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Research Article

The Impact of High-Speed Railway Accession on Agricultural Exports: Evidence from Chinese Agriculture-Related Enterprises

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Although many studies have analyzed the transportation infrastructure effects on economic and trade development, little is known about the relationship between transportation infrastructure and trade in the agricultural sector. We take the opening of China's high-speed railway (HSR) as a quasi-natural experiment and use multiperiod DID model to explore the impact and mechanism of HSR on agriculture-related enterprises' exports. The results show that HSR can promote export growth of agriculture-related enterprises by 6.9%, and it will reach 10% in 5 years. However, the effect of HSR on the export of agriculture-related enterprises only exists within 45 km around HSR stations. HSR can reduce information barriers and costs for enterprises to enter the international market by providing transportation convenience and improving market access levels. HSR also offers local areas more transportation advantage compared to other surrounding areas, which in turn makes a siphon effect on export activities. Both these mechanisms are significant within 45 km, and it is extremely obvious for poor transportation areas and enterprises with higher productivity, and the siphon effect is even stronger than market access. Heterogeneity analysis results demonstrate that HSR has different effects for different types of enterprises.

1. Introduction

Agriculture is the foundation of the economy for a country, and the export of agricultural products is an important manifestation of the agricultural international competitiveness. Since the 21st century, Chinese agricultural exports have shown a gradually increasing trend, making China become the world fifth largest agricultural exporter (Chinese agricultural exports from 15.449 billion dollars in 2001 increase to 76.989 billion dollars in 2019. The data comes from the UN Comtrade database). However, Chinese agricultural exports lack international competitiveness with a lower market share compared to other countries (in 2019, it accounted for only 4.89% of the world's agricultural exports, which was lower than the EU (39.13%), USA (9.00%), ASEAN (8.54%), and Brazil (4.97%). The data comes from the UN Comtrade database and has been sorted and calculated). In China, agricultural products have also shown a trend of marginalization in the export structure. Their share of total exports has gradually decreased from 5.81% in 2001 to 3.08% in 2019, while the EU, USA, ASEAN, and Brazil have maintained their share of agricultural exports stable and rising trend, keeping an important position in its export structure (the share of EU agricultural exports in total exports has gradually increased from 8.12% in 2001 to 9.83% in 2019, the USA has increased from 7.67% to 8.61%, ASEAN has risen from 7.69% to 9.10%, and Brazil has increased from 27.90% to 34.93%. The data comes from the UN Comtrade database). The export influence of Chinese agricultural products is far less than that of developed countries. And, there is still a considerable gap compared with some developing countries such as Brazil and ASEAN. More importantly, compared with industrial enterprises, China's agricultural enterprises are generally small in scale and low in technology intensity, in addition to China's vast territory, poor traffic, and information conditions in counties and townships, imposing the export of agricultural products under high restrictions and barriers to enter the

international market. In 2017, the Chinese government proposed a rural revitalization strategy to revitalize the declining agriculture and rural areas and clearly requested to promote the prosperity of agricultural and rural industries. Therefore, we need to support the development of agricultural enterprises and encourage agricultural enterprises to expand the market scope to enter the international trade market. It can facilitate the export of Chinese agricultural products and revitalize Chinese agricultural and rural areas. How to break through geographic restrictions and market information barriers and lower the thresholds to enter the international market so that more agricultural enterprises participate in the export has become a critical issue for China's agriculture. The emergence of high-speed railway (HSR) offers possibilities to solve this problem.

HSR has brought a new growth engine for Chinese economy, and it also has a huge impact on Chinese agricultural trade. HSR has gone through a fast development in China since the construction of its first high-speed railway in 2008. By the end of 2019, Chinese HSR operating mileage has reached 35,000 km, becoming the largest HSR's country in the world (the data comes from the 2019 China Statistical Yearbook). At the same time, the "eight horizontal and eight vertical" network pattern and trunk lines have basically been formed, and a series of branch HSR lines have been extended from trunk lines, further improving Chinese HSR's network. As a result, the coverage of HSR in small- and medium-sized cities and even county areas rather than just large cities has greatly improved the convenience of transportation in those areas and stimulated the vitality of local industry. The downward extension of HSR's network takes charge of the agricultural and rural economy within the scope of HSR. Its space-time compression has greatly narrowed the barriers and obstacles to communicate with the outside world and brought huge development opportunities to the agricultural enterprises in these areas. In county-level and township areas, agriculture and agricultural product processing industries account for a large proportion of the industry, which play a crucial role in the growth of local employment and income. Under the dual background of Chinese promotion of rural revitalization strategy and the improvement of HSR's construction, will HSR become an important force for agriculture-related enterprises to break through the time-space limitation and enhance the participation of export? If HSR can promote the export of agriculture-related enterprises, it will raise a series of theoretical and practical questions: should we explore the degree of HSR's effect on the export of enterprises and the impact's mechanism? Will the effect of HSR on the exports be affected by the distance between enterprises and HSR's stations? Will the policy effects of HSR on different enterprises be heterogeneous? The discussion of the above questions will enrich and improve the relevant theories of HSR's economy and also expand the application research in Chinese agricultural trade.

In this paper, we take the opening of Chinese HSR as a quasi-natural experiment to explore the impact and mechanisms of HSR on export of agriculture-related enterprises. Then, we group the distance between enterprises and HSR stations to further discuss the role of distance threshold in determining HSR's effect on enterprises. We use instrumental variables to deal with endogenous problems and adopt robustness and placebo tests to verify the reliability of the results. Furthermore, we examine the mechanisms from two aspects: market access and siphon effect. Finally, we analyze the heterogeneous impact of HSR on different enterprises. To sum up, the research in this paper will contribute to and further supplement the existing literature. First of all, although there are many literature confirming the positive impact of roads, highways, railways, and other transportation infrastructure on economic growth and international trade, because HSR is an emerging transportation infrastructure, there is a lack of literature on the impact of HSR on international trade. Our paper will focus on HSR and supplement this part; second, we are concerned about the development of China's agriculture and the impact of China's HSR in agricultural development. There are few literature in this part, but this has very important practical significance for China's agricultural development; finally, we discuss the mechanism of the impact of HSR on trade and make up for the lack of previous literature on mechanism research. Then, the rest of the thesis is organized as follows. Section 2 provides a literature review. Section 3 offers a theoretical analysis. Section 4 presents empirical strategy and data. Section 5 presents estimation results, solution of endogenous problems, robustness checks, and placebo test. Section 6 discusses the mechanisms and heterogeneous effects. Section 7 concludes and offers policy suggestions.

2. Literature Review

Transport improvements can be regarded as a key component of regional economic competitiveness. "If you want to get rich, build roads first" shows the importance of transportation infrastructure construction for the local economy [1]. Most studies have fully confirmed the positive role of transportation infrastructure in regional economic growth [2–5]. As a fast-reaching transportation, HSR can operate at a speed of more than 200 km/h, up to and can reach a maximum of 350 km/h. It significantly breaks the time-space constraints and has an obvious impact on economic activities. Zou et al. explored the impact of the HSR network on the economic growth of 110 major cities in China and found that the start of HSR has an apparent positive effect [6]. Diao et al., respectively, verified the positive effects of HSR on regional economic growth according to the changes in fixed asset investment and the intensity of night light before and after the opening of HSR [7, 8].

With the deepening of globalization and trade liberalization, the impact of transportation infrastructure on international trade has gradually received greater attention from researchers. Many studies have shown that the transportation infrastructure plays a crucial role in reducing transportation costs and facilitating the growth of trading activities [9–11]. Countries with large trade value in the world usually have relatively better domestic transportation

conditions [12–14], and low-level domestic transportation infrastructure has a restraining effect on the international trade [15, 16]. In the research on transportation infrastructure and trade, the traffic objects such as roads and railways are mainly studied, with relatively less focus on HSR. The main reason is that HSR is an emerging transportation infrastructure. Only a few countries in the world, such as China, have a complete HSR's network. Therefore, the impact of HSR on export has been rarely studied, which is far from enough and requires further improvement. Xu et al. provided some research evidences in this field, showing that the construction of HSR can help promote the growth of local export [17–19].

Many scholars have discussed how transportation infrastructure affects export. The most intuitive conclusion is that the construction of transportation infrastructure can reduce the transportation cost of enterprises, and enterprises can conduct export activities at lower costs, thereby promoting the growth of export [20–23]. However, it is worth noting that China's HSR cannot directly reduce transportation costs because it does not directly transport goods. It enables scholars to explore the mechanism of HSR on trade from other aspects. Some scholars think that trade relations depend on the interaction of producers, intermediate traders, and foreign buyers. Therefore, close communication between trading partners plays a key role in information sharing and identification of trade opportunities [24, 25]. A good transportation infrastructure can increase the frequency of external contacts. It has created an efficient information communication mechanism to reduce information barriers and improve trade efficiency. Cosar and Demir pointed out that the construction of highways has reduced access barriers to international markets [26]. Some scholars also believe that HSR plays a very important role in increasing the frequency of communication between enterprises and reducing information costs and barriers. However, there are not many direct research studies on trade, most of which are focused on the business activities of enterprises. Faber pointed out that constructing transportation facilities would connect the central and surrounding cities and reduce trade cost by strengthening communication and exchanges between regions [27]. This kind of communication is reflected in improving commuting efficiency between regions and exchanging information between corporate headquarters and branches [28]. And, it enables enterprises to strengthen their ties with the outside areas and reduce their market search and business outsourcing costs by enhancing their matching efficiency with suppliers, thereby improving the business performance of enterprises along the route [29].

This paper mainly contributes to the literature in the following ways. Firstly, more and more literature have confirmed the positive effects of transportation infrastructure such as road, highway, and railway on economic growth and international trade. But there is still lack of research on HSR in the trade field. So, we will use the export data of Chinese enterprises to further improve from a micro-perspective. Secondly, this paper studies the impact of HSR on the export of agriculture-related enterprises. Previous studies have rarely involved research on the application of HSR in the agricultural field. With the improvement of Chinese HSR's network and the implementation of rural revitalization strategy, it is necessary and worthwhile to study the impact of HSR on agricultural-related industries. Thirdly, we have discussed the impact of the distance between enterprises and HSR's station on the export and confirmed that the opening of HSR can only affect the export of enterprises within 45 km, with no significant effect beyond 45 km. This is a novel point of view compared to previous studies. Finally, the previous literature has not sufficiently discussed the mechanism of HSR on trade. We have considered the mechanism of HSR on trade from two aspects: market access and siphonic effect, which have effectively made up for the deficiencies of the previous literature on the mechanism. China's vast territory provides extremely rich agricultural resources, and plenty of agriculture-related enterprises use agricultural products as their main raw materials or final products, which provide rich samples for this research. This paper is significant for China to attach great importance to agriculture and rural areas, and it also has significant referential effects for other developing countries with the attempt to establish rapid transportation infrastructure similar to HSR to promote agricultural export.

