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Transcontinental Railways and Hinterland Development

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Abstract

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Keywords: transcontinental railway, China-Europe Express Railway, hinterland development
JEL Classification: J61, O18, R12, R41

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1 Introduction

Transportation infrastructure plays a vital role in shaping trade flows and the landscape of economic activity for most of human history. As transportation technology evolves, the relative advantage in market access ebbs and flows across space. For example, cities in the vast Eurasia hinterland prospered along the Silk Road before the Age of Exploration and perished with the rise of sea freight. The dominant role of maritime shipping in international trade nowadays leads to the imbalance between coastal and inland regions. Among the world's top 50 cities by 2022 GDP, 29 are located within 100 kilometers from a coastline.[1] This coastal region also hosts nearly 40% of the world's population (UNEP, 2014).

Transcontinental railway, as an alternative mode for international freight, has the potential to boost hinterland development. The railroad had its glory day in domestic trade before being challenged by trucks and airlines. About one and a half century ago, railway dominated domestic freight transportation in the U.S., and areas around railway roads flourished from the improvements in market access (Donaldson & Hornbeck, 2016). Around the same time, the expansion of railroad network in colonial India increased trade flows and real income (Donaldson, 2018) as well as city size (Fenske et al., 2023). That golden age left us a global railway network of 786,130 kilometers track length in 2021, which connects many of the countries in Europe, Asia, and North America and makes transcontinental railway a promising alternative for long-haul freight.[2] Transcontinental railway has its advantage in shipping time compared to sea freight and in shipping cost compared to air freight. By directly connecting inland cities to the global market, transcontinental railway may facilitate cross-border trade flow and incentivize manufacturing plants to locate in the hinterland.

Taking advantage of the recent expansion of an ambitious transcontinental railway network—the China-Europe Railway Express (CERE), this paper conducts one of the first evaluations of transcontinental railways' effects on hinterland development. As a key logistical component in the Belt and Road Initiative (BRI), the CERE aims to utilize existing rail trackage across Eurasian countries for freight transport between China and Europe through international cooperation.[3] Since its official launch in 2011, the CERE has been well received by national and local governments in different countries. The number of cities in China connected to Europe by the CERE and the volume of rail freight have both expanded substantially (Figure 1). Over the past decade, 81,000 train trips have brought 7.6 million twenty-foot equivalent units of Chinese products worth over 340 billion

[1] https://en.wikipedia.org/wiki/List_of_cities_by_GDP, retrieved on March 12, 2024.

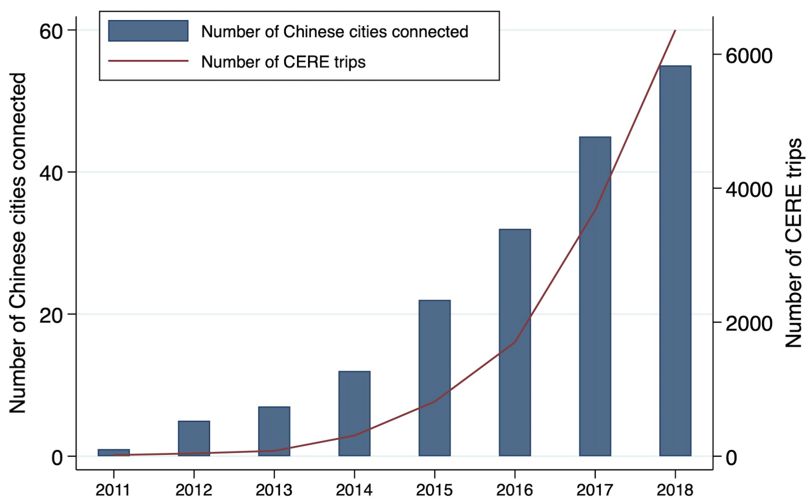
[2] https://data.worldbank.org/indicator/IS.RRS.TOTL.KM?skipRedirection=true&view=map, retrieved on March 12, 2024. Based on the authors' calculation, the total rail route is 310,848 kilometers in Europe, 237,042 kilometers in Asia, 196,703 in North America, 37,643 in Africa, and 3,894 in South America.

[3] There has been an international coordination framework between railway companies/government agencies of related countries. A Joint Working Group for Transport of the CERE, established in 2017, is now the key part for coordination.

U.S. dollar to Europe.[4]

The CERE, in particular the railway stations in China's hinterland, provides a suitable case for studying transcontinental railway and hinterland development, for at least two reasons. First, there is a great economic imbalance between hinterland and coastal regions in China. In 2010, the GDP per capita in the hinterland was $3,751, less than half of that in the coastal area ($8,232).[5] The CERE greatly improves the market access of hinterland cities by facilitating container shipping to Europe. Second, the CERE routes and operating cities are solely selected by China Railway, a state-owned enterprise under the direct control of the central government. This to some extent alleviates the endogeneity concern over the location of CERE stations.

Figure 1: The Expansion of the China-Europe Express Railway in the 2010s



Notes: The number of connected cities in China is calculated based on the China-Europe Railway Timetable. The number of CERE trips is obtained from the China Europe Railway Express Construction Development Plan.

To investigate the effect of transcontinental railways on hinterland development, we use rich firm-level data from multiple sources. We first obtain the universe of international trade transaction records of China between 2010 and 2016 from the China Custom Database (CCD). Second, firm production during the same period is provided by the National Tax Survey Database (NTSD). This database is a nationally representative panel of firms and has recently been used in e.g., Z. Chen et al. (2021) and Z. Chen et al. (2023). Third, the National Enterprise Credit Information Publicity System (NECIPS) covers the population of firm entries between 2010 and 2018. Fourth, capital flows from publicly listed firms between 2010 and 2018 are constructed from the China

[4]https://english.www.gov.cn/news/202312/02/content_WS656a7753c6d0868f4e8e1d10.html, retrieved on March 12, 2024.

[5]Computed by the authors based on the China Statistical Yearbook. The coastal region includes all provinces with a coastal line. The hinterland includes the remaining provinces.

Research Data Service Platform (CNRDS). In addition to those firm-level data, we also obtain the data for labor migration from the population census (2005, 2010, and 2015) and nighttime light intensity from 2012 to 2018 from the Visible and Infrared Imaging Radiometer Suite (VIIRS).

Annual firm-level data on trade transaction, production, and entry are used in a difference-in-differences (DID) estimation. We focus on 22 hinterland railway stations (treatment) that launched the CERE between 2011 and 2018. Control stations are those without CERE services and no less than 200 kilometers away from any treatment station. Our empirical strategy compares firms inside a 100km-radius neighborhood around the treatment and control stations. A major portion of our analyses is carried out at the firm level and at the 5km-by-5km grid level, except migration that is available only at the city level.

We first examine CERE's effect on hinterland exports to Europe. On average, the CERE significantly increases the value of exports to Europe by $14,900 per square kilometer in grids adjacent to a CERE station, relative to those near a non-CERE station. A back-of-the-envelope calculation suggests that the relative increase in exports of treated firms amounts to 2.41% of China's total exports to Europe in 2010. The increase in exports occurs through both extensive and intensive margins: the number of exporters per square kilometer increases by 0.056 around the treated stations, and the value of exports to Europe per firm increases by $2,400.

We find that the export effect of the CERE attenuates with the distance to the railway station, suggesting that the effect arises from the CERE operation rather than other place-based policies. As the neighborhood radius gradually declines from 100 kilometers to 10 kilometers, the point estimate on exports to Europe increases monotonically from $14,900 per square kilometer to $144,900 per square kilometer. We also find that the average treatment effect masks substantial heterogeneity across different types of goods. The exports of intermediate goods and those of high time value goods à la Hummels & Schaur (2013) increase substantially, while goods in the other categories witness an increase with smaller magnitudes. The exporters have a higher willingness to pay to reduce time costs for high time value products, as the CERE is a faster, though more expensive transportation mode than seaborne shipment.

