereby facilitating regional comparative advantages and regional specialized division of labor, and further reducing the production costs of enterprises. As per the heterogeneous firm theory, the reduction in production costs can enable incumbent firms that have already exported to export products at lower prices, allowing them to gain a larger export market share through lower prices. For firms below the critical export level, this cost reduction can lower the threshold level for exporting, leading to more firms entering the export market (Melitz, 2003)[4]. Increasing market integration through the deepening of DVCs can thus help firms reduce production costs and gain a larger export market share, leading to an increase in the intensive and extensive margins of export.

However, empirical evidence from a considerable number of studies suggests that market integration exerts a significant negative impact on firms' export performance. Firms face high domestic exotic market entry costs at low levels of market integration, which prompts them to expand their market share through exports. Under such circumstances, improving market integration reduces the cost of domestic exotic entry, which increases the proportion of domestic sales (Ye et al., 2017)[5]. As a result, some products originally intended for export are sold domestically, leading to a decline in the export intensive margin. Considering that the fixed costs faced by firms after they start exporting fall significantly, to avoid the high sunk costs they need to pay to re-enter the market, firms usually choose to continue exporting even after the domestic market demand expands (Berman et al., 2010)[6], resulting in a much lesser dampening effect of market integration on the domestic demand squeeze brought about by new product exports, compared to the boosting effect brought about by its resulting reduction in production costs. Consequently, the effect of domestic value chains on the city's export intensive margin is U-shaped, while the effect on the extensive margin is linear and positive.

From a market competition perspective, the promotion of market competition can be facilitated by the establishment of domestic value chains. Developed economies hold an asymmetric advantage over emerging economies by monopolizing the production technology or patents of core intermediate goods through control over the selling price of imported intermediate goods, forcing emerging economies dependent on GVCs to lose bargaining power and even face the risk of supply disconnection (Meng et al., 2013)[7]. The construction of DVCs can break the market monopoly and price monopoly of multinational corporations and large enterprises, leading to a reduction in enterprise monopoly profits and ensuring the orderliness of market competition. Intense market competition prompts enterprises to invest more in product development to secure market share and gain profits (Correa & Ornaghi, 2014)[8], resulting in a decrease in fixed costs. The fierce competition among enterprises further leads to the "survival of the fittest", promoting overall productivity. According to the Melitz (2003)[4] theory, productivity improvement helps firms enhance their competitiveness in exports. This implies that DVCs are capable of promoting R&D and technological innovation via the reinforcement of market competition, resulting in reduced production costs and overall improved productivity of enterprises. Consequently, firms can enter into the export market or acquire larger export market shares, leading to heightened export extensive and intensive margins of cities.

Furthermore, as firms become increasingly invested in the production of new products, the scale of existing production may decrease, thereby decreasing existing exports. When market competition is low, the impact of competition on productivity improvement is also low. In this case, the influence of firm investment in new products on the export of original products is greater than that of the increase in productivity due to market competition on the export of original products. In other words, the negative effect of market competition is greater than the positive effect, thereby inhibiting the intensive margin of export. Nevertheless, with the intensification of market competition, the positive effect gradually becomes stronger than the negative effect, leading to an increase in the intensive margin of city's export. Importantly, market competition does not exert the

aforementioned squeezing effect on the export of new products, thereby not inhibiting the export of new products. In conclusion, the impact of market competition on the export intensive margin of the domestic value chain is U-shaped, while the impact on the export extensive margin is linear and positive.

Drawing on the analysis presented above, this paper advances two hypotheses for empirical testing: (i) DVCs have a positive U-shaped nonlinear effect on the export intensive margin and a linear positive effect on the extensive margin, (ii) DVCs can influence the intensive and extensive margins of city's export through two major channels: market integration and market competition.

3. Core Indicators Measurement and Data Description

3.1. Measurements of Core Indicators

3.1.1. Explanatory variable: domestic value chain (DVC)

Matching the world input-output table with the four-digit code of the Chinese industrial enterprise database to obtain the input-output coefficients at the enterprise level, the city-level domestic value chain is defined by equation (1):

$$DVC_c^t = \sum_{i=1}^{i=n^c} dvc_i^t \times \left(\frac{output_i^t}{output_c^t} \right), i \in c \quad (1)$$

where DVC_c^t represents the domestic value chain of city c in year t . dvc_i^t is the full domestic input-output coefficient of enterprise i in year t . $\frac{output_i^t}{output_c^t}$ represents the share of the total output value of enterprise i located in city c to the total output value of city c .