3. Theoretical Background and Analysis Framework

We explore the effect of HSR on export under the following theoretical background. With reference to the methods of Grossman et al. [30, 31], we assume that the export products of agriculture-related enterprises need to be made by several manufacturers in multiple regions, from raw material acquisition, product processing, and transportation to external sales. This process is restricted by the cost of information such as communication between the two regions. The substantial improvement of transportation infrastructure made by HSR can greatly improve the local market access level. Local agriculture-related enterprises, especially those around HSR's stations, can take full advantage of the transportation superiorities brought by HSR, quickly reach other regions, and establish more frequent contacts with producers, middlemen, and traders in other regions. It can help agriculture-related enterprises fully understand the market information and find more production orders and trade opportunities. Therefore, this passenger-oriented transportation mainly improves the market access level and lowers the threshold of entering the local market. It is conductive to the frequent face-to-face communication between local enterprises and the outside world to drive the growth of economic and trade activities.

HSR can improve the local market access level and then guide economic and trade activities in surrounding regions without HSR flow to HSR's location. It is easy to cause trade competition between different regions, resulting in a siphonic effect. Krugman [12] used "center-periphery" model to analyze economical activities' spatial location and believed that economic activities tend to gather from periphery to central area, which has a siphonic effect on

economic and trade activities in peripheral areas. HSR will increase spatial mobility of the resources and the clustering from non-HSR regions to HSR's regions and enable local agriculture-related enterprises to gain benefits in trade competition among similar enterprises in surrounding areas. Since agriculture-related enterprises mainly export low-end and homogenized products, export trade activities have strong regional substitutability. HSR helps local enterprises to compete for more trade opportunities and export orders, forming a siphonic effect for enterprises in surrounding regions. While promoting the export growth of agriculture-related enterprises in HSR's regions, it has also led to a decrease in exports of enterprises without HSR.

Furthermore, we take the mechanism of market access as an example for the theoretical derivation of export. In international trade, we treat all countries as our own country and foreign countries. Our country is composed of N regions, and each has a lot of agriculture-related enterprises. There is also a trade relationship between agriculture-related enterprises in each region and foreign countries. For easy distinction, we mark the starting point of the export as region a and all destination countries of export as country b.

3.1. Consumer Preferences. We assume that consumers in country b consume a series of differentiated products i and have a standard CES preference for product i. The utility function is

$$U_b = \left(\int_0^{\Omega} x_b(i)^{(\sigma-1)/\sigma} \mathrm{d}i \right)^{\sigma/(\sigma-1)}. \tag{1}$$

In formula (1), Ω represents the set of products available for consumers in country b, σ represents the elasticity of mutual substitution between products, and $\sigma > 0$, and $x_k(i)$ represents the consumption of product i by consumers in country b, which is constrained by the income level of consumers in country b:

$$y_b = \int_0^{\Omega} p_b(i) x_b(i) \mathrm{d}i. \tag{2}$$

In formula (2), $p_b(i)$ represents price of product i in country b and y_b represents the per capita income level of country b.

3.2. Production Technology Level. We assume that production factors of each region include land (L), labor (H), and capital (K). The production function is in the form of Cobb–Douglas:

$$X_a(i) = z_a(i) L_a(i)^{\alpha} H_a(i)^{\gamma} K_a(i)^{1-\alpha-\gamma}, \tag{3}$$

$$\mathrm{MC}_a(i) = \frac{q_a^{\alpha} w_a^{\gamma} r_a^{1-\alpha-\gamma}}{z_a(i)}. \tag{4}$$

In formula (3), $z_a(i)$ represents average productivity, $\mathrm{MC}_a(i)$ represents marginal cost of product i in the region a, q_a, w_a, and r_a, respectively, indicate the factor return rates of land, labor, and capital, and average productivity $z_a(i)$ obeys following distribution:

$$F_a(z) = \Pr(Z_a \le z) = \exp\left(-A_a z^{-\theta}\right). \tag{5}$$

In formula (5), θ represents the change in productivity within region a and A_a represents the technological level of region a.

At the enterprise level, we learn from Melitz and assume that the production of agriculture-related enterprises has increasing returns to scale, the products produced have subtle differences, and there is heterogeneity among enterprises [32]. Therefore, productivity φ of agriculture-related enterprises obeys following distribution:

$$G(\varphi) = 1 - \varphi^{\gamma}. \tag{6}$$

In formula (6), $\varphi \ge 1$ for an agriculture-related enterprise m with a productivity of φ, the marginal cost of production is (mc_s/φ), and mc_s represents marginal cost of lowest-productivity firm s, so the higher a company's productivity is, the lower marginal cost it will face.

3.3. Trade Cost and Enterprise Export. We use a simple "iceberg cost" to describe trade cost, assuming that the trade cost between a and b is τ_{ab}, and the trade cost between a and b is symmetrical, that is, $\tau_{ab} = \tau_{ba}$, $\tau_{ab} = \tau_{ba} > 1$. If product i is produced in region a and directly supplied to region a, the price of product i is $p_{aa}(i)$. But if product i is produced in region a and then sold to country b through international trade, the price of the product i is $p_{ab}(i)$; these two prices satisfy the following relationship:

$$p_{ab}(i) = \tau_{ab} \times p_{aa}(i) = \tau_{ab} \times \mathrm{MC}_a(i) = \tau_{ab} \times \frac{q_a^{\alpha} w_a^{\gamma} r_a^{1-\alpha-\gamma}}{z_a(i)}. \tag{7}$$

For ordinary consumers, when they make a commodity purchase decision, they are sensitive to its price, and they usually choose commodity with the lowest price, so goods' price is often affected by productivity distribution.

From Eaton and Kortum, we can get two important conclusions [33]. Firstly, the price index of trade destination country b satisfies

$$(P_b)^{-\theta} = \kappa_1 \sum_a \left[A_a \left(q_a^{\alpha} w_a^{\gamma} r_a^{1-\alpha-\gamma} \right)^{-\theta} \tau_{ab}^{-\theta} \right] \equiv \mathrm{CMA}_b. \tag{8}$$

In formula (8), we define CMA_b as the market access of consumers in country b, which reflects low-priced products' availability in market for consumers in country b. The other important conclusion is the total value of products sold from region a to country b, as shown below:

$$X_{ab} = \kappa_1 A_a \left(q_a^{\alpha} w_a^{\gamma} r_a^{1-\alpha-\gamma} \right) Y_b \tau_{ab}^{-\theta} \mathrm{CMA}_b^{-1}. \tag{9}$$

In formula (9), we can see that the total value of products X_{ab} sold by region a to country b is a standard gravitational equation. When the target country's trade cost decreases, the export trade from region a to country b will increase; otherwise, export trade will decrease.

3.4. Market Access and Enterprise Export. Since we treat all export trading countries as country b, we can sum up formula (9) to get

$$X_a = \sum_b X_{ab} = \kappa_1 A_a \left(q_a^{\alpha} w_a^{\gamma} r_a^{1-\alpha-\gamma}\right)^{-\theta} \sum_b \left(\tau_{ab}^{-\theta} \mathrm{CMA}_b^{-1} Y_b\right). \tag{10}$$

In formula (10), X_a is the total income of region a representing whole exports to all foreign countries, that is, the total amount of exports. We define the enterprise market access level of region a as follows:

$$\mathrm{FMA}_a \equiv \sum_b \tau_{ab}^{-\theta} \mathrm{CMA}_b^{-1} Y_b. \tag{11}$$

In formula (11), enterprise's market access is composed of the market size Y_b, the consumer market access CMA_b of the destination country, and trade cost τ_{ab} between region a and country b. Market size and level of market competition in country b are often not affected by region a, so the market access level of enterprises in region a largely depends on trade cost τ_{ab} between these two places.

Because the trade cost between a and b is symmetrical, that is, $\tau_{ab} = \tau_{ba}$, according to Donaldson and Hornbeck, it can be obtained $\mathrm{FMA}_a = \lambda \mathrm{CMA}_a$ and $\mathrm{FMA}_b = \lambda \mathrm{CMA}_b$, $\lambda > 0$. It shows that, for the same region, there is a linear correlation between the enterprise market access and the consumer market access, and this linear correlation feature λ will not affect the analysis, so we can get

$$\mathrm{FMA}_a = \lambda \mathrm{CMA}_a = \mathrm{MA}_a, \tag{12}$$

$$\mathrm{MA}_a = \lambda \sum_b \tau_{ab}^{-\theta} \mathrm{MA}_b^{-1} Y_b. \tag{13}$$

We put formula (13) into (10), and we can get

$$X_a = \kappa_2 A_a \left(q_a^{\alpha} w_a^{\gamma} r_a^{1-\alpha-\gamma}\right)^{-\theta} \mathrm{MA}_a. \tag{14}$$

Substituting the factor income of land, labor, and capital into formula (14), we can get

$$X_a = \left(\kappa_3 A_a\right)^{1/(1+\theta\alpha+\theta\gamma)} \left(\frac{\alpha}{L_a}\right)^{-(\theta\alpha/1+\theta\alpha+\theta\gamma)} \left(\frac{\gamma}{H_a}\right)^{-(\gamma\alpha/1+\theta\alpha+\theta\gamma)} \left(\frac{1-\alpha-\gamma}{K_a}\right)^{-((1-\alpha-\gamma)\alpha/1+\theta\alpha+\theta\gamma)} \mathrm{MA}_a^{(1+\theta(1+\alpha+\gamma))/\theta(1+\theta\alpha+\theta\gamma)}. \tag{15}$$

In formulas (13)–(15), we can see that when the cost of trade between a and b decreases, the market access level of region a can be greatly improved, further increasing the income level brought by export trade. With the size of the destination market and the degree of market competition unchanged, reducing trade cost between these two places is a crucial way to ameliorate market access and promote export trade.