The CERE further boosts inland manufacturing production. Along the extensive margin, the point estimate implies a 35% increase in the number of manufacturing firm entries, relative to the sample mean. Comparing CERE's impact on the number of new manufacturers and that of exporters, the impact on the latter is more pronounced. This implies that incumbent manufacturers that used to focus on domestic markets start to export with the CERE initiation. Along the intensive margin, the CERE contributes to a 7.88% increase in output, 7.92% increase in employment and 8.01% increase in net fixed assets for an inland manufacturing firm. These estimates are within the range of estimates found in the prior literature examining the impacts of place-based industrial policies and transportation policies across the world, suggesting that CERE's impact on hinterland economic development is economically significant. As China's place-based policies implemented before 2010 contribute little to hinterland development (M. Lu & Xiang, 2016), increasing market access through transcontinental railroad seems to be a valid policy alternative.

We present supportive evidence by investigating CERE's impact on several other economic indicators. First, the CERE contributes to the expansion of service industries. We find significant increases in the number of producer service firms and trade intermediaries but fail to detect any significant impact on consumer services. Second, we find that the intensity of nighttime light increases by 13 percentage points, suggesting that economic activities become more active in adjacent neighborhoods of CERE stations. Third, the CERE initiation in the hinterland region is accompanied by capital inflow from the coastal region. Relative to grids adjacent to non-CERE stations, grids close to CERE stations experience a 34.7% increase in capital inflow, as measured by the establishment of inland subsidiaries by publicly listed manufacturing firms in the coastal region. However, manufacturing firms located in the hinterland do not prefer the area surrounding CERE stations when setting up subsidiaries. Fourth, we show that the CERE reduces inland outmigration to coastal cities by 37.4% relative to inland cities without the CERE, but has no impact on migration within the hinterland.

We conduct a host of robustness checks including testing the parallel trend assumption and addressing potential endogeneity concerns. First, inspection of the coefficients in the pre-treatment period suggests that we cannot reject the parallel trend assumption. Second, we show that the CERE does not have any effect on exports to U.S. as a placebo test. This mitigates the concern of potential confounders that are destination neutral. Third, we provide evidence that our results are not driven by another policy that identified 39 core cities to enhance connectivity with foreign countries under the Action and Vision of the Belt and Road Initiative. Fourth, although China's expansion of its passenger-dedicated High-Speed Railway (HSR) network overlapped with the period when the CERE was initiated, we do not detect any evidence that the expansion of the HSR network led to the initiation of the CERE or to the increase in exports via the CERE. Fifth, local leaders who care more about career advancement could adopt a package of policies including the CERE, but we do not find significant differential effects on exports across cities whose leaders are faced with different likelihood of political promotion. Lastly, we instrument whether a freight railway station initiated the CERE during the study period with its distance to post routes and post stations built in the Ming dynasty. Constructed half a millennium ago, Ming post routes and stations were selected at places with best geological conditions to ensure efficient transport of military information. Importantly, the routes and the stations were not selected based on economic development. In a long-difference variant of the baseline difference-in-differences specification, we find that the estimates of the instrument variables approach are not significantly different from the OLS estimate, suggesting that the latter estimate is causal.

There is a huge literature in urban, development economics, and economic geography that investigates the role of transportation infrastructure in developing countries. A major portion of this literature focuses on domestic transportation infrastructure and documents controversial findings. For instance, Ghani et al. (2016) find that a large-scale highway construction project in India facilitated diffusion of manufacturing activities from major cities to less developed districts along the highway. Positive impacts of enhanced domestic transportation on peripheral regions' development are also found in Indonesia (Rothenberg, 2013; Gertler et al., 2022), African countries (Storeygard, 2016; Jedwab & Moradi, 2016), Turkey (Coşar et al., 2022), and Peru (Martincus et al., 2017). In contrast, Asher & Novosad (2020) find that the construction of roads to poor India villages incentivized local labor to leave and has no discernible impact on local income. Nil or negative impacts are also documented in Brazil (Bird & Straub, 2020) and China (Faber, 2014; Banerjee et al., 2020; Baum-Snow et al., 2020). We add to this literature by considering a cross-country transport mode that directly connects poor hinterland regions to the international market. By improving the international market access, transcontinental railway contributes to trade and manufacturing expansion of the hinterland.

Our paper is related to the literature on the role of international trade in shaping the uneven economic development across regions (Behrens & Picard, 2011; Coşar & Fajgelbaum, 2016; Fan, 2019; Xu & Yang, 2021; Fajgelbaum & Redding, 2022). Due to domestic trade costs, inland regions are more isolated from international trade than coastal regions. This has led to substantial disparity between coastal and inland regions in terms of population density and urbanization (Fajgelbaum & Redding, 2022), specialization patterns (Coşar & Fajgelbaum, 2016), and wage (Fan, 2019). As a result, the literature proposes lowering domestic trade costs to reduce regional inequality (Behrens & Picard, 2011; Fan, 2019; Xu & Yang, 2021). We complement this literature by focusing on an alternative solution that directly lowers international trade costs for inland regions and has the potential to reduce regional inequalities.

Since CERE is a key component of the Belt and Road Initiative (BRI), our study also adds to the recent literature on the economic impact of the BRI. Baniya et al. (2020), M. X. Chen & Lin (2020), and De Soyres et al. (2020) examine the effects of the BRI on trade, foreign direct investment, and welfare across countries. Compared with these studies, we focus on the impact of CERE on the spatial distribution of economic activities within a country. Closely related to our paper, Lall & Lebrand (2020) and Bird et al. (2020) investigate how the BRI affects welfare across regions within China and Central Asia, using region-level aggregate data. We complement these studies by using detailed firm-level data, and by investigating a broader range of outcomes, including trade, firm entry, service sectors, capital flow, and labor migration. Finally, all the aforementioned studies on the BRI rely on the trade cost reduction induced by the *planned* BRI projects estimated in De Soyres et al. (2019). We instead study the actual effects of a truly-implemented BRI project.

The rest of the paper is organized as follows. Section 2 introduces the development of the China-Europe Railway Express from 2011 to 2018. Section 3 describes the identification strategy and data. Section 4 reports the empirical findings. Section 5 concludes.

2 Contextual Background

2.1 The CERE

The *China-Europe Railway Express*, a transcontinental railway network based on the *Trans-Eurasia Logistic*, utilizes existing rail trackage across Eurasian countries for freight transport between China and Europe. The CERE is a key logistical cog in the Belt and Road Initiative, a development strategy proposed by China's president Xi Jinping that focuses on connectivity and cooperation on a transcontinental scale. The BRI roughly follows and expands the Ancient Silk Road on the land side and complements it with a maritime part to build a series of economic corridors with the goal of boosting trade and stimulating economic growth across Asia, Europe, and Eastern Africa (De Soyres et al., 2019).

The CERE is part of the Belt Initiative that provides an alternative transportation modal to container shipping. It operates on a gigantic network of railways that spans over 20 countries across the Eurasian continent, departing from China, passing through Russia and Central Asia, and arriving in Western Europe through Poland, Belarus, and Turkey (Figure 2). To ensure transportation efficiency, CERE trains run between the origin station and the destination station without stopping, except for gauge conversion and supply replenishments.[6] This "point-to-point" feature implies that only the international transportation cost is reduced for a freight railway station that operates CERE trains. Goods produced at other locations need to be transported to the CERE station for being embarked onto China-Europe freight trains.

[6]Railways in different countries operate on different track gauge, i.e., the distance between the rails. Trains generally cannot run through without some form of conversion between gauges, adding delay and inconvenience to travels.

Figure 2: China-Europe Express Railway Routes

Source: The China Europe Express Railway Construction and Development Plan.

In terms of cost-effectiveness, the CERE has positioned itself between air and sea, cheaper than the faster air route and faster than seaborne freight. Depending on the route and the destination, a typical rail journey from China to Europe takes between 10 to 20 days, which is roughly one third to one half the time it takes to move containers by ship. The transport cost per 40-foot container by the CERE is roughly twice to three times the cost of sea freight and a quarter that of air freight.[7]

As of October 2023, the CERE has bridged more than 217 cities in 25 countries across the Eurasian continent, including Azerbaijan, Belgium, China, Czech Republic, Slovakia, France, Germany, Kazakhstan, Spain, the United Kingdom, Russia, etc. Since the official launch of the BRI in 2013,[8] the idea of transporting goods via existing railways as a substitute for container shipping has been well received by governments in different countries. Consequently, the number of CERE runs expanded exponentially since its initiation. In the first four years, there were in total only 1,881 runs; the total value of goods transported was $1.7 billion. By mid-2021, the total number of runs exceeded 40,000 and the value of goods transported was over $200 billion. The CERE also

[7]Based on data from the official site of China Express Railway (http://cn.cetrains.com), information from Wutong International Logistics Network (http://inter.chinawutong.com), and DSV global Transport and Logistics (www.dsv.com), a 40-foot container (22,000kg of goods) costs $1,500-$4,000 to transport by sea, $7,500-$10,000 to transport by rail, and $25,000-$32,000 to transport by air.