3.1.2. Dependent variables: intensive margin (spec) and extensive margin (Indive)

This paper employs the standardized Herfindahl index as an indicator of export intensive margins, drawing on the work of Al-Marhubi (2000)[9]. The index is defined by equation (2), where W_{ijt} represents the exports of a specific 4-digit code industry j from city i in year t , W_{it} refers to the total exports of all industries in city i in year t , and spec represents the intensive margin index of the city t in year t . To obtain the necessary data, the total exports of all industries and specific 4-digit code industry exports of each city are extracted from the China Industrial Enterprise Statistical Database.

$$spec_{it} = \frac{\sqrt{\sum_{j=1}^n \left(\frac{W_{ijt}}{W_{it}} \right)^2} - \sqrt{\frac{1}{n}}}{1 - \sqrt{\frac{1}{n}}} \quad (2)$$

Additionally, the number of 4-digit code industries exported by each city is utilized as the number of export categories (dive) for that city, in line with Herzer et al. (2006)[10]. To calculate the extensive marginal index (Indive), the logarithm of the number of industries exported in each city is taken, and the data is obtained from the database of Chinese industrial enterprises.

3.2. Data Description

The present study focuses on the period from 2000 to 2013 and employs three main sources of data: the World Input-Output Database (WIOD) 2016 version, which provides country-industry level data for measuring DVCs; the Chinese

industrial enterprise database, from which this study excludes various variables such as total output, sales industrial value added, intermediate inputs, total fixed assets, net fixed assets annual average balance with missing, negative, or zero values, as well as the number of employees that are missing or less than 8, used to measure DVCs, intensive margins, and extensive margins; and Calendar Yearbook of Urban Statistics of China, using linear difference method for missing values, used to measure control variables.

4. Empirical Analysis

4.1. Measurement Model Setting

This paper aims to investigate the influence of city's domestic value chain on export expansion from two distinct perspectives: the intensive margin and the extensive margin. We propose an econometric model to examine this relationship, where i refers to the city and t refers to the time, indicating 2000-2013. The dependent variables in the model include $spec$ and $ln\text{dive}$, which represent the city's export intensive margin and the city's export extensive margin, respectively. The primary explanatory variable in this study is DVC, which stands for the city's domestic value chain. Additionally, X denotes a set of control variables, while u_i represents the city fixed effect, u_t is the year fixed effect, ε_{it} is the random disturbance term, and $\alpha_0, \alpha_1, \alpha_2, \beta$ is the parameter to be estimated.

$$spec_{it} = \alpha_0 + \alpha_1 DVC_{it} + \alpha_2 DVC_{it}^2 + \beta X_{it} + u_i + u_t + \varepsilon_{it} \quad (3)$$

$$\ln\text{dive}_{it} = \alpha_0 + \alpha_1 DVC_{it} + \beta X_{it} + u_i + u_t + \varepsilon_{it} \quad (4)$$

Based on the existing literature, this paper has identified a

set of relevant city-level control variables, namely government market participation ($gove$), total sales of foreign enterprises ($ln\text{fdv}$), total freight transportation ($ln\text{stru}$), scientific research investment (rd), human capital ($ln\text{humc}$), and urban gross domestic product ($ln\text{gdp}$). Specifically, $gove$ is used to assess the extent of government intervention in the market, $ln\text{fdv}$ reflects the contribution of foreign enterprises to the local economy, $ln\text{stru}$ measures the degree of infrastructure development, rd captures the government's investment in scientific research, $ln\text{humc}$ is an estimate of human capital based on the educated year method, and $ln\text{gdp}$ represents the local market effect.

4.2. Full-sample Regression

Table 1 presents the regression outcomes for the DVCs with the export binary margin. Where column (1) considers only the effect of the core explanatory variable (DVC) and its squared term (DVC^2) on the intensive margin ($spec$), the results show that the estimated coefficients of the DVC primary and squared terms are negative and positive, respectively, and both pass the significance test. Correspondingly, the estimation results remain robust with the inclusion of city-level control variables (as shown in column (3)). This indicates that the impact of DVCs on the city's export intensive margin shows a positive U-shaped characteristic and trend of first inhibiting and then promoting. Moreover, column (2) examines the effect of DVC on the city's extensive margin ($ln\text{dive}$), revealing a significantly positive coefficient at the 1% level. This result remains robust even after adding control variables, as demonstrated in column (4), suggesting an upward trend in the city's extensive margin as DVC in Chinese cities increases. These findings are consistent with the hypothesis.