4. Methods and Materials

4.1. Empirical Model Setting. Considering that different regions open HSR in different times, we learn from the methods of Lin and Qin and use a multiperiod DID model to examine the effect of HSR on export of agriculture-related enterprises [34, 35]. In the DID model, we take the regions where the HSR has not been opened as the control group and the regions where the HSR has been opened as the experimental group and obtain the policy effect of the HSR's opening through two differences. The benchmark model adopts following settings:

$$\ln \mathrm{export}_{ict} = \beta_1 \mathrm{HSR}_{ct} + \beta_2 E_{ict} + \beta_3 C_{ct} + \xi_i + \xi_{pt} + \xi_{nt} + \mu_{ict}. \tag{16}$$

In formula (16), $\ln \mathrm{export}_{ict}$ represents agriculture-related enterprise's export value and HSR_{ct} indicates whether this region c has opened HSR. When HSR is opened, $\mathrm{HSR}_{ct} = 1$; otherwise, $\mathrm{HSR}_{ct} = 0$. β_1 is the estimated coefficient of HSR. In order to obtain the net effect of HSR's opening on the export of enterprises, we need to control other factors that affect the export of enterprises. It mainly comes from two aspects: on the one hand, it comes from the enterprise itself, and some enterprise's own factors will also affect the export. E_{ict} are control variables at the enterprise level, including variables that measure individual characteristics of agriculture-related enterprises to control their impact on exports such as the size of enterprise (lnsize); the larger the enterprise scale, the stronger the export capacity. The operating time of enterprise (lnage): as the operating time has become longer, the business and trade relationships of the enterprise have gradually stabilized, and the enterprise has also passed the dangerous period of survival. It is more likely to explore the higher risk international market, which will help the enterprise's export growth. The labor productivity (lnlarborate): Melitz points out that enterprises with higher productivity are more likely to engage in export activities. Therefore, enterprise productivity has a significant positive impact on exports. Other factors that affect the export of enterprise are the external trade dependence (open) and financial liquidity (finance). On the other hand, some region characteristics will also affect the export activities of enterprises. C_{ct} are control variables at the regional level that affect export such as the level of road traffic (lnroad); good road conditions are conducive to product transportation, reduce transportation and trade costs, and then promote enterprise exports. The gross domestic product of agriculture (lnagriculture): a region with a higher agricultural production value will make the agricultural enterprises in that region more likely to export. In addition, economic development (lnpgdp), total population (lnpopulation), and Internet development (lninternet) will also affect the exports of enterprise. Therefore, we need to add these control variables to the empirical model. For some

fixed effect choices, we use a fixed effect model to analyze the impact of HSR on enterprise exports, so we need to control the fixed effects at the enterprise level. ξ_i is a enterprise's fixed effect, which is used to control factors that enterprise does not change over time. Since enterprise's location is fixed, when we control enterprise's fixed effect, regional fixed effect will be controlled accordingly. Finally, in the industry and provincial level, there are some unobservable time trends, which will also affect the export of enterprises. For example, if some industries develop rapidly, the export of enterprises in these industries will be significantly faster than that of enterprises in other industries. Therefore, we control the industry-time fixed effect and province-time fixed effect in the model setting. ξ_{nt} represents industry-time fixed effect, ξ_{pt} represents province-time fixed effect, which is used to control time trend at the industry and provincial level, and μ_{ict} represents the random disturbance item.

4.2. Parallel Trend Test. Due to the inconsistency of HSR's opening time in different regions, it is impossible to directly obtain a parallel trend of policy effects. Therefore, we learn the event analysis method from Beck et al. [36] and add dummy variables before and after the policy on the basis of formula (16):

$$\ln \text{export}_{ict} = \sum_{m=1}^{10} \beta_m \text{BFHSR}_{c,t-m} + \sum_{n=0}^{6} \beta_n \text{AFHSR}_{c,t+n} + \beta_2 E_{ict} + \beta_3 C_{ct} + \xi_i + \xi_{pt} + \xi_{nt} + \mu_{ict}. \quad (17)$$

In formula (17), $\text{BFHSR}_{c,t-m}$ represents the m years before HSR's opening and $\text{AFHSR}_{c,t+n}$ represents the n years after HSR's opening. When the coefficient β_m is close to 0, it indicates that, before the opening of HSR, there is no significant difference in exports of agriculture-related enterprises between the experimental and control group. When the coefficient β_n is significantly different from 0, it is means policy effect is very obvious. The results are shown in Figure 1: HSR has brought a significant and continuous increasing for agriculture-related enterprises' export.

4.3. The Distance between Agriculture-Related Enterprises and HSR Stations. The reason why the problem of distance is introduced to the analysis of this article is mainly due to the differences in city form and geographic location of enterprises, which are rarely considered in previous studies. They treat different cities as homogeneous, regardless of the geographical distribution of enterprises in the city and the resulting distance issues. In China, the differences between prefecture-level cities are very obvious. Some prefecture-level cities have a huge area and are composed of many counties. The distance from east to west and from south to north is very long. Some prefecture-level cities are very small, consisting of only municipal districts and a few counties. In addition, the construction sites of China's HSR stations are also quite dissimilar. Some are rebuilt from the original railway stations, and these HSR stations are often closed to the city center.

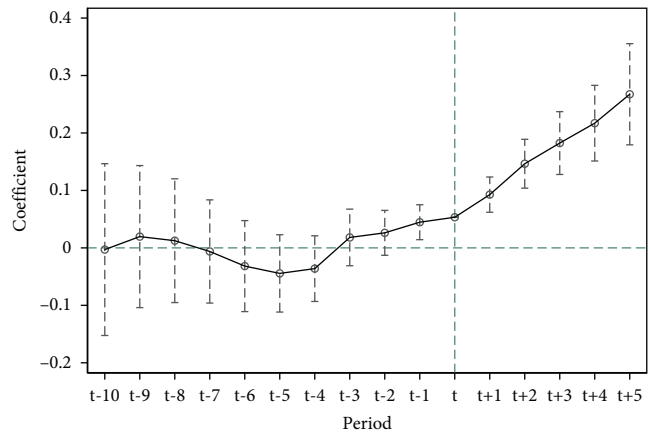

Figure 1: Parallel trend test on the export of agriculture-related enterprises.

Some cities elect to build HSR stations in the suburbs due to land rent; these HSR stations are often far from the city center and industrial parks. That makes the distance between enterprises and HSR stations very different. Some enterprises are close to the HSR station and can enjoy the convenience of transportation brought by the opening of the HSR, thereby helping enterprises make better use of the HSR to carry out economic and trade activities and drive the growth of exports. Enterprises that are far away from the HSR station take longer time to reach the HSR station and use the HSR less frequently so that the opening of HSR has almost no impact on the exports of such enterprises. We take a sample of agriculture-related enterprises in regions where HSR was opened in 2013 as an example and analyze the spatial distance distribution between agriculture-related enterprises and HSR stations (the radius is roughly calculated based on the area of the prefecture-level city's administrative and district. The calculation formula is $(s/\pi)^{(1/2)}$, where s is the area and π is the ratio of the circumference of a circle to its diameter. Among them, the prefecture-level city's district is generally the central city where the prefecture-level city's government is located, and it is also a city in a narrow sense). As shown in Figure 2, taking 15 km as an interval, we can see that the distance between enterprises and HSR stations is mostly within 105 km, and the number of enterprises in 15–30 km interval is the largest. There are many enterprises within 45 km, and the apex of the normal distribution curve is also in 30–45 km interval. At the same time, we also discussed the radius of prefecture-level city's administrative area, the radius of prefecture-level city's districts, and the distance from HSR stations to a city's center. As shown in Figures 3–5, a large number of prefecture-level city's administrative area's radius in China are within 120 km, with the most in the range of 50–70 km, while the radius of prefecture-level city's districts is mostly within 20 km. The distance from the HSR station to city center is also mostly concentrated within 25 km.

4.4. Data Source and Variable Description. The first part is HSR data of prefecture-level cities, which is mainly from China Railway Corporation website, China Railway

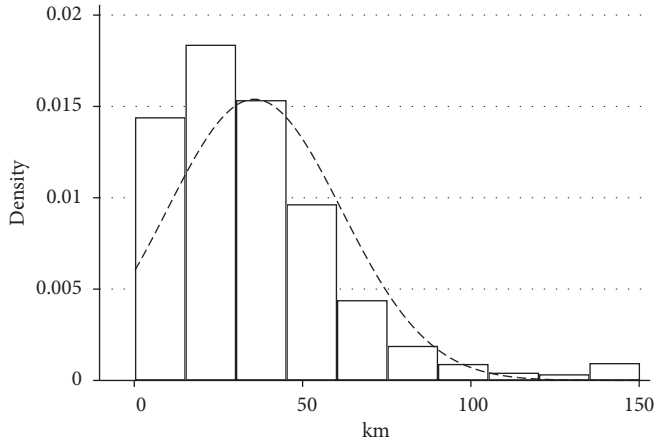

Figure 2: Distance between enterprises and HSR stations.

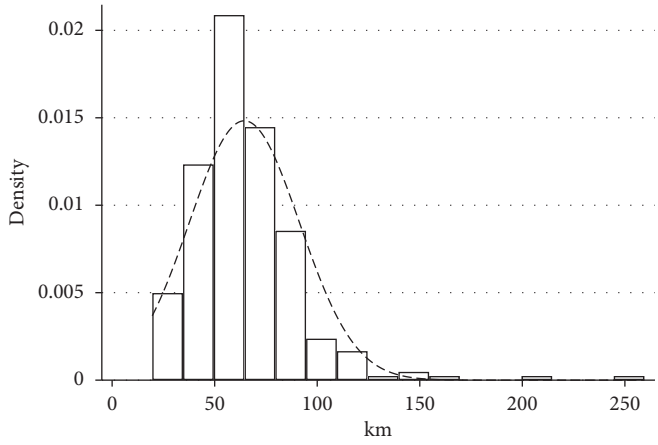

Figure 3: The radius of prefecture-level city's area.

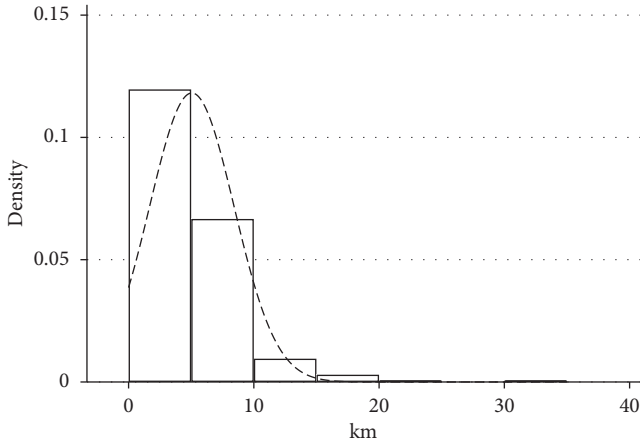

Figure 4: The radius of prefecture-level city's districts.