[8]Despite being the key logistic cog under the BRI, the first CERE route, which connects Chongqing China and Duisburg Germany, was launched in 2011.

has become an irreplaceable alternative for China's trade to Europe. In 2011, only 0.4% of China's exports to Europe and 0.6% of imports from Europe were transported through the CERE. In 2018, the numbers had increased by more than ten-folds and six-folds, to 4.8% and 3.9%, respectively.[9]

The variety of goods transported by the CERE has gradually expanded from mainly IT products, i.e., laptops, printers, cell phones to clothing, automobile accessories, food and beverage, furniture, chemicals, machinery and equipment, etc. Starting from 2023, electrical vehicles, lithium-ion battery products, and photovoltaic products become the most popular goods transported by the CERE, due to strong European market demand.

China and Europe are located on the two edges of the Eurasian continent. The CERE connects rail stations in China to those in Central Asia and Europe through three major routes—the *western*, the *central*, and the *eastern channel*.[10] All three necessarily travel through China's hinterland regions.

The choices of CERE routes and operating cities are selected by the China State Railway Group Co., Ltd. (China Railway), a state-owned enterprise under the management of the Chinese central government. To launch CERE operations in a city, the local government could submit an application to the China Railway, or the China Railway could propose to operate the CERE in that city. In either case, China Railway sends a group of experts to consult with the local government and railway bureau and run a thorough investigation of local transportation capacity and cost, including freight train stations, warehouses, and routes. Interviews with a senior manager at the China Railway reveal that the company regards the city's economic size, industry types, and production capacity as the most important indicators, as the decision to run China-Europe trains is primarily driven by its expected profitability to the company. However, the company does not take the impact of the CERE on local economic development as its main consideration.[11] This decision process implies that whether a city launches the CERE is more likely correlated with its past economic performance, but less so with concurrent shocks that may impact its future performance.

[9]Export and import shares from China to Europe through the CERE are based on the China Railway Express Development Report 2019.

[10]The western channel, which mainly attracts imports and exports between the central and west China (i.e., inland China) and Europe, enters and exits China from Alashankou and reaches Europe through Kazakhstan, Russia, Belarus and Poland. An alternative route, also considered as part of the west channel, is the southwest channel that enters and exits China from Alashankou and reaches Europe via Kazakhstan, Uzbekistan, Turkmenistan, Iran, Turkey to Europe. The central channel, which mainly attracts imports and exports between the north and central China and Europe, enters and exits from Erlian Port and reaches Europe via Mongolia, Russia, Belarus and Poland. The eastern channel, mainly attracting imports and exports between the east and south coasts of China, northeast China and Europe. It enters and exists from Manzhouli port, and reaches Europe through Russia, Belarus and Poland.

[11]There have been no cases where a local government refuses to operate the CERE when the China Railway proposes to launch the CERE in the city, or local government nonetheless operates the CERE without the permission from the China Railway. This again shows the decision to launch the CERE is made by the central government rather than the local government.

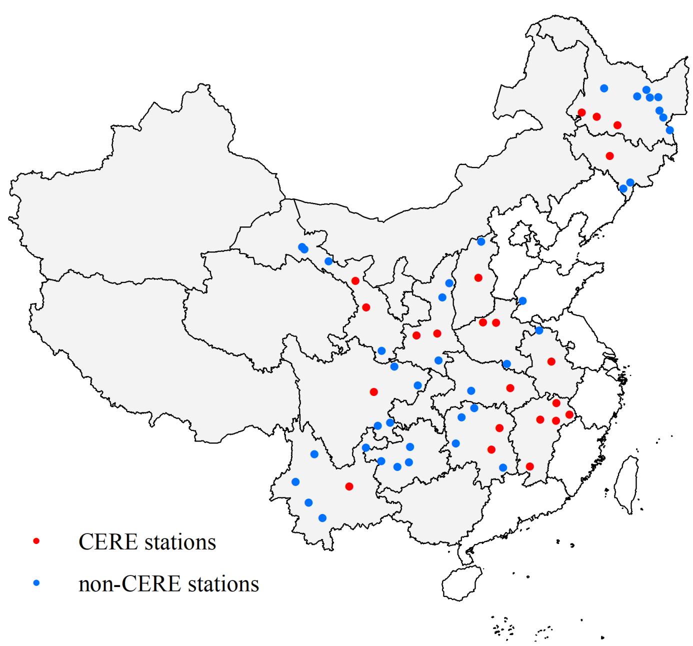
3 Empirical Strategy, Data and Variables

Our empirical analyses seek to identify the causal impact of the CERE on hinterland development. This section introduces the empirical strategy, data and variables, and summary statistics.

3.1 Empirical Strategy

Between 2011 to 2018, the China Railway selected 22 hinterland freight railway stations to operate CERE trains between China and Europe (Figure 3). The hinterland here is mainly defined as provincial units in China without a coastal line.[12] Appendix Table A.1 lists the initiation date of each CERE railway station. The key institutional feature of "point-to-point" trips without loading/unloading goods in the middle suggests that the CERE does not change domestic transport costs. Since goods need to be transported to the origin station before travelling to Europe via domestic transportation, the benefit of using the CERE for exports to Europe is expected to be localized and diminishes with the distance to the station.

Figure 3: Hinterland CERE stations in China between 2011 and 2018



Note: The staggered introduction of the 22 CERE stations (red dots) in hinterland China (the gray region), constructed from the China-Europe Railway Express Timetables. Control stations (blue dots) include those without CERE services and at least 200 kilometers away from any treatment station.

We employ a staggered difference-in-differences strategy, comparing the outcome of firms close to a CERE station to that of firms adjacent to a non-CERE freight railway station before and

[12]There are two exceptions: Beijing is excluded from the hinterland defined here as it is highly developed and around 100 kilometers away from the coast, and Guangxi is included as it is usually taken as the less developed region. This does not change our results because there are no treatment or control railway stations in these two provincial units.

after the CERE initiation. Specifically, we track all freight rail stations in the hinterland and draw a 100-kilometer neighborhood around each station. Depending on the granularity of data, an observation is defined either at the 5km-by-5km grid level or at the firm level, which is then assigned to the treatment/control group depending on whether the rail station initiated the CERE during the study period. A 5km-by-5km grid is assigned to the treatment/control if the distance of its center is within 100 kilometers of a treatment/control railway station. Since some of our data cover a period between 2010 and 2016, while others cover a longer period from 2010 to 2018, regressions using the former data assign 16 CERE stations opened during 2011-2016 as the treatment, and regressions using the latter data assign all the 22 CERE stations opened during 2011-2018.

Our concentric ring approach that focuses on firms/grids centering around rail stations is similar to the identification strategy used in Bernard et al. (2019). This approach helps address the issue of confounding policies that usually are implemented by administrative boundaries. We can also vary the radius of the neighborhood to see whether the effect attenuates with the distance to the railway station.

We further impose two restrictions over the railway stations. First, we keep only one station in each city to exclude multiple treatments or the spillover effect on the controls. If a city has initiated the CERE in one or multiple stations during the sample period, we select the first station that initiated the CERE. If a city has not initiated any CERE during the sample period, we select the largest freight rail station in terms of its 2010 transport volume.[13] Second, we drop any control railway station that are within 200 kilometers from CERE stations even if they may be in different cities. In doing so, we avoid the overlap between the neighborhood of a treatment station and that of a control station. After imposing these two restrictions, we identify a total of 61 hinterland rail stations, of which 22 are CERE stations and 39 are control stations.