Table 1. Full-sample Regression

	(1) int. margin	(2) ext. margin	(3) int. margin	(4) ext. margin
DVC	-1.6378*** (-4.2624)	0.4223*** (3.1076)	-1.3797*** (-3.5839)	0.4708*** (3.3486)
DVC ²	0.4687*** (4.4109)		0.4106*** (3.8562)	
$gove$			-0.2277** (-2.2945)	1.0146*** (3.4873)
$ln\text{fdv}$			0.0100*** (3.2993)	-0.0169* (-1.8974)
$ln\text{stru}$			-0.0297*** (-4.2594)	0.0486** (2.3880)
rd			0.0258 (0.9084)	0.0387 (0.4659)
$ln\text{humc}$			-0.0090 (-0.3811)	0.0633 (0.9165)
$ln\text{gdp}$			0.0589*** (2.9943)	0.2513*** (4.3650)
Constant	1.8382*** (5.3028)	2.5609*** (11.5720)	1.4815*** (3.7433)	0.3335 (0.5699)
Observation	2730	2730	2730	2730
R-square	0.0504	0.2692	0.0693	0.2801

Notes: We control for the fixed effects of year and city. ***, **, and * denote passing the test at the 1, 5, and 10% significance levels, respectively.

4.3. Regional Heterogeneity Analysis

As a consequence of China's uneven regional economic development, the effects of DVCs on export activities in

different regions may be subject to considerable variation due to differences in the economic development, export trade levels, and regional location of various cities. In light of this, the current study employs a further subdivision of the

research sample, whereby the sample is categorized according to the geographic location of cities into the eastern, central, and western regions, and by economic development levels into first- and second-tier cities, and third-tier cities and below, intending to examine the heterogeneous effects of DVCs on

export binary margins across different types of cities. The empirical equations employed in the study align with the overall research approach. The specific findings are presented in Table 2.

Table 2. Sub-regional Tests

	Eastern regions		Central regions		Western regions		First and second-tier cities		Third-tier cities and below	
	(1) Int.	(2) ext.	(3) Int.	(4) ext.	(5) Int.	(6) ext.	(7) Int.	(8) ext.	(9) Int.	(10) ext.
DVC	-1.06** (-2.50)	0.07 (-0.50)	-1.27* (-1.69)	0.70** (-2.00)	-2.59*** (-2.88)	0.47* (-1.90)	-2.00*** (-3.48)	0.19 (-0.95)	-1.43*** (-2.93)	0.62*** (-3.55)
DVC ²	0.30*** (-2.59)		0.37* (-1.81)		0.77*** (-3.05)		0.51*** (-3.22)		0.44*** (-3.27)	
gove	-0.20 (-1.01)	-0.03 (-0.06)	-0.29 (-1.13)	5.70*** (-6.28)	-0.06 (-0.35)	-0.09 (-0.23)	0.12 (-0.39)	-0.82 (-1.04)	-0.16 (-1.47)	1.06*** (-3.21)
lnfdiv	0.00 (-0.46)	0.02 (-1.41)	0.01** (-2.44)	-0.05** (-2.20)	0.02*** (-2.66)	0.00 (-0.30)	0.01 (-0.92)	0.02 (-1.38)	0.01*** (-3.31)	-0.03** (-2.50)
lnstru	-0.01 (-0.80)	0.00 (-0.09)	-0.05*** (-3.75)	-0.03 (-0.65)	-0.03 (-1.26)	0.17*** (-3.18)	0.02 (-1.51)	0.04 (-0.94)	-0.03*** (-4.25)	0.04* (-1.86)
rd	0.05** (-2.22)	-0.20*** (-3.31)	0.02 (-0.32)	0.34 (-1.58)	0.18 (-1.58)	-0.66** (-2.54)	0.10*** (-2.95)	-0.09 (-0.94)	-0.08* (-1.78)	0.20 (-1.49)
lnhumc	0.00 (-0.17)	0.10 (-1.58)	0.02 (-0.41)	-0.15 (-0.91)	-0.03 (-0.44)	0.24 (-1.64)	0.12*** (-2.92)	0.03 (-0.22)	-0.07** (-2.34)	0.12 (-1.41)
lngdp	-0.01 (-0.63)	0.30*** (-4.96)	-0.10** (-2.49)	1.18*** (-8.39)	0.23*** (-5.29)	-0.28*** (-2.71)	-0.01 (-0.28)	0.26*** (-2.86)	0.07*** (-3.01)	0.25*** (-3.64)
Constant	1.35*** (-3.17)	1.43** (-2.22)	2.25*** (-2.82)	-3.51*** (-2.78)	1.79* (-1.94)	0.40 (-0.37)	1.16* (-1.85)	1.68* (-1.72)	1.83*** (-3.71)	-0.39 (-0.55)
Observation	1092	1092	868	868	770	770	616	616	2114	2114
R-square	0.1209	0.5614	0.1211	0.3946	0.1099	0.2138	0.2493	0.4588	0.0635	0.2601

Notes: We control for the fixed effects of year and city. ***, **, and * denote passing the test at the 1, 5, and 10% significance levels, respectively.