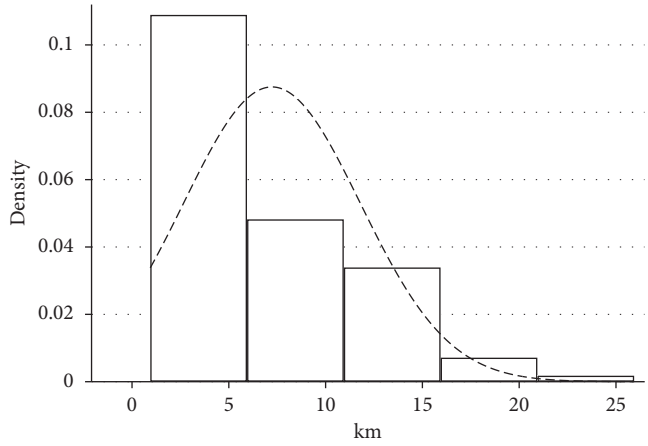

Figure 5: The distance from HSR stations to the city's center.

Yearbook, and 12306 website. We manually collect HSR lines and the opening time of each station from 2000 to 2013. We use the Baidu Map API to obtain the latitude and longitude coordinates of agriculture-related enterprises and HSR stations along the line and calculate the straight distance between agriculture-related enterprises and the nearest HSR station.

The second part is the microdata of agriculture-related enterprises, which mainly comes from two sources. The first is

from China Industrial Enterprise Database, which provides detailed enterprise information, including the year of establishment, total industrial output value, industrial sales output value, and industry. The second is the export data of enterprises, which comes from the Chinese Customs Database. The database records detailed trade information of enterprises, including export products, export values, quantities, prices, and export destination countries. We use the method of Brandt et al. to match the microenterprise data of these two databases to get export information of Chinese industrial enterprises and further obtain samples of agriculture-related enterprises from matching data [37]. We adopt two methods to identify whether the enterprise is an agriculture-related enterprise: The first is based on industry attributes in the Chinese industrial enterprise database. According to the classification method of the soft science research group of the Ministry Agriculture China, the industry category codes in Chinese industrial enterprise database are 13–23 and 29, including agricultural and sideline food processing, and food manufacturing belongs to agricultural product processing industries. The second depends on HS classification code in Chinese Customs Database. Export products of HS01–HS24 are usually classified as agricultural products, and we also classify enterprises that export such goods as agriculture-related enterprises. After screening export samples, we add them to the enterprise level by year. Then, we refer to methods of Brandt et al. [37, 38] and exclude samples with fewer than 8 employees, industrial output value, total assets, fixed assets, and sales revenue from main business with zero or missing, as well as samples that do not conform to GAAP, including enterprises whose both current assets and fixed assets are greater than total assets.

The third part is economic data at the regional level, which is mainly from the China Regional Statistical Yearbook and the National Bureau of Statistics of China, including economic development, road traffic conditions, agricultural output level, population, and informatization in each region. Descriptive statistics: mean, standard deviation, minimum, median, and maximum values for each variable are shown in Table 1.

5. Results and Discussion

5.1. Benchmark Regression Results. Under the controlling of firm fixed effects, province-time fixed effects, and industry-time fixed effects, we sequentially add control variables for regression (because provincial capitals and municipalities have obvious political advantages in the HSR construction planning, in order to eliminate the estimation bias on the model results, the sample of enterprises located in provincial capitals and municipalities will be deleted). The results are shown in Table 2. With the successive addition of control variables, the coefficients of HSR are all significantly positive at the 1% level, indicating that HSR can significantly promote agriculture-related enterprises' export growth. In column (10), the result shows that HSR will increase the export growth of agriculture-related enterprises by about 6.9%, compared with enterprises in regions without HSR. When more and more small- and medium-sized cities and counties open HSR, enterprises and individuals in these regions will enjoy the policy dividends brought by HSR. Especially for Chinese agricultural and rural areas, HSR provides an opportunity to conduct external communication and exchanges in the Chinese agricultural system. It will reduce the threshold and cost to accept peripheral information and expand market search radius for agriculture-related enterprises. At the same time, HSR guides economic and trade activities to gather in the region of HSR's location through passenger transportation, strengthening the local advantage in economic and trade competition with non-HSR regions. More importantly, HSR can encourage agriculture-related enterprises to participate in international competition and promote their products to the international market.

For the control variables, it is important to control the impact of other factors on the export of the enterprise so that we can accurately identify the impact of HSR's opening on enterprise exports. From the perspective of enterprise, the age, scale, export dependence, financing restrictions, and labor productivity of the enterprise will have an impact on the export. And, from the perspective city, economic development, road traffic conditions, agricultural output value, total population, and Internet informatization level will also have an impact on the export of agriculture-related enterprises. At the enterprise level, we can find that the coefficient estimates of control variables have a very significant positive impact on the export of agriculture-related enterprises. At the regional level, economic development has a critical negative impact on the export of agriculture-related enterprises. That is mainly because the region with higher economic development level has lower agriculture proportion. Correspondingly, the coefficients of the agricultural output value on the exports are significantly positive at the level of 5%. If a region has a higher agricultural output value, it can provide more abundant agricultural resources as raw materials for enterprise production. The coefficients of road traffic conditions on exports are also remarkable and positive. Ameliorating road traffic conditions can significantly reduce transportation time and cost and promote the outward of agricultural products. The coefficients of population density are not significant, while the level of Internet informatization has a positive impact on exports at the 10% level. It shows that, to a certain extent, the improvement of informatization can help enterprises to obtain market information, which is beneficial to export behavior. The coefficients of main control variables are statistically significant and in line with expectations and economic principles.

5.2. Dynamic Effect of HSR on Exports. In order to explore the dynamic impact of HSR on export, we examine the coefficient of HSR lag term on exports. As shown in columns (1)–(5) in Table 3, HSR has a clear dynamic impact on the exports of agriculture-related enterprises. It can be observed that, in 1–5 years after, HSR still has a positive effect in promoting export growth of local agriculture-related enterprises. Especially in the fourth to fifth year, the policy effect of HSR has been significantly improved, which can

Table 1: Descriptive statistics of each variable.

Variable	Variable explanation	Mean	SD	Min	p50	Max
lnexport	Logarithm of export value	14.099	1.902	8.189	14.381	17.771
HSR	Whether to open high-speed railway	0.253	0.435	0.000	0.000	1.000
lnage	Enterprise age, logarithm of opening time	2.083	0.648	0.000	2.197	3.761
lnsize	Enterprise size, logarithm of total assets	15.290	1.339	12.549	15.186	19.002
Open	Export dependence, export delivery value divided by total industrial output value*100%	48.420	42.243	0.000	46.928	123.246
Finance	Financing constraints, current assets divided by total assets*100%	55.784	26.114	1.513	58.833	97.832
lnlarborate	Labor productivity, logarithm of per capita gross industrial output	10.377	1.017	8.053	10.334	13.070
lnpgdp	The level of economic development, logarithm of per capita GDP	8.549	0.783	5.892	8.650	9.875
lnroad	Logarithm of local road density	0.708	0.223	0.186	0.710	1.158
lnagriculture	Logarithm of the agriculture gross domestic product	18.850	0.828	16.287	18.969	20.366
lnpopulation	Logarithm of local population density	6.632	0.769	4.212	6.563	8.375
lninternet	Internet penetration, number of computers per 100 households	13.425	1.033	10.608	13.505	15.512

Table 2: The impact of HSR's opening on the export: benchmark model results.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSR	0.062***	0.076***	0.076***	0.074***	0.082***	0.068***	0.063***	0.068***	0.068***	0.069***
	(3.67)	(4.56)	(4.60)	(4.51)	(4.92)	(4.10)	(3.83)	(4.09)	(4.02)	(4.10)
lnage	0.318***	0.235***	0.207***	0.204***	0.195***	0.196***	0.195***	0.195***	0.195***	0.195***
	(19.61)	(14.77)	(13.12)	(13.00)	(12.49)	(12.53)	(12.45)	(12.41)	(12.41)	(12.37)
lnsize		0.345***	0.347***	0.351***	0.320***	0.320***	0.321***	0.321***	0.321***	0.320***
		(37.50)	(37.63)	(38.12)	(34.61)	(34.69)	(34.74)	(34.74)	(34.71)	(34.44)
Open			0.006***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***	0.006***
			(46.76)	(45.79)	(47.06)	(46.99)	(46.99)	(46.95)	(46.94)	(46.62)
Finance				0.002***	0.002***	0.002***	0.002***	0.002***	0.002***	0.002***
				(10.53)	(10.63)	(10.53)	(10.49)	(10.52)	(10.52)	(10.51)
lnlarborate					0.151***	0.152***	0.153***	0.152***	0.152***	0.152***
					(23.36)	(23.57)	(23.62)	(23.54)	(23.53)	(23.43)
lnpgdp						−0.192***	−0.203***	−0.206***	−0.206***	−0.209***
						(−3.45)	(−3.65)	(−3.69)	(−3.54)	(−3.60)
lnroad							0.184***	0.180***	0.180***	0.165**
							(2.70)	(2.63)	(2.63)	(2.42)
lnagriculture								0.098**	0.098**	0.102**
								(2.33)	(2.32)	(2.38)
lnpopulation									0.001	0.020
									(0.00)	(0.16)
lninternet										0.023*
										(1.66)
_cons	12.505***	7.435***	7.000***	6.885***	5.771***	7.492***	7.465***	5.652***	5.647***	5.212***
	(60.08)	(29.51)	(27.00)	(26.52)	(21.51)	(13.26)	(13.19)	(5.87)	(3.94)	(3.59)
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	179236	179228	170161	170161	169520	169520	169520	169319	169319	167886
Adj. *R*-sq	0.086	0.107	0.135	0.136	0.143	0.143	0.143	0.143	0.143	0.143

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

increase export growth by about 10%. In addition, we multiply HSR and time dummy variable after opening as the explained variable and add it to the model. As shown in column (6) in Table 3, in 2008, when HSR was first put into operation, the export growth of agriculture-related enterprises was not obvious. After 2009, the coefficient of the interaction term was very positive and gradually increased, and it was 0.093 and 0.110 in 2012 and 2013, respectively, and both were significant at the 1% level, which was consistent with the regression results of the lag term. The main reason is that there are only 3 HSR lines opened in 2008, and the lines have very short mileages and few stations (the 3 HSR lines is the Jing-Jin intercity railway from Beijing to Tianjin, the He-Ning section of the Ning-Rong railway from Hefei to Nanjing, and the Jiao-Ji railway from Jinan to Qingdao). Since 2009, the lines of HSR have gradually increased. China has successively opened many main lines such as the Beijing-Guangzhou HSR and the Beijing-Shanghai HSR. As the HSR network has gradually improved, a large number of regions along the lines have been included in the HSR network,

Table 3: The impact of HSR on the exports of agriculture-related enterprises: dynamic effects.