3.2 Data and Variables

Our paper examines the effect of the CERE on hinterland development along a wide array of dimensions, including exports, manufacturing production, service expansion, nighttime light intensity, and others. This section describes the definitions of the outcome variables and the data used to construct them.

Exports. Data for hinterland exports are obtained from the Chinese Custom Database (CCD) for year 2010-2016. The data report transaction-level exports and imports for the universe of Chinese firms. Variables include firm name, address, product type (reported at HS 8-digit level), and destination and origin country.[14] Each firm is matched to a 5km-by-5km grid. We then compute the total export value (in millions of US dollars) to Europe per square kilometer. We further examine exports along the extensive and the intensive margins, where the extensive margin is measured

[13] Transport volume for each railway station is obtained from China's Statistical Yearbook 2020.

[14] Transport mode for each transaction, in particular road-borne, is not available after 2012. Otherwise we can examine the impact of the CERE on exports to Europe via different modes.

by the total number of exporting firms per square kilometer, and the intensive margin is measured by the average export value (millions of US dollars) to Europe per exporting firm.[15]

Manufacturing Performance. We measure manufacturing performance along both the extensive and intensive margins. Along the extensive margin, we calculate the number of newly registered manufacturing firms at the grid level for each year during 2010-2018 from the China National Enterprise Credit Information Publicity System (NECIPS), which is collected and maintained by the State Administration for Market Regulation of China. The data records the population of new business registries in China, including variables such as firm name, industry classification, address, registered capital, and descriptions on the scope of operation. Each newly registered firm is geocoded using Baidu Maps API and assigned to a 5km-by-5km grid. Along the intensive margin, we obtain annual firm-level industrial output, employment, net fixed asset during 2010-2016 from China's National Tax Survey Database (NTSD) from the State Administration of Taxation of China.[16] In both the NECIPS and the NTSD, we identify manufacturing firms based on their 2-digit industry codes following Brandt et al. (2012).[17]

Service Performance. We also investigate whether the CERE opening contributes to the expansion of service industries. We generate three variables representing the numbers of different types of service firms per square kilometer: (1) producer services, (2) consumer services, and (3) freight agencies, using the NECIPS. In the NECIPS, each firm is associated with a 2-digit Chinese industry classification code. To determine whether a firm serves producers or consumers, we utilize the Statistical Classification of Producer Service Industries (SCPSI), a concordance between producer service types and 4-digit Chinese industry classifications.[18] Using the SCPSI concordance, a 2-digit classification is roughly taken as producer service if over 50% of the 4-digit subclassifications under it are producer services; otherwise consumer service. We then calculate the number of producer service firms and that of consumer service firms per square kilometer at the grid level, respectively.

The third variable is local trade-related services, represented by the number of freight agencies per square kilometer at the grid level. Freight agencies are identified based on all firm registries in the NECIPS using the following criteria. First, the firm belongs to the service sector. Second, the firm name includes at least one of the three keywords: "import (*jin kou* in Chinese)", "export (*chu kou* in Chinese)" or "trade (*mao yi* in Chinese)". Third, at least one of the two keywords, "agency (*dai li* in Chinese)" or "consulting (*zi xun* in Chinese)", appears in the description of the scope of

[15]For grids where there are no exporting firms, the average value of export per firm is set to zero.

[16]Liu and Mao (2019) provide a detailed description of the dataset. Initiated and maintained jointly by the State Administration of Taxation and the Ministry of Finance, the NTSD surveys a rolling sample of firms on an annual basis, covering over 700,000 firms from a broad range of industries and regions across the nation. We use a panel of firms that have annual records between 2010 and 2016.

[17]Specifically, industry codes 1-6 correspond to agriculture, 7-11 to mining, 13-43 to manufacturing, 44-46 to electricity, water and heat, and 46 and above to service.

[18]The SCPSI was developed by China's State Council in 2019, with the goal of monitoring the scope of producer service industries.

firm operation.

Nighttime Light. We use the intensity of nighttime light (NTL) at the grid level as a proxy for local economic activity (Henderson et al., 2012). Data on NTL intensity for each 500m-by-500m grid is obtained from the Visible and Infrared Imaging Radiometer Suite (VIIRS) for 2012-2018. We then calculate the average NTL intensity for each 5km-by-5km grid.

Capital Flow. Capital flow to inland is measured using the number of newly established subsidiaries by publicly listed manufacturing firms based in the coastal region. Information on the subsidiaries of publicly listed firms is obtained from the Chinese Research Data Service Platform (CNRDS) during 2010-2018. We obtain the names of subsidiaries for each firm from their annual reports. We then match the names of subsidiaries to the NECIPS data to identify the location and establishment year of each subsidiary.[19] Appendix A.2 provides a detailed description of the variable construction.

Labor Migration. We use the 2010 Population Census and the 2015 mini-Census to construct migration flows between pairs of cities. The population census does not provide information on the detailed street address of the respondents, preventing us from assigning individuals to the 100-kilometer neighborhood of a rail station. As an alternative, we construct inland city to coastal city outmigration and take the first difference of labor outmigration between 2015 and 2010. Appendix A.3 presents a detailed description of the variable construction.

Appendix Table A.2 presents the descriptive statistics for the main variables. During the study period, for grids within 100 kilometers from the 61 hinterland freight rail stations, the per square kilometer export value to Europe is $20,000 per year. On average, there are 126 exporting firms, 942 new manufacturing firm registries per year, 5,055 entries of producer service firms, 4,239 entries of consumer service firms, and 691 entries of freight agencies in a 100-kilometer neighborhood around a freight railway station.[20] A coastal publicly listed manufacturing firm sets up 0.002 subsidiaries in a hinterland city each year, or about 0.12 hinterland subsidiaries each year (across the 61 hinterland cities in the sample). There are fewer migrants who move from an inland city to a coastal city in 2015 compared to 2010.

4 Empirical Framework and Results

4.1 Estimation Equation

We identify the effect of the CERE through a staggered difference-in-differences strategy, comparing firm-level or grid-level outcomes in the neighborhood of CERE rail stations and those

[19] We use a name disambiguation procedure to coarsely match subsidiary names that appear in the CNRDS to those in the NECIPS. We first match the subsidiary names disclosed from annual reports of the listed firms with the NECIPS. In case there is no perfect match, we search for a perfect match with respect to historical names used by the firm. For the remaining firms, we re-do the matching procedure by excluding "LLC", "L.L.", "limited liability corporation", etc., from firm names. A subsidiary will be dropped if it still cannot be matched to the NECIPS after these steps.

[20] The numbers are calculated by multiplying the corresponding statistics in Appendix Table A.2 by $\pi \times (100km)^2$.

around control stations, before and after the opening of the CERE. Specifically, we estimate the following differences-in-difference (DD) equation:

$$Y_{ijt} = \alpha + \beta CERE_{jt} + \gamma X_{jt} + \theta_i + \rho_t + \epsilon_{ijt} \quad (1)$$

where Y represents the outcome variable and i indexes the unit of analysis. For most of the outcome variables, i represents a 5km-by-5km grid or a firm in the 100 kilometers neighborhood of the freight railway station j. For migration where grid-level information is unavailable, the unit of analysis is a pair of inland and coastal cities. t represents year. The key independent variable, $CERE_{jt}$, is a dummy variable taking the value of one if the rail station j operates CERE trains in year t, and zero otherwise. Grid or firm fixed effects (θ_i) and year fixed effects (ρ_t) are included.[21] X_{jt} are control variables for the city where the rail station j is located, including (1) GDP per capita, (2) population, and (3) government expenditure, all in logs.[22] Standard errors are clustered at the station level.

To examine the dynamic effects of the CERE and parallel pre-trends between the treatment and control groups, we also estimate an event study version of Equation 1:

$$Y_{ijt} = \alpha + \sum_{k=-5}^{m} \beta_k CERE_{j,t+k} + \gamma X_{jt} + \theta_i + \rho_t + \epsilon_{ijt} \quad (2)$$

where k indicates the time gap between year t and the year when the CERE is launched. The year just prior to the CERE initiation ($k = -1$) is set as the base period. m represents the last post-CERE year, which depends on the data coverage (either 2010-2016 or 2010-2018). Definitions for other variables are identical to Equation 1.