According to the test results, the impact of DVCs on export intensive margin exhibits a significant positive U-shaped feature for cities in different geographic locations, regardless of whether they are located in the eastern, central, or western regions of China. The inflection point of the DVC level is relatively higher in the central region, indicating that enhancing the export intensive margin through DVCs requires a higher degree of participation in the central region compared to other regions. In terms of the extensive margin, the coefficient of the effect of DVCs on the local export extensive margin is insignificant in the eastern region but significantly higher in the central region than the coefficient of the full sample test. The coefficient in the western region is close to the coefficient of the full sample. This suggests that the effect of DVCs on the extensive margin has not yet been revealed in the eastern region, while the effect of DVCs on the extensive margin is greater in the central and western regions than in the eastern region, with the greatest effect observed in the central region.

The occurrence of DVCs on export expansion in the central and western regions is evident relative to the eastern region probably because: the eastern region uses more foreign intermediate products in its exports and puts in a lower proportion of intermediate products from other regions of China, and gains less benefit from cooperation with the central and western regions because of relatively more advanced technology. In contrast, the main path for the central and western regions to gain value added in exports is with the help of domestic intermediate products to the eastern coastal provinces and cities and then embedding GVCs with the help

of direct exports from the eastern provinces and cities, which can both absorb the spillover benefits from the high-end factors in the eastern region through participation in the DVCs and also integrate the production materials within the region, thus improving production efficiency. He et al. (2023)[11] suggested that the export products of central and western China are mostly resource-intensive products, and the DVCs are reinforced more through the upstream supply of central and western regions, which makes it difficult for the advanced production factors in eastern regions to carry out the interregional division of labor and collaboration. Therefore, with the continuation of the single model of "Midwest→East," DVCs will face the risk of low-end. Hence, China needs to pay attention to grasping the relationship between intra-regional cooperation and extra-regional cooperation, pay attention to the value interaction and flow characteristics among regions, and actively integrate into GVCs to realize the multi-level and all-round value chain upgrading of each internal region.

The findings indicate that DVCs have a significant positive U-shaped relationship with the intensive margin of export across cities with different economic development levels, regardless of whether they are classified as Tier 1 and Tier 2 or Tier 3 and below. Moreover, the DVC is relatively higher in Tier 3 and below cities. However, the coefficient of the effect of DVC on the extensive margin in Tier 1 and Tier 2 cities fails to pass the significance test. In contrast, the coefficient of the extensive margin in Tier 3 and below cities is significantly higher than that of the full sample test. This suggests that the impact of DVC on export expansion is more

pronounced in Tier 3 and below cities than in Tier 1 and 2 cities. This trend may arise due to several factors. For instance, Tier 1 and Tier 2 cities possess a higher level of economic development that enables them to attract and nurture firms with advanced technology levels, thereby maintaining a dominant position in DVCs and gaining fewer benefits from synergistic cooperation with Tier 3 and below cities. In contrast, Tier 3 and below cities with more backward technology can participate in DVCs to acquire technology spillovers from other regions and achieve production material integration, thereby improving production efficiency and facilitating export expansion.

5. Conclusion

This paper investigates the relationship between DVCs and export expansion using a value chain analysis framework and a heterogeneous trade theory research approach. By analyzing panel data of 195 prefecture-level cities from 2000-2013, this study uncovers several key findings. First, DVCs may have a negative impact on cities' exports in the short run but can promote export expansion in the long run. This conclusion is supported by examining the effects of DVCs on the intensive margin and the extensive margin. Second, market integration and competition can strengthen the positive effect of DVCs on the export binary margin. As market integration and competition reach a certain level, promoting them can better leverage the positive effect of DVCs on export expansion. Third, the study finds that the integration of central and western regions into domestic regional value chains can promote local export expansion more strongly compared with the eastern regions. This result is consistent with empirical evidence and extensive literature and suggests the need for further exploration on how to accelerate market exchanges between the eastern and central/western regions to achieve a multi-level and comprehensive value chain upgrading in each region in China.

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