Variable	(1)	(2)	(3)	(4)	(5)	(6)
L.HSR	0.090***					−0.028
	(4.75)					(−0.72)
L2.HSR		0.087***				0.061**
		(4.28)				(2.33)
L3.HSR			0.080***			0.061***
			(3.28)			(2.65)
L4.HSR				0.107***		0.065***
				(3.28)		(2.99)
L5.HSR					0.106*	0.093***
					(1.80)	(3.95)
HSR ∗ year						0.110***
						(3.83)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	118238	89899	67320	50387	37828	167886
Adj. *R*-sq	0.092	0.076	0.074	0.075	0.075	0.143

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively. And, the *t* statistic value is in parentheses. The results of other control variables are not displayed in the table, the same as below.

which has strengthened communication and connection between inland regions along HSR lines and the developed coastal areas or port cities. As a result, the policy effect of HSR on local enterprises' exports has gradually increased, which is consistent with the results in Figure 1. It is foreseeable that the HSR will play an increasingly important role in the export process of Chinese agriculture-related enterprises in the future.

5.3. Distance Threshold for the Impact of HSR on Exports. The policy effects of HSR may be affected by the distance between agriculture-related enterprises and HSR stations. We calculated the straight distance between each agriculture-related enterprise and the nearest HSR station, taking 15 kilometers as an interval and dividing it into 0~15, 15~30, 30~45, 45~60, 60~75, 75~90, and 90~105 km. Then, we examine the HSR's coefficients of different distance thresholds on exports. As shown in Table 4, when the distance is within 45 km, HSR will significantly enhance export of agriculture-related enterprises. It will promote the export growths about 7.9% within 15 km and 10% between 15 to 45 km especially. When the distance exceeds 45 km, HSR will no longer have apparent impact on exports. Therefore, we can see that HSR has a very obvious spatial distance threshold about 45 km for exports.

Figures 2–5 show the distance between agriculture-related enterprise and HSR's station, the radius of prefecture-level city's administrative region and district, and the distance from the HSR station to the city center. We can find that the threshold of 45 km is roughly equivalent to 2 times the radius of prefecture-level city's district and 2 times the distance between the HSR station and the city center. We use a simplified diagram to analyze the influence of the distance threshold, as shown in Figure 6: the circle *N* represents the range of the city's districts, the region out of *M* represents the county, township, and rural area, *O* represents the city center, *ON* represents the radius of city's districts, and the distance of *ON* is 20 km. According to the distance between the HSR's station and the city center, we first assume that the HSR's station is located in the center of city, as expressed by point *S*. It can affect the surrounding agriculture-related enterprises within 45 kilometers (within the circle *M*). The enterprise *u* within the scope can conveniently use HSR to carry out business communication and trade activities, and foreign enterprises can also easily reach the enterprise *u* through the HSR station, thereby promoting trade opportunities and export orders of enterprise *u*. The enterprises *v* outside this range are far away from the HSR's station, and it takes longer time to reach the HSR's station, leading to less frequent economic and trade activities through HSR to other regions and reducing the willingness and subjective initiative to conduct market search and expansion. It is unfavorable for the enterprise *v* to carry out economic and trade activities. When the HSR's station is located outside the circle *N*, it can also cover the entire districts of the city, and the result is consistent with the former.

5.4. Resolution of Endogenous Problems. In this study, the endogenous problem mainly comes from the nonrandom nature of HSR construction. Regions with better economic development conditions tend to have more possibility of opening HSR, and they may have more export trade activities. We use the instrumental variable regression method to do further endogeneity processing [39]. Firstly, we learn from the method of Faber and use the "least-cost path-spanning tree network" as an IV for the opening of HSR [27]. Secondly, we use China's railway lines in 1961 as an IV. A historical railway line of 1961 has reference meaning for the designing of HSR. Therefore, historical lines have a high correlation with HSR lines, and it is not related to other factors that affect enterprises' export, meeting the exogenous assumption. Finally, we also use the railway passenger

Table 4: The impact of HSR on the export: different geographical distance intervals.

Variable	[0, 15) (1)	[15, 30) (2)	[30, 45) (3)	[45, 60) (4)	[60, 75) (5)	[75, 90) (6)	[90, 105) (7)
HSR	0.079**	0.105***	0.100**	0.006	0.074	0.138	−0.164
	(1.97)	(2.90)	(2.39)	(0.13)	(1.01)	(1.33)	(−0.95)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	34360	36949	30203	24169	13113	8613	5305
Adj. *R*-sq	0.153	0.171	0.163	0.192	0.143	0.112	0.159

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

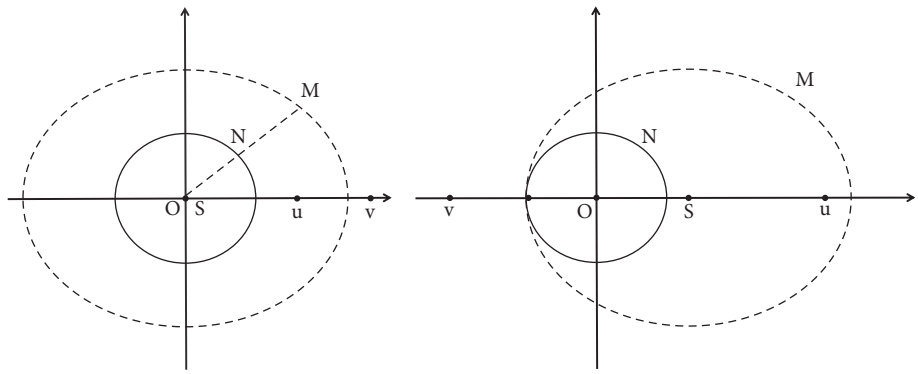

Figure 6: Distribution of the city center, HSR's station, and enterprises.

volume of each region in 1998 as an IV. HSR needs to give priority to regions with more transport demand and satisfy correlation assumptions. Moreover, it is unlikely that historical traffic and transportation pattern are related to other factors affecting current enterprise's export, which satisfies the exogenous assumption.

The results of IV regression are shown in Table 5: the coefficients of HSR in IV regressions are 0.394, 0.335, and 0.371, which are all very positive at the 1% level, and coefficients of these three are relatively close. At the same time, compared with coefficient of 0.069 in the benchmark regression model, the coefficients of IV regression are only expanded by 4–6 times. Jiang analyzed the papers using IV regression in the top financial journals and found that IV estimation expanded the coefficient by an average of 9 times [40]. The expansion of HSR's coefficients in this study is in an acceptable range, indicating that the estimation of IV is more reliable. In addition, the first-stage regression coefficients of IV for HSR are, respectively, 0.050, 0.030, and 0.023, which are significantly positive at the 1% level. The Kleibergen-Paap *F* statistic far exceeds the first-stage empirical value of 10 [41], so the hypothesis of weak instrumental variables can be rejected, which fully reflects the effectiveness of IV.

5.5. Robustness Test. We will adopt the following methods to verify the robustness of the estimation results: (1) we replace the explained variables and use the total export volume and per capita export delivery value instead of export value to perform model regression. (2) We will add samples of enterprises in the municipalities and provincial capitals. (3) Keep data from 2008–2013 and shorten the sample period. (4) Keep odd and even year data separately. (5). Extending the sample period to 2016, use the export data of agricultural products from the 2000–2016 for model regression (we will not be able to control the influencing factors at the enterprise level by using the export data of agricultural products in Chinese Customs Database from 2000 to 2016. Only the influencing factors at the city level can be controlled). The robust results are shown in Table 6; all coefficient are significantly positive at the 1% level and relatively close to the 0.069 obtained in benchmark model results (the average value of seven coefficient estimates is 0.063), which can explain why the empirical results obtained by model estimation are robust and reliable.

After checking the robustness of the benchmark regression results, we need to further verify the robustness affected by distance threshold of HSR to agriculture-related enterprises' export. In Table 4, we conducted a segmented regression with 15 km as an interval. Therefore, we first change the interval and use the 14 and 16 km adjacent to 15 km for segmentation. Secondly, we use half of the 45 km interval at 22.5 km, then use the 22 and 23 km adjacent to 22.5 km for segmentation, and verify the robustness of the distance threshold through squeeze theorem. The results are shown in Table 7; in columns (1)-(2), the coefficients of HSR are significantly positive within 42 and 48 km, indicating that HSR has an apparent effect on increasing the export of agriculture-related enterprises

Table 5: Regression results of instrumental variables.

Variable	Least-cost path-spanning tree network			Was the railway connected in 1961			Railway passenger traffic in 1998		
	(1)			(2)			(3)		
HSR second stage	0.394***			0.335***			0.371***		
	(7.59)			(3.93)			(3.30)		
IV reduced regression		0.020***			0.010***			0.008**	
		(5.42)			(2.78)			(2.33)	
IV first stage for HSR			0.050***			0.030***			0.023***
			(48.03)			(29.21)			(21.45)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	156232	167886	167886	156232	167886	167886	156232	167886	167886
Adj. *R*-sq		0.119	0.423		0.119	0.402		0.119	0.397
Kleibergen-Paap *F* statistic		5169.985			1890.736			1127.994	

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

Table 6: The impact of HSR's opening on the export: robustness check.

Variable	Export volume	Per capita export delivery value	All cities	2008–2013	Odd years	Even years	2000–2016
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
HSR	0.056***	0.020***	0.076***	0.044***	0.070***	0.081***	0.092***
	(3.00)	(3.07)	(5.06)	(2.91)	(3.42)	(3.37)	(5.63)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	No
N	167886	164740	211985	109814	84257	83629	201438
Adj. *R*-sq	0.078	0.744	0.142	0.098	0.166	0.162	0.026

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

Table 7: Robustness check for different geographical distance intervals.

The interval of 14 km		The interval of 16 km		The interval of 22 km		The interval of 22.5 km		The interval of 23 km	
(1)		(2)		(3)		(4)		(5)	
[0, 14)	0.083**	[0, 16)	0.087**	[0, 22)	0.117***	[0, 22.5)	0.120***	[0, 23)	0.114***
	(2.01)		(2.30)		(3.71)		(3.81)		(3.67)
[14, 28)	0.126***	[16, 32)	0.068*	[22, 44)	0.057**	[22.5, 45)	0.056**	[23, 46)	0.062**
	(3.29)		(1.89)		(2.18)		(2.17)		(1.98)
[28, 42)	0.094**	[32, 48)	0.123***	[44, 66)	0.009	[45, 67.5)	0.028	[46, 69)	−0.003
	(2.31)		(3.11)		(0.25)		(0.73)		(−0.08)
[42, 56)	−0.006	[48, 64)	−0.008	[66, 88)	0.081	[67.5, 90)	0.056	[69, 92)	0.122
	(−0.13)		(−0.16)		(1.06)		(0.71)		(1.52)
[56, 70)	−0.000	[64, 80)	0.085	[88, 110)	−0.175	[90, 112.5)	−0.139	[92, 115)	−0.188
	(−0.00)		(1.06)		(−1.29)		(−0.98)		(−1.32)

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

within this distance. In columns (3)–(5), the coefficient estimates are very positive at the level of 5% within 45 km, indicating that the estimation of spatial distance threshold is robustness and reliability. We have further changed the division of distance intervals. For example, we divided by 13, 17, 21, and 24 km and performed model regression, which had no effect on the robustness of results. The effect of HSR on the export of agricultural enterprises is about 45 km, and once exceeding this distance, HSR will no longer have an impact on the export of agricultural enterprises.