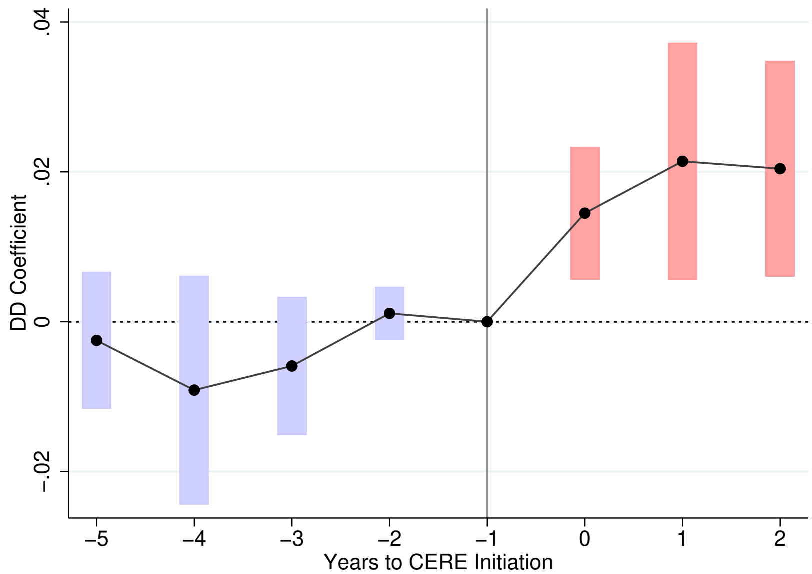
4.2 Effects on Inland Exports

Baseline Results. We first examine the effects of the CERE on inland exports to Europe. We estimate Equations 1 and 2 at the 5km-by-5km grid level. The dependent variable is the total value of exports to Europe per square kilometer (in million US dollars). Figure 4 visualizes the results for the event study specification in Equation 2. There is a significant increase in exports to Europe in grids within 100 kilometers of the CERE stations after the CERE initiation, relative to grids neighboring control stations. The effects are persistent three years after the CERE initiation. On the contrary, before the CERE initiation, we do not observe any significantly different trends in exports between the treatment and the control group.

[21] The unit of analysis i and the corresponding fixed effect θ_i varies with data granularity. When the unit of analysis is a firm, we control for firm fixed effects. When the unit of analysis is a firm×station, firm×station fixed effects and firm controls are added. When the unit of analysis is an inland city×coastal city pair, the data are first-differenced, and coastal city fixed effects and inland city controls are added.

[22] City-level controls are obtained from the China's City Statistical Yearbook 2010-2018.

Figure 4: The Dynamic Effect of the CERE on Inland Export



Notes: This graph shows point estimates of CERE's effects on exports to Europe for 5km-by-5km grids within 100 kilometers of the inland freight rail stations and their associated 95% confidence intervals.

Column 1 of Table 1 reports the estimation results of Equation 1 with exports to Europe as the outcome variable. Column 2 of Table 1 adds the city-level controls. In both cases, the point estimate is remarkably stable. On average, the CERE increases per square kilometer exports to Europe by around $15,000.

Table 1: The Effect of the CERE on Inland Exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Exports to Europe		No. of Firms		Exports per Firm		Exports to U.S.	
CERE	0.0150***	0.0149***	0.0568**	0.0563**	0.0024*	0.0024*	0.0073	0.0072
	(0.0053)	(0.0051)	(0.0282)	(0.0273)	(0.0012)	(0.0012)	(0.0076)	(0.0074)
Controls								
City	No	Yes	No	Yes	No	Yes	No	Yes
F. E.								
Grid	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	559,769	559,769	559,769	559,769	559,769	559,769	559,769	559,769

Note: This table reports estimated results of CERE's effects on exports to Europe. "Exports to Europe" is the per square kilometer exports to Europe in 5km-by-5km grids located within 100 kilometers of inland freight railway stations. "No. of Firms" and "Exports per Firm" are the number of exporters to Europe and the average value of exports to Europe per firm, respectively. "Exports to U.S." is defined analogously as "Exports to Europe." The key explanatory variable *CERE* is one after the rail station initiates the CERE and zero otherwise. City level control variables include: (1) GDP per capita ($), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the station level, are in parentheses. *10%, **5%, ***1% significance levels.

To get a sense of the economic significance of the point estimate, we conduct a back-of-the-envelope calculation to aggregate the impact to the regional level. Within 100 kilometers from the CERE stations, the export value per square kilometer increases by $14,900 (Column 2 of Table 1). Multiplying $14,900 by the size of the 100km-radius circle yields an aggregate increase in exports to Europe by 0.46 billion dollars around each CERE station. Since there are 16 inland rail stations that initiated the CERE during 2011-2016, aggregating over all inland CERE stations yields an increase in exports to Europe by 7.5 billion dollars. According to the China Trade and External Economic Statistical Yearbook, China's overall exports to Europe is 311.2 billion dollars in 2010. The incremental change in exports to Europe due to the CERE initiations thus amounts to 2.41% of total exports to Europe in 2010. Note that this 2.41% is a relative change between places with and without the CERE as our calculation is based on difference-in-differences estimates.

We further examine whether the increase in exports is driven by the number of exporters (the extensive margin) or the exports per exporter (the intensive margin). We run Equation 1 with the dependent variable being the number of exporters per square kilometer and the export value per firm, respectively. Columns 3 and 4 of Table 1 show that, along the extensive margin, there are 0.056 more exporting firms per square kilometer after the adjacent rail station launches the CERE. This is a starkly huge increase, which equals 15.5 times the average number of exporting firms per square kilometer in the sample (0.0036). Along the intensive margin, the point estimates in Columns 5 and 6 show that the value of exports to Europe per firm increased by $2,400. Compared with the mean export value in our sample (0.186 million), this amounts to a 1.2% increase. In summary, the CERE facilitates export growth both at the extensive and intensive margins.

Exports to the U.S. Since the CERE only facilitates exports to Europe, it should have no impact on inland exports to non-European destinations. As a falsification test, we examine the impact of the CERE on exports to the U.S. similarly by comparing grids near CERE stations and those near non-CERE stations. Columns 7 and 8 of Table 1 report the findings. Consistent with our conjecture, the point estimates are not statistically significant. The fact that the CERE increases exports to Europe but not to the U.S. addresses the endogeneity concern over unobservable confounders that are destination neutral. In Section 4.5, we further discuss the endogeneity issue by applying an instrumental variable strategy.

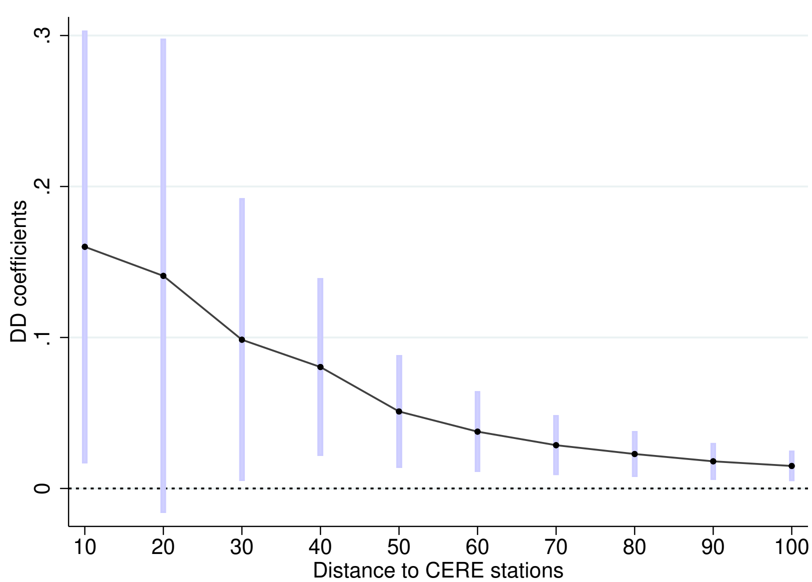
Robustness. There remains the concern that other policies and incentives could contribute to the expansion of exports to Europe near CERE stations and potentially correlate with the launching of the CERE. The alternative policies and incentives we consider include: (1) a policy that enhances connectivity of 39 core cities in China with foreign countries under the Belt and Road Initiative, (2) the expansion of High-Speed Rail, and (3) the incentive for political promotion. We do not find any empirical evidence that these alternative explanations drive the expansion of exports to Europe in the neighborhood of CERE stations. A detailed discussion can be found in Section 4.5.

In addition, a nascent econometric literature casts doubt on the validity of the two-way fixed effects DD approach with staggered treatment (De Chaisemartin & d'Haultfoeuille, 2020; Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021; Sun & Abraham, 2021; Arkhangelsky et al., 2021; Baker et al., 2022). To address the potential bias from DD estimators, we present results using the CSDD estimator (Callaway & Sant'Anna, 2021) and the CDDD estimator (De Chaisemartin & d'Haultfoeuille, 2020). Appendix Table B.1 presents the CSDD and CDDD estimates.

Heterogeneous Effects by Distance to CERE Stations. In our baseline results, we examine all 5km-by-5km grids in the 100-kilometer neighborhood of the CERE stations. Considering the relatively high domestic transportation cost, we expect that the export effect of the CEREs is localized as exporters closer to CERE stations benefit more from the launching of the CERE. To test this hypothesis, we re-estimate Equation 1, with the radius of the neighborhood varying from 10 kilometers to 100 kilometers. In all regressions, we use the identical treatment and control stations as in the baseline. We expect the point estimates to decrease with the radius of the neighborhood, indicating that the impact of the CERE gets smaller for places farther away from the CERE station.

Figure 5 plots the point estimates and their associated 95% confidence intervals for each radius. As expected, the estimates decline monotonically with the radius of the neighborhood around CERE stations. Within 10 kilometers from CERE stations, the intensity of exports to Europe is \$144,900 higher than that adjacent to non-CERE rail stations. As the radius of the neighborhood increases to 100 kilometers, the impact drops by 9.7 times, to \$14,900, which is our baseline estimate.

Figure 5: Heterogeneity by Distance to CERE stations



Note: This graph shows point estimates and their associated 95% confidence intervals that investigates the effect of the CERE on the per square kilometer exports to Europe for grids within 10 kilometers to 100 kilometers from railway stations.

Heterogeneous Effects by the Time Value of Goods. A major advantage of the CERE over seaborne shipping is being much faster. Fast transportation is valuable as lengthy shipping causes additional costs from inventory-holding, depreciation of goods, and potential default of timely delivery. We expect the CERE to increase exports particularly for products with a high time value. For example, for fresh produce or goods with rapid technological obsolescence, fast shipment is more critical (Djankov et al., 2010). Also, in a supply chain, fast shipment is important because untimely delivery can lead to default costs and loss of business reputation (Hummels & Schaur, 2013).

Empirically, we build on results from Hummels & Schaur (2013) to categorize goods into groups with different time values. We use two approaches. The first approach identifies whether goods are used as inputs in a supply chain. Specifically, we split goods into "intermediate inputs" and "non-intermediate inputs" by whether the product description contains the key word "parts" or "components." Intermediate inputs are expected to be more sensitive to transport timeliness. The second approach assigns a 2-digit Chinese manufacturing industry into a "high time value" group if any of the following keywords appear in its description: (1) food, (2) beverages, (3) automotives, and (4) electronics. The remaining industries are categorized into the "low time value" group. This classification follows the argument in Hummels & Schaur (2013) that fresh produce and fast product turnovers are associated with a high time value of transport.

Table 2 reports regression results of Equation 1 for each group of goods/industries. For the first classification approach, Columns 1 and 2 show that the CERE increases the relative intensity of exports by \$9,500 per square kilometer for intermediate inputs, and \$5,300 for non-intermediate inputs. The coefficient for non-intermediate inputs is significant at only the 10% level. For the second classification approach, Columns 3 and 4 show a significant increase in exports for high time value industries (\$12,500 per square kilometer, significant at the 1% level), but no significant increase for low time value industries (\$2,500 per square kilometer, not significant). Overall, these findings provide support to the hypothesis that CERE's impacts on hinterland exports are stronger for products/industries with a high sensitivity to timeliness.

Table 2: Heterogeneity by the Time Value of Goods

	(1)	(2)	(3)	(4)
Time Value	Intermediate Input	Non-Intermediate	High Time Value	Low Time Value
CERE	0.0095***	0.0053*	0.0125***	0.0025
	(0.0033)	(0.0030)	(0.0032)	(0.0033)
Controls				
Inland City	Yes	Yes	Yes	Yes
Fixed Effects				
Grid	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs.	559,769	559,769	559,769	559,769

Note: This table reports estimated results of CERE's heterogenous impacts by the time value of goods. The time value of goods is defined following two approaches suggested by Hummels & Schaur (2013). The first approach classifies goods into "Intermediate inputs" and "Non-intermediate inputs." The second approach categorize industries into "High Time Value" and "Low Time Value" groups. See the main text for detailed definitions. The key explanatory variable *CERE* turns one after the rail station initiates the CERE and zero otherwise. Inland city level control variables include: (1) GDP per capita ($), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the station level, are in parentheses. *10%, **5%, ***1% significance levels.

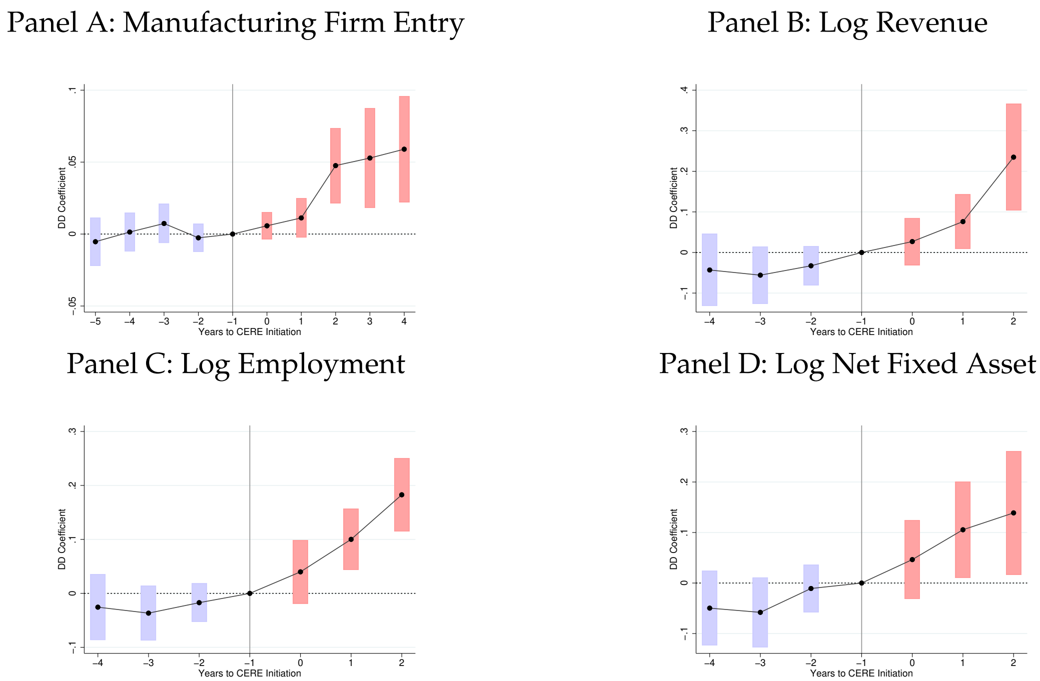
4.3 Effects on Inland Manufacturing Performance

Given that the CERE provides additional export opportunities for manufactured goods, we further investigate how it affects the performance of the inland manufacturing sector both along the extensive and intensive margins.

On the extensive margin, we estimate Equations 1 and 2 at the 5km-by-5km grid level, with the dependent variable being the number of manufacturing firm entries per square kilometer from the NECIPS data. On the intensive margin, we estimate Equations 1 and 2 at the firm level, with the dependent variable being the log revenue, log employment, and log net fixed assets of manufacturing firms in the National Tax Survey Data.

Figure 6 presents the event study results of Equation 2. We observe a significant increase in the number of new manufacturing firms (Panel A), manufacturing firms' revenue (Panel B), employment (Panel C), and net fixed assets (Panel D) after the CERE initiation. On the contrary, there is no significant difference between the treatment and control groups before the CERE initiation. These results suggest an expansion of production activities for existing manufacturing firms as well as an increase in manufacturing firm entry due to the CERE initiation.

Figure 6: The Dynamic Effect of the CERE on Inland Manufacturing Production



Note: This graph shows point estimates and their associated 95% confidence intervals of CERE's effects on inland manufacturing production in each year along the extensive margin (5km-by-5km grid level) and intensive margin (firm level).

Table 3 presents the estimation results of Equation 1. Along the extensive margin, the point coefficient in Column 1 shows that the CERE leads to an additional entry of 0.0106 manufacturing firms per square kilometer relative to the control group. Compared to the sample mean (0.0298), the point estimate amounts to a 35% increase. Note that the point estimate here is considerably smaller than that obtained for the number of exporters in Column 4 of Table 1. This implies that some of the new exporters are incumbent manufacturers. Intuitively, after the CERE initiation, manufacturers that originally focus on only domestic market may start to utilize the transcontinental railway to sell goods to the European market. This leads to a larger increase in the number of exporters than that of manufacturer entries.

Table 3: The Effect of the CERE on Inland Manufacturing Production

Dep. Var.	(1) Extensive Margin No. of. Firms	(2) Output	(3) Intensive Margin Net Fixed Asset	(4) Employment
CERE	0.0106**	0.0788**	0.0792**	0.0801***
	(0.0047)	(0.0379)	(0.0359)	(0.0286)
Controls				
Inland City	Yes	Yes	Yes	Yes
Fixed Effects				
Grid	Yes	No	No	No
Firm	No	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs.	711,501	262,122	251,527	264,831

Note: This table reports estimated results of CERE's effects on inland manufacturing production. "No. of Firms" is the per square kilometer number of new manufacturing firm registries in a 5km-by-5km grid located within 100 kilometers from inland freight railway stations. "Revenue", "Net Fixed Asset," and "Employment" are the log of revenue, net fixed asset and manufacturing employment of the same set of firms. The key explanatory variable *CERE* turns one after the rail station initiates the CERE and zero otherwise. Inland city level control variables include: (1) GDP per capita ($), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the circle level, are in parentheses. *10%, **5%, ***1% significance levels.

Along the intensive margin, the CERE on average increases manufacturing firms' revenue by 7.88%, net fixed asset by 7.92%, and employment by 8.01%, respectively. We compare these estimates to the literature that investigates the impact of place-based policies on regional economic development across the world.[23] Overall, despite that policies vary across many dimensions, we find that our estimates are within the range of previous estimates, suggesting that CERE's impact on manufacturing firms' production is economically significant.

During 2000-2010, the Chinese government had initiated a sequence of place-based industrial policies to develop its hinterland. But these efforts proved to be largely in vain (M. Lu & Xiang, 2016). Y. Lu et al. (2019) argue that the primary reason is the lack of market access; inland regions are too far away from ports along the east coast. In contrast, results in this section suggest that the CERE is an effective place-based policy in encouraging inland manufacturing production. Unlike other place-based industrial policies that redirect resources to the targeted region, the CERE improves the region's market access to the international market. In addition, the benefit of the CERE escalates with the number of cities (and countries) connected. Hence, this institutional innovation of multinational transport network has accomplished what previous industrial policies of China have failed for developing its hinterland.

[23]In terms of industrial policies, for instance, Criscuolo et al. (2019) find that a 10% increase in the maximum investment subsidy of the Regional Selective Assistance in the UK increases local manufacturing firms' output by 3.9%, manufacturing employment by 6.7%, and capital investment by 16.6%. For policies related to transportation infrastructure, Martincus et al. (2017) document that road expansion in Peru has increased firms' employment by 3%-4%. The point estimates here are also comparable to several other studies, e.g. Chaurey (2017) for the industrial policy in India, B. Chen et al. (2019) and Givord et al. (2013) for economic zones in China and France, respectively, and Rothenberg (2013) for the transportation policy in Indonesia.

4.4 Supportive Evidence

The analysis so far has focused on the effect of the CERE on the manufacturing sector. In this section we further investigate whether the CERE has facilitated the local development in other sectors.

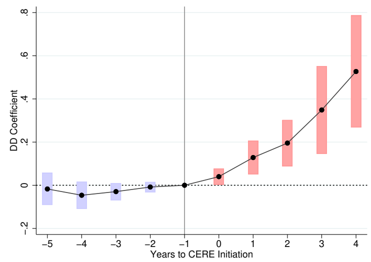
Impacts on service industries. We examine the expansion of service industries along two dimensions. The first dimension is the development of consumer services vs. producer services, with the former fulfilling final demand and the latter providing intermediate inputs. The expansion in manufacturing production could lead to a larger development for services to producers, as the demand for intermediate inputs increases. In contrast, as manufacturing expansion is triggered by enhanced trade to Europe, we expect the impact on services to local consumers is less pronounced. To test these hypotheses, we examine the impacts of the CERE on the number of producer service firms and that of consumer service firms per square kilometer, respectively. The second dimension is the development of trade-related services. The increased demand for transportation, logistics, and communication may facilitate the development of trade-related service sector. Empirically, we examine the impact of the CERE on the number of newly registered freight agencies per square kilometer.

The event study results in Figure 7 show a significant increase in the number of producer service firms and that of freight agencies after the CERE initiation, while no such effect is witnessed for the consumer service firms. For all three variables, point estimates are always statistically insignificant during the pre-CERE periods. Columns 1 to 3 of Table 4 further report the difference-in-differences coefficients. The number of producer service firms per square kilometer within 100 kilometers from rail stations increases by 0.17 (significant at the 1% level) after the station initiates the CERE, relative to that within 100 kilometers from non-CERE stations. The point estimate represents a 105% increase relative to its sample mean. In contrast, the estimate for consumer service firms is much smaller (0.0124) and not statistically significant. The number of freight agencies per square kilometer increases by 0.0231, a 107% increase relative to the sample mean.

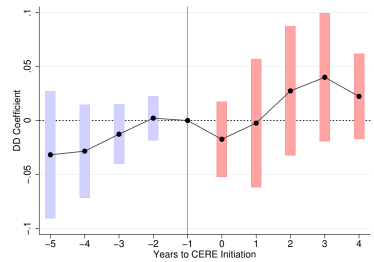
Impacts on nighttime light. Since the CERE contributes to local manufacturing expansion and to some extent, service expansion, it is natural to estimate CERE's impacts on overall economic performance. Accordingly, we investigate CERE's impact on the overall economic activities in the neighborhood of railway stations using average intensity of nighttime light as the proxy. The event study in Figure 7 shows a rising trend of nightlight intensity. Table 5 Column 5 shows that the CERE increases the intensity of nighttime light by 0.0541, which implies a 13% increase in local economic activities relative to the mean.

Figure 7: The Dynamic Effect of the CERE on Other Outcomes

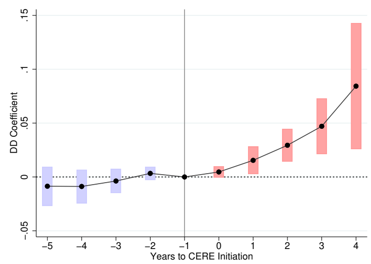
Panel A: Producer Service



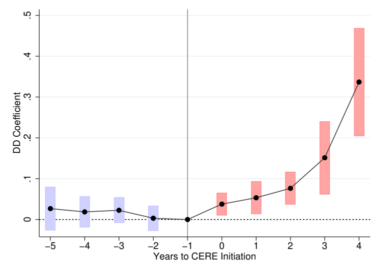
Panel B: Consumer Service



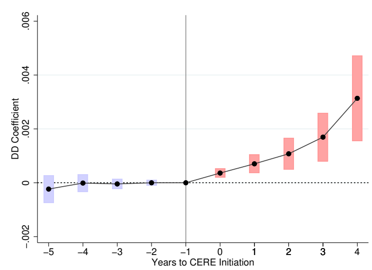
Panel C: Freight Agencies



Panel D: Nighttime Light



Panel E: Capital Flow



Note: This graph shows point estimates and their associated 95% confidence intervals of CERE's impacts on service industries, nighttime light, and capital flow from coast to inland in each year.

Table 4: The Impact of the CERE on Service Industries and Nighttime Light

	(1)	(2)	(3)	(4)
Dep. Var.	Producer Service	Consumer Service	Trade Agencies	NTL
CERE	0.1701***	0.0124	0.0231***	0.0541***
	(0.00471)	(0.0186)	(0.0064)	(0.0194)
Controls				
Inland City	NO	Yes	Yes	Yes
Fixed Effects				
Grid	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs.	711,501	711,501	711,501	559,769

Note: This table reports estimated results of CERE's impact on inland service industry expansion and nighttime light. Refer to the main text for definitions of "Producer Service", "Consumer Service", and "Trade Agencies." "NTL" is the average intensity of nighttime light in a 5km-by-5km grid. The key explanatory variable *CERE* turns one after the rail station initiates the CERE and zero otherwise. Inland city level control variables include: (1) GDP per capita ($), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the circle level, are in parentheses. *10%, **5%, ***1% significance levels.

Impacts on capital inflow. Expansion in local economic activities is usually associated with the capital and labor flow from other places. To proxy for capital inflow, we calculate the number of subsidiaries established by publicly listed companies in the manufacturing sector based in the coastal region. The point estimate in Column 1 of Table 5 suggests that the CERE significantly increases the number of inland subsidiaries by 0.0008 per square kilometer (significant at 1% level) within 100 kilometers from CERE stations, relative to the area surrounding non-CERE stations. This implies a 34.7% increase with respect to the sample mean (0.0023). Figure 7 plots the event-study coefficients of CERE's impacts on the number of subsidiaries.

As the CERE reduces the international transport cost, we expect exporting firms to have stronger incentives to establish subsidiaries near CERE stations than non-exporting firms. In addition, since the CERE primarily facilitates international trade to Europe, we also expect that the incentive to establish inland subsidiaries should increase with the firm's share of exports to Europe. To test these hypotheses, we categorize coastal firms into exporters and non-exporters, defined as whether a coastal firm or any of its subsidiaries exported to the world in 2010. We also calculate a firm's share of exports to European countries, measured as the value of the firm's exports to Europe divided by its total exports in 2010. For firms without any exports in 2010, we set its share to Europe as zero.

We then interact a firm's export status (Exp as one for exporters in Table 5) and its share of exports to Europe (ESE in Table 5) with the CERE, respectively, to investigate the heterogeneous effects on capital flow from coast to inland. Table 5 Columns 2 and 3 report the estimates. In both cases, we find the interactions are statistically significant at the 1% level, confirming that the incentive to establish inland subsidiaries near CERE stations is stronger for exporters and for those with a higher share of exports to Europe. In contrast, the point estimates on the CERE variable are not statistically significant in both columns, implying that the incentive to set subsidiaries near

CERE stations is negligible for non-exporters or exporters that export little to Europe.

We also check whether the launching of the CERE services drives capital inflow from other inland cities. Column 4 in Table 5 reports the estimate on capital inflow from inland publicly listed manufacturing firms to the neighborhood of inland railway stations. The point estimate is not statistically significant, implying that such firms do not prefer the neighborhood around CERE stations when setting up inland subsidiaries. This is good news as there is no systematic capital reallocation within the hinterland induced by the CERE.

Table 5: The Effect of the CERE on Capital Flow

	(1)	(2)	(3)	(4)
Dep. Var.	No. of Subsidiaries Around Inland Stations			
	From coastal firms			From inland firms
$CERE$	0.0008***	0.0003	0.0002	0.0004
	(0.0001)	(0.0002)	(0.0001)	(0.0005)
$CERE \times Exp$		0.0005***		
		(0.0002)		
$CERE \times ESE$			0.0008***	
			(0.0002)	
Controls				
Inland City	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
Fixed Effects				
Firm×Station	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs.	303,004	303,004	303,004	86,230

Note: This table reports estimated results of CERE's impacts on subsidiaries established in the neighborhood of inland rail stations by publicly listed manufacturing firms based in the coastal region, or by those based in the hinterland. The key dependent variable is the number of subsidiaries per square kilometer within 100 kilometers from inland freight railway stations. The key explanatory variable $CERE$ turns one after the rail station initiates the CERE and zero otherwise. Exp is a dummy indicating whether a firm or any of its subsidiaries exports to the world in 2010, and ESE is its 2010 share of exports to Europe. Firm level control variables include: (1) total profit (million US dollars), (2) total asset (million US dollars), and (3) total employment. Inland city level control variables include: (1) GDP per capita ($), (2) population (million); and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the station level, are in parentheses. *10% **5%, ***1% significance levels.

Impacts on migration. Finally, we assess the impact of the CERE on labor migration. Given that the dominant proportion of labor migration in China is from inland to coastal cities, we examine whether the CERE has reduced the outflow of labor from inland to coastal cities. The population census data do not provide information on the detailed address of sampled individuals. We thus cannot conduct the grid-level analysis as we did for the other variables. Alternatively, we run the following regression at the city pair level:

$$\Delta log(outmigration_{ij,2010,2015}) = \alpha + \beta CERE_j + \gamma X_{j,2010} + \eta_i + \epsilon_{ij} \tag{3}$$

where i represents a coastal destination city, and j an inland origin city. The dependent variable $\Delta log(outmigration_{ij,2010,2015})$ is the change in log standardized number of out-migrants from inland city j to coastal city i between year 2010 and 2015, measured using the two waves of the population census data. $CERE_j$ is a dummy indicating whether the inland city j launched CERE services within its administrative boundary between 2010 and 2015. We also exclude control cities that are within 200 kilometers of any CERE station. We add the origin city covariates in year 2010 identical to the ones used in Equation 2. Destination city fixed effects are also added. Standard errors are clustered at the origin inland city level. The regression compares the change in standardized numbers of out-migrants to a coastal destination city during 2010-2015 from a city with the CERE with that from a city without the CERE.

Table 6 presents the empirical findings. The point estimate in Column 1 shows that the volume of outmigration from an inland city with the CERE to a coastal city dropped by more than 37% between 2010 and 2015, relative to that from an inland city without the CERE. Columns 2 to 5 further examine the heterogeneity by gender and by job sector. The idea is that manufacturing labor in China is more likely to be male,[24] so we expect a stronger incentive for male labor and manufacturing labor to stay in inland cities after the CERE initiation. As expected, the CERE contributes to a 34% reduction in male workers' outmigration to the coast (Column 2), whereas the magnitude of the impact on female workers is only 19% and less statistically significant (Column 3). Column 4 then shows that manufacturing labor experiences a sharp decline by more than 52% in willingness to out-migrate due to the CERE. Column 5 shows that there is a decline in outmigration for service workers as well, though with a smaller magnitude.

We further conduct a falsification test. If the change in labor migration is truly the consequence of the CERE, we should not observe any significant change during the pre-CERE period. Column 6 investigates the change in outmigration patterns between 2005 and 2010. During this period, we do not detect any significant relationship between migration and the CERE initiation.

[24]To show that there is more male labor in the manufacturing industries in China, we calculate the male to female labor ratio in the manufacturing industries using the Chinese Annual Survey of Industrial Firms. The sample contains all Chinese firms that are either state-owned or with annual sales above 5 million RMB ($840,000). In 2010, the annual sales threshold for firms being chosen increased to 20 million RMB ($3,300,000). The data are considered a good representation of the overall Chinese manufacturing sector between 1998 and 2014. However, information related to male and female workers is recorded only between 2004-2007. Male to female labor ratios between 2004 and 2007 are 4.22, 3.73, 4,00 and 3.88, respectively, for all firms, and 3.92, 3.37, 3.54 and 3.23, respectively, for firms located in coastal cities. In summary, there are substantially more male workers in Chinese manufacturing industries.

Table 6: The Effect of the CERE on Labor Outmigration from Inland to Coast

	(1)	(2)	(3)	(4)	(5)	(6)
Period			2010-2015			2005-2010
	Overall	Male	Female	