5.6. Placebo Test. We conduct a placebo test on the regression results of the benchmark model. This placebo test has two main parts: firstly, we make the policy shock of HSR on agriculture-related enterprises in specific regions become random (the policy shock is generated randomly by a computer) and estimate the impact of HSR on agricultural enterprises' exports. Then, we repeat this random process 200 times to obtain the distribution of coefficients and *t* statistic values of policy shock. If the coefficient estimates and *t* statistic of HSR are concentrated around 0, it indicates that policy effect is not random, but it is indeed from HSR.

Secondly, we advance the time of HSR's opening by 5 to 8 years. During this period, when HSR was not opened in the same area, we follow the benchmark model settings and use data from 2000 to 2007 to perform the model regression again. If we get the same significant and positive results, it means that the causality in the benchmark model is not correct.

The results of the placebo test are shown in Figure 7 and Table 8. In Figure 7, the coefficients of policy shock obtained after random processing are distributed between −0.02 and 0.02, and most of the t statistic values are also between −1.96 and 1.96 (between the dotted lines in Figure 7) and clustering around 0, indicating that the random policy shock of HSR has almost no impact on exports of agriculture-related enterprises. In Table 8, at each advanced time, all the coefficients of HSR are far less than 0.069, the benchmark result, and they are not statistically significant. The result of the benchmark model also has robustness and reliability. The opening of HSR can significantly promote the export growth of local agriculture-related enterprises.

6. Further Discussion

In the benchmark regression model, endogenous treatment, robustness check, and placebo test, we finally concluded that HSR can bring about growth in agriculture-related enterprises' export. Therefore, we will further discuss the mechanism of HSR on export growth of agriculture-related enterprises from two aspects: market access and siphonic effect, combined with distance threshold between enterprises and HSR's stations.

6.1. Mechanism Analysis

6.1.1. Mechanism of Market Access. We learn from Donaldson to measure the market access caused by HSR, identifying the mechanism of HSR on export growth of agriculture-related enterprises, as shown in the following formula:

$$\mathrm{MAHSR}_a = \sum_{b=1} \tau_{ab}^{-\theta} \mathrm{GDP}_b. \tag{18}$$

Due to the opening of HSR and the improved transportation convenience, the local market access level has been greatly improved. MAHSR refers to the market access level brought by the opening of HSR. In formula (18), MAHSR_a represents market access brought by HSR. We set our benchmark model to deform, and we can get

$$\ln \mathrm{export}_{ict} = \beta_m \mathrm{MAHSR}_{ct} + \beta_2 E_{ict} + \beta_3 C_{ct} + \xi_i + \xi_{pt} + \xi_{nt} + \mu_{ict}. \tag{19}$$

In order to explore the impact of market access on the export of agriculture-related enterprises in different distance threshold, we divided the distances from enterprises to HSR's stations every 15 km. The results are shown in Table 9: the results in column (1) showed that the construction of HSR has improved the level of local market access, reduced the cost of time and space, facilitated local agriculture-related enterprises to conduct more frequent foreign exchanges, strengthened the division of labor and cooperation between enterprises, and reduced the degree of information asymmetry, thereby improving the matching efficiency. It can encourage agriculture-related enterprises to expand their market search radius, enhance their subjective initiative to enter the international market, and obtain more export opportunities. In the segmented regression of different geographic distance thresholds, the results in column (2)–(4) showed that market access brought by HSR to enterprises gradually reduced, with the impact on enterprises' exports within 45 kilometers. HSR has only increased exports of the agriculture-related enterprises in 0–45 km. This is consistent with the results in Table 4, which is mainly because these enterprises are closer to HSR's station. When the HSR is opened, they can enjoy the improved market access brought by HSR in spatial priority and grasp opportunities for external communication brought by HSR to strengthen economic and trade exchanges with outside market more effectively. When the distance exceeds 45 km, the agriculture-related enterprises are not efficient in using HSR, and their communication frequency with outside regions has little changed. At the same time, higher market entry barriers also make these enterprises be less willing to take part in domestic market division of labor cooperation and international trade, which thus cannot significantly promote the export.

In order to further identify the impact of market access caused by HSR on the export, we divided samples according to regional traffic conditions and enterprise's productivity level. Firstly, according to the regional traffic conditions, the average road traffic level in the top 50% of the country from 2000 to 2007 is divided into regions with higher traffic conditions, and the bottom 50% is divided into regions with lower traffic conditions. Secondly, according to the level of the enterprise's productivity, the top 50% of the annual per capita total industrial output value is classified as a higher labor productivity of the enterprise, and the bottom 50% is classified as a lower labor productivity of the enterprise. The results are shown in Table 10: in columns (1)-(2), compared to regions with high-level traffic conditions, HSR has brought bigger effects of export growth to agriculture-related enterprises located in regions with low-level traffic conditions. Regions with backward transportation, such as the central and western provinces of China, have poor economic foundations and inherently inadequate terms of trade. HSR provides enterprises in these regions with late-mover advantages and more opportunities for foreign exchanges and participation in the industrial division of labor and cooperation, thus obtaining more international and domestic market information to promote international trade. In columns (3)-(4), compared with low-level productivity enterprises, high-level productivity enterprises can gain greater competitive advantage from the opening of HSR. According to the heterogeneous-firm trade theory, high-productivity firms have a higher tendency of export. These agriculture-related enterprises often possess advanced production technology and

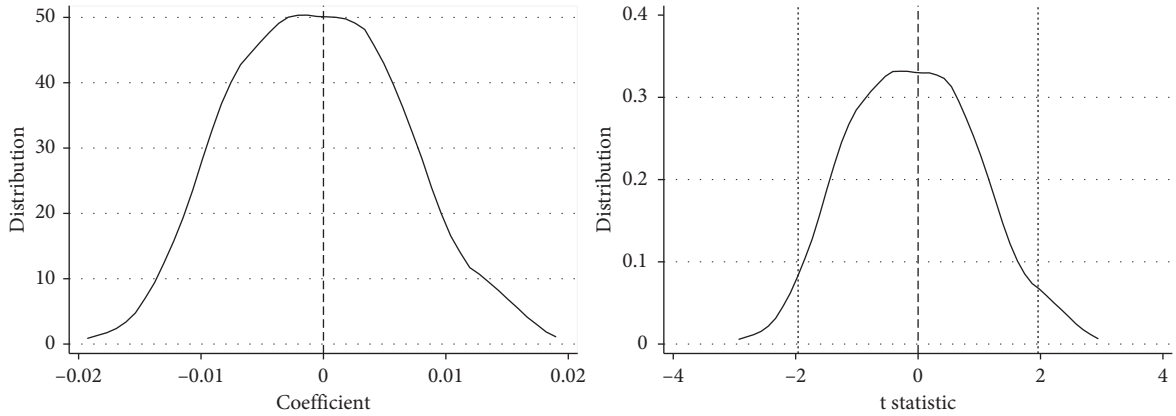

Figure 7: Placebo test: random impact.

Table 8: Placebo test: time advanced.

Variable	Forward_8 years (1)	Forward_7 years (2)	Forward_6 years (3)	Forward_5 years (4)
HSR	−0.026	−0.014	0.014	0.013
	(−1.25)	(−0.76)	(0.61)	(0.55)
Control variables	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
N	72764	72764	72764	72764
Adj. *R*-sq	0.146	0.146	0.146	0.146

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

Table 9: The impact of market access on the export under different geographic distances.

Variable	All (1)	[0, 15) (2)	[15, 30) (3)	[30, 45) (4)	[45, 60) (5)	[60, 75) (6)	[75, 90) (7)	[90, 105) (8)
MAHSR	0.003***	0.007**	0.005**	0.006**	−0.000	0.002	0.005	−0.014
	(2.99)	(2.34)	(2.26)	(2.07)	(−0.12)	(0.47)	(0.63)	(−1.02)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	166480	34360	36949	30130	24009	12935	8359	5143
Adj. *R*-sq	0.144	0.153	0.171	0.163	0.193	0.144	0.110	0.170

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

Table 10: The impact of market access under different levels of traffic and productivity conditions.

Variable	Traffic		Productivity	
	High-level (1)	Low-level (2)	High-level (3)	Low-level (4)
MAHSR	0.003***	0.022***	0.006***	0.000
	(2.59)	(3.35)	(3.42)	(0.13)
Control variables	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
N	154713	11767	80485	85995
Adj. *R*-sq	0.147	0.134	0.136	0.163

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

management experience, with a stronger willingness and tendency to participate in the export. So, they can easily grasp the policy opportunities of market access brought by HSR to enter the international market.

6.1.2. Mechanism of Siphon Effect. HSR can improve the local market access level, reduce communication and information barriers, and strengthen the understanding of outside and international market information. However, HSR will also widen gaps in infrastructure construction between local regions and surrounding areas without HSR. Regions with HSR can obtain more communication and information convenience compared with other places. They have more advantages in regional export trade competition,

so they may take away export trade opportunities from surrounding regions. As a result, their agriculture-related enterprises' export increases. Meanwhile, exports of enterprises in surrounding regions without HSR will relatively decrease, forming a siphonic effect of export. In this regard, we verify the siphonic effect mechanism by deform formula (16):

$$\ln \text{export}_{ift} = \beta_n \text{NEARHSR}_{ct} + \beta_2 E_{ift} + \beta_3 C_{ft} + \xi_i + \xi_{pt} + \xi_{nt} + \mu_{ift}. \tag{20}$$

In formula (20), when the region c, which is the closest to region f, does not open HSR, $\text{NEARHSR}_{ct} = 0$, and after opening HSR, $\text{NEARHSR}_{ct} = 1$. For example, Jiangsu Nantong did not open HSR, while JiangSu WuXi, the nearest city to NanTong, opened HSR in 2010. Therefore, for JiangSu NanTong, $\text{NEARHSR}_{ct} = 0$ before 2010 and $\text{NEARHSR}_{ct} = 1$ after 2010. The coefficient β_n reflects whether siphonic effect exists. When $\beta_n < 0$ $\sqrt{s/\pi}$ and it is statistically significant, it indicates that HSR in surrounding regions will have a significant siphonic effect. We also divide the distance into 7 intervals and perform model regression, respectively. The results are shown in Table 11; the results in column (1) indicate that the mechanism of siphonic effect is established. HSR breaks the balance of regional export behavior, and agriculture-related enterprises in the region where HSR is opened can obtain more outside and international market information, thereby forming a competitive advantage and relatively obtaining more export opportunity. The results in columns (2)–(4) show that export of agriculture-related enterprises in this interval will drop sharply with the opening of HSR in neighboring regions, resulting in a stronger siphonic effect. When the distance is longer than 45 kilometers, siphonic effect becomes very small. From the absolute value of the coefficient, we can see that siphonic effect is greater than market access, which means that, in these two mechanisms, the siphonic effect of inter-regional competition triggered by opening HSR is the dominant mechanism which leads to export growth of agriculture-related enterprises. Enterprises with HSR could not only gain greater trade competitive advantage compared to those regions where HSR is not open but also seize export opportunities and orders from similar enterprises in surrounding areas, thereby strengthening their exports' growth.

In Table 12, the results in column (1)-(2) demonstrate that regions with low-level traffic conditions have a bigger siphon effect after HSR's opening in adjacent regions. In recent years, a series of fierce competition about the direction of HSR lines and the distribution of stations have erupted in China. Regions with HSR have gained economic and trade competitive advantage over those without HSR. That is more noticeable in the central and western regions with poor traffic conditions. In regions with backward transportation, limited resources are mainly located in regions where HSR is opened, allowing enterprises in such places to obtain more resource input and trade opportunities. It makes export orders flow from enterprises in regions without HSR to enterprises in regions where HSR was opened. From perspective of productivity conditions, the results in columns (3)-(4) show that the siphonic effect produced by HSR has greater impact on agriculture-related enterprises with high-level productivity. High-productivity enterprises have a higher tendency of export and are also more susceptible to unfavorable market competition brought by HSR. These enterprises in regions without HSR are at a disadvantage in competition with similar enterprises in regions with HSR, and their exports are relatively declined.

6.2. Heterogeneity Analysis

6.2.1. Heterogeneity of Enterprises Ownership. As to different ownership types of agriculture-related enterprises, the impacts of HSR on export may also be different (the main ownership types of Chinese enterprises are as follows: state-owned/collective enterprises, Sino-foreign joint/cooperative, exclusively foreign-owned enterprises, and private enterprises). The model estimates are carried out according to different ownership types, and results are shown in Table 13: HSR has a significant positive effect on the export of state-owned/collective, Sino-foreign cooperation/joint, and private agriculture-related enterprises, and the most obvious effect is in state-owned/collective enterprises. However, exclusively foreign-owned enterprises cannot benefit from HSR. The main reason is that exclusively foreign-owned enterprises are more focused on the Chinese market, and the proportion of domestic sales is higher than that of export, so export promotion effect brought by HSR is limited. More importantly, the planning and construction of HSR are closely related to the local government. Domestic enterprises, including state-owned/collective, Sino-foreign cooperative/joint, and private agriculture-related enterprises, are more adaptable to local conditions and have actual advantages in grasping policy changes. They can accurately adjust their business and export strategy according to changes in the external environment.

6.2.2. Heterogeneity of Enterprise Development Stage. We divide agriculture-related enterprises into three different development stages, start-up, developing, and maturity (the start-up are enterprises in the early stages of development. According to the definition of the Global Entrepreneurship Observation (GEM) report, they usually refer to enterprises established within 42 months, that is, within 3.5 years. The enterprises that have been established for more than 10 years are relatively mature enterprise, while those in between are an enterprise that in the developing stage), to discuss the differences of enterprises' export in three stages affected by HSR. Results are shown in Table 14: HSR can effectively promote export growth of agriculture-related enterprises in the developing and maturity stage. For the agriculture-related enterprises of start-ups, HSR cannot bring significant export growth. The main reason is that, compared with enterprises in developing and mature stages, most enterprises in start-up stages are in danger of survival within 3 years after their establishment, and nearly half of them survive less than 5 years (the data comes from the "Report on

Table 11: The impact of siphonic effect on export under different geographical distances.

Variable	All (1)	[0, 15) (2)	[15, 30) (3)	[30, 45) (4)	[45, 60) (5)	[60, 75) (6)	[75, 90) (7)	[90, 105) (8)
NEARHSR	−0.074***	−0.154***	−0.093**	−0.114***	−0.012	−0.075	−0.128	0.152
	(−4.52)	(−3.89)	(−2.51)	(−2.66)	(−0.27)	(−1.05)	(−1.60)	(1.43)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	167886	34360	36949	30203	24169	13113	8613	5305
Adj. *R*-sq	0.143	0.154	0.171	0.163	0.193	0.143	0.112	0.159

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

Table 12: The impact of siphonic effect under different levels of traffic and productivity conditions.

Variable	Traffic		Productivity	
	High-level (1)	Low-level (2)	High-level (3)	Low-level (4)
NEARHSR	−0.069***	−0.244***	−0.098***	−0.033
	(−4.05)	(−3.26)	(−3.88)	(−1.46)
Control variables	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
N	155053	12833	81322	86564
Adj. *R*-sq	0.147	0.129	0.135	0.163

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

Table 13: The impact of HSR's opening on the export with different enterprises' ownership.

Variable	State-owned/collective (1)	Sino-foreign joint/cooperative (2)	Exclusively foreign-owned (3)	Privately-owned (4)
HSR	0.214**	0.075**	0.028	0.064**
	(2.33)	(2.11)	(0.89)	(2.46)
Control variables	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes
N	11358	43920	47287	65321
Adj. *R*-sq	0.137	0.142	0.144	0.179

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

the Survival Time of Chinese Domestic Enterprises" in 2013). They are not yet familiar with the international export market, and their export behavior is unstable and fragile, so HSR cannot drive the exports growth of these enterprises. The business and trade relations of developing and mature enterprises have gradually stabilized. The opening of HSR has just provided these enterprises with a larger market search radius and more potential trade opportunities to promote export growth.

6.2.3. Regional Heterogeneity of Enterprise. We divide regions into three parts: the east, central, and western parts, and discuss different impact of HSR on different regions. The results are presented in Table 15; from the perspective of policy effects, the coefficients of HSR increase from east to west, but only in the eastern and western regions are statistically significant. The eastern region has a geographical advantage along coast, and HSR has strengthened the dominant position of local enterprises in industrial chain, division of labor, cooperation with similar enterprises, and integrating market information, thereby improving the efficiency of eastern agriculture-related enterprises in export trade. In the western region, due to its low level of overall transportation infrastructure, HSR has gained infrastructure advantages over surrounding regions, which can greatly enhance competitive advantage in the international market. For enterprises in the central region, the impact of HSR on their exports is not statistically significant. The foremost reason is that the central region lacks coastal location advantage compared with the eastern region, and they also lack of strong trade potential and late-comer advantages

Table 14: The impact of HSR's opening on the export with different development stages.

Variable	Start-up (1)	Developing (2)	Mature (3)
HSR	−0.038	0.093***	0.070**
	(−0.64)	(4.10)	(2.54)
Control variables	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes
N	31675	79192	57019
Adj. *R*-sq	0.231	0.100	0.095

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

Table 15: The impact of HSR's opening on the export with different regions.

Variable	Eastern (1)	Middle (2)	Western (3)
HSR	0.068***	0.116	0.542**
	(3.92)	(1.34)	(2.12)
Control variables	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes
Province-year FE	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes
N	154934	9956	2996
Adj. *R*-sq	0.144	0.159	0.189

Note. ***, **, and * indicate the significance level of 1%, 5%, and 10%, respectively, and the *t* statistic value is in parentheses.

compared with the western region. With the continuous upgrading of HSR's network, many low-end industries gradually transfer from the eastern region to the central and western regions. The central region will become an important gathering place for agriculture-related enterprises and their export to the international market. At that time, HSR will play a significant role in promoting the export of agriculture-related enterprises in the central region.

7. Conclusions and Suggestions

We take the opening of HSR in China as a quasi-natural experiment, analyze its impact on the export of agriculture-related enterprises, and then explore the mechanism about it. On the basis of early research, our research has many expansions and innovations. In the research on the impact of transportation infrastructure construction on the economy, we pay attention to the impact of China's HSR on trade, and there are few economists who paid attention to the impact of China's HSR; In the discussion of the mechanism of the impact of transportation infrastructure on exports, early studies have shown more that the construction of transportation infrastructure can reduce the transportation cost of enterprises, and enterprises can carry out export activities at a lower cost, thereby promoting the growth of exports. In our research, because HSR does not directly transport goods, we have opened up new mechanisms including market access and siphon effect to explore the impact of HSR on exports; in the literature on the China story, the research on Chinese agriculture is a very important part. Unlike previous studies, our research combines Chinese agriculture with China's HSR and explores the impact of the opening of HSR on agricultural enterprises.

More specifically, the results of our research show that HSR can promote the agriculture-related enterprises' export growth by 6.9%, and this result is robust because we get almost consistent results in the regression of changing different control variables. Meanwhile, the effect of this policy has continued to increase over time. Furthermore, the policy effect of HSR is closely related to geographical distance. HSR has only an effect on the export of enterprises within 45 km, but when the distance exceeds 45 km, HSR will no longer have apparent impact on exports. HSR improves local market access level, strengthens the frequency of communication, reduces the information barriers to the outside world, and lowers the cost for obtaining information. It can help local agriculture-related enterprises to enter the international market. At the same time, HSR has strengthened local infrastructure advantage compared with regions without HSR, which became a competitive strength in economic and trade activities. As a result, it has formed a siphonic effect in export. The policy effect of HSR has distance threshold for market access and siphonic effect. When the distance is within 45 km, both the market access and siphonic effect are established, but when the distance exceeds 45 km, the HSR has neither market access nor siphonic effect on export. Compared with the market access, HSR has a stronger siphon effect on exports for agriculture-related enterprises. In addition, market access and siphonic effects are more pronounced in regions with lower primitive traffic conditions and enterprises with higher productivity. Finally, the results of heterogeneity analysis show that HSR has different effects for different types of enterprises; for agricultural enterprises with different ownership, HSR has a significant positive impact on the export of state-owned/collective, Sino-foreign cooperative/joint ventures, and private agricultural-related enterprises, and the effect is most obvious in state-owned/collective enterprises. However, exclusively foreign-owned enterprises cannot benefit from HSR. For agricultural enterprises at different stages of development, HSR can effectively promote the export growth of agricultural enterprises in the mature stage of development. For start-up agriculture-related enterprises, HSR cannot bring significant export growth. As a populous country with abundant land resources, China's agricultural development is of vital importance. In the process of sustainable agricultural development, HSR also provides a new opportunity for the increasingly involved agricultural sector, which has great significance for transformation and upgrading Chinese agricultural industry and its export-oriented development path. Armed with this research, we come up with views and policy recommendations.

Firstly, the results of this paper shows that HSR can significantly promote the export growth of agriculture-related enterprises, indicating that the Chinese government should comprehensively focus on the development opportunities brought by HSR to the agricultural sector and rural

revitalization, encourage agriculture-related enterprises to make use of opportunities to integrate agricultural resource in counties and townships, and vigorously develop export-oriented agriculture. On this basis, high-quality agriculture-related enterprises should be encouraged to actively explore the international market and promote the export of famous agricultural products to earn income. This will drive Chinese agriculture to go global.

Secondly, HSR only has an impact on the export of agriculture-related enterprises within 45 km around HSR stations. The local government can rationally plan industrial development based on the location of HSR's stations and accelerate the construction of modern industrial parks, industrial strong towns, and characteristic industrial clusters near transportation stations. At the same time, local governments should guide newly-built enterprises to geographically get close to transportation stations so as to improve the convenience of external communication by means of transportation advantages. The central government should actively promote the transfer of low-end industries such as agricultural products processing industries from developed cities in eastern coastal regions to inland counties along HSR routes, strengthen the industrial and economic foundations of counties and townships, and promote the growth of agricultural exports in these regions.

Thirdly, there are two main mechanisms for the impact of HSR on the export of agriculture-related enterprises: market access and siphonic effect. The market access effect indicates that we should strengthen the construction of transportation infrastructure, reduce the local market barriers and restrictions, so as to attract external and international enterprises to enter the local market for economic and trade activities, and help more local enterprises enter the international market. The siphon effect is greater than the market access effect, indicating that Chinese HSR's construction is still unbalanced, triggering economic and trade competition between regions. It is necessary to accelerate the popularization of HSR networks, rationally plan the layout of HSR routes, and promote the coverage of HSR in inland areas, counties, and other backward regions. HSR should be fully covered in cities and counties where conditions permit. At the same time, we should vigorously develop cargo transportation for HSR to reduce the time and cost of cargo transportation, so as to fundamentally reduce the trade costs of Chinese agricultural sector and agricultural products.

Finally, HSR has different export effects on different types of agriculture-related enterprises. It can significantly promote the export of high-productivity enterprises and mature enterprises, but it has no impact on the export of low-productivity and start-up enterprises. The results of this paper show that we should encourage agriculture-related enterprises to increase investment in scientific and technological innovation, continuously improve technological level and total factor productivity, and transform from low-end quantity-driven export mode to the high-end quality-driven export mode. Local governments should encourage cooperation among different ownership enterprises. State-owned enterprises, foreign-funded enterprises, and private enterprises should give full play to their respective advantages and work together to promote export growth.

Data Availability

The data used to support the findings of this study are available from corresponding author upon request.

Conflicts of Interest

The authors declare that they do not have any conflicts of interest.

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References

[1] E. E. Hagen and R. Nurkse, "Problems of capital formation in underdeveloped countries," *Econometrica*, vol. 23, no. 2, 1955.

[2] G. Duranton and M. A. Turner, "Urban growth and transportation," *The Review of Economic Studies*, vol. 79, no. 4, pp. 1407–1440, 2012.

[3] M. Roberts, U. Deichmann, B. Fingleton, and T. Shi, "Evaluating China's road to prosperity: a new economic geography approach," *Regional Science and Urban Economics*, vol. 42, no. 4, pp. 580–594, 2012.

[4] Y. Wang and B. Wu, "Railways and the local economy: evidence from qingzang railway," *Economic Development and Cultural Change*, vol. 63, no. 3, pp. 551–588, 2015.

[5] A. Banerjee, E. Duflo, and N. Qian, "On the road: access to transportation infrastructure and economic growth in China," *Journal of Development Economics*, vol. 145, Article ID 102442, 2020.

[6] W. Zou, L. Chen, and J. Xiong, "High-speed railway, market access, and economic growth," *International Review of Economics & Finance*, 2019, In press.

[7] M. Diao, "Does growth follow the rail? The potential impact of high-speed rail on the economic geography of China," *Transportation Research Part A: Policy and Practice*, vol. 113, pp. 279–290, 2018.

[8] L. Zheng, F. Long, Z. Chang, and J. Ye, "Ghost town or city of hope? The spatial spillover effects of high-speed railway stations in China," *Transport Policy*, vol. 81, pp. 230–241, 2019.

[9] S. Bougheas, P. O. Demetriades, and E. L. W. Morgenroth, "Infrastructure, transport costs and trade," *Journal of International Economics*, vol. 47, no. 1, pp. 169–189, 1999.

[10] J. S. Wilson, C. L. Mann, and T. Otsuki, "Assessing the benefits of trade facilitation: a global perspective," *The World Economy*, vol. 28, no. 6, pp. 841–871, 2005.

[11] J. Francois and M. Manchin, "Institutions, infrastructure, and trade," *World Development*, vol. 46, pp. 165–175, 2013.

[12] P. Krugman, "Increasing returns and economic geography," *Journal of Political Economy*, vol. 99, no. 3, pp. 483–499, 1991.

[13] K. Behrens, "International integration and regional inequalities: how important is national infrastructure?" *The Manchester School*, vol. 79, no. 5, pp. 952–971, 2011.

[14] G. Duranton, P. M. Morrow, and M. A. Turner, "Roads and trade: evidence from the US," *The Review of Economic Studies*, vol. 81, no. 2, pp. 681–724, 2014.

[15] S. Djankov, C. Freund, and C. S. Pham, "Trading on time," *The Review of Economics and Statistics*, vol. 92, no. 1, pp. 166–173, 2006.
[16] B. Hoekman and A. Nicita, "Trade policy, trade costs, and developing country trade," *World Development*, vol. 39, no. 12, pp. 1–23, 2008.
[17] M. Z. Xu, *Riding on the New Silk Road: Quantifying the Welfare Gains from High-Speed Railways*, University of California, Davis, CA, USA, 2017.
[18] C. Volpe Martincus, J. Carballo, and A. Cusolito, "Roads, exports and employment: evidence from a developing country," *Journal of Development Economics*, vol. 125, pp. 21–39, 2017.
[19] D. Niu, W. Sun, and S. Zheng, "Travel costs, trade, and market segmentation: evidence from China's high-speed railway," *Papers in Regional Science*, vol. 99, no. 6, pp. 1799–1825, 2020.
[20] N. Limao and A. J. Venables, "Infrastructure, geographical disadvantage, transport costs, and trade," *The World Bank Economic Review*, vol. 15, no. 3, pp. 451–479, 2001.
[21] H. G. Jacoby and B. Minten, "On measuring the benefits of lower transport costs," *Journal of Development Economics*, vol. 89, no. 1, pp. 28–38, 2009.
[22] A. K. Cosar and P. D. Fajgelbaum, "Internal geography, international trade, and regional specialization," *American Economic Journal: Microeconomics*, vol. 8, no. 1, pp. 24–56, 2016.
[23] D. Donaldson, "Railroads of the raj: estimating the impact of transportation infrastructure," *The American Economic Review*, vol. 108, no. 4-5, pp. 899–934, 2018.
[24] G. Duranton and M. Storper, "Rising trade costs? Agglomeration and trade with endogenous transaction costs," *Canadian Journal of Economics*, vol. 41, no. 1, pp. 292–319, 2008.
[25] A. D. Cristea, "Buyer-seller relationships in international trade: evidence from U.S. states' exports and business-class travel," *Journal of International Economics*, vol. 84, no. 2, pp. 207–220, 2011.
[26] A. K. Cosar and B. Demir, "Domestic road infrastructure and international trade: evidence from Turkey," *Journal of Development Economics*, vol. 81, pp. 232–244, 2016.
[27] B. Faber, "Trade integration, market size, and industrialization: evidence from China's national trunk highway system," *The Review of Economic Studies*, vol. 81, no. 3, pp. 1046–1070, 2014.
[28] P. Charnoz, C. Lelarge, and C. Trevien, "Communication costs and the internal organisation of multi-plant businesses: evidence from the impact of the French high-speed rail," *The Economic Journal*, vol. 128, no. 610, pp. 949–994, 2018.
[29] A. B. Bernard, A. Moxnes, and Y. U. Saito, "Production networks, geography, and firm performance," *Journal of Political Economy*, vol. 127, no. 2, pp. 639–688, 2019.
[30] G. M. Grossman and E. Rossi-Hansberg, "Trading tasks: a simple theory of offshoring," *The American Economic Review*, vol. 98, no. 5, pp. 1978–1997, 2008.
[31] D. Donaldson and R. Hornbeck, "Railroads and American economic growth: a "market access" approach," *Quarterly Journal of Economics*, vol. 131, no. 2, pp. 799–858, 2016.
[32] M. J. Melitz, "The impact of trade on intra-industry reallocations and aggregate industry productivity," *Econometrica*, vol. 71, no. 6, pp. 1695–1725, 2003.
[33] J. Eaton and S. Kortum, "Technology, geography, and trade," *Econometrica*, vol. 70, no. 5, pp. 1741–1779, 2002.
[34] Y. Lin, "Travel costs and urban specialization patterns: evidence from China's high speed railway system," *Journal of Urban Economics*, vol. 98, pp. 98–123, 2017.
[35] Y. Qin, ""No county left behind?" The distributional impact of high-speed rail upgrades in China," *Journal of Economic Geography*, vol. 17, no. 3, pp. 489–520, 2016.
[36] T. Beck, R. Levine, and A. Levkov, "Big bad banks? The winners and losers from bank deregulation in the United States," *The Journal of Finance*, vol. 65, no. 5, pp. 1637–1667, 2010.
[37] L. Brandt, J. Van Biesebroeck, and Y. Zhang, "Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing," *Journal of Development Economics*, vol. 97, no. 2, pp. 339–351, 2012.
[38] R. C. Feenstra, Z. Li, and M. Yu, "Exports and credit constraints under incomplete information: theory and evidence from China," *The Review of Economics and Statistics*, vol. 96, no. 4, pp. 729–744, 2014.
[39] S. J. Redding and M. A. Turner, "Transportation costs and the spatial organization of economic activity," *Handbook of Regional and Urban Economics*, vol. 5, pp. 1339–1398, 2015.
[40] W. Jiang, "Have instrumental variables brought us closer to the truth," *The Review of Corporate Finance Studies*, vol. 6, no. 2, pp. 127–140, 2017.
[41] D. Staiger and J. H. Stock, "Instrumental variables regression with weak instruments," *Econometrica*, vol. 65, no. 3, pp. 557–568, 1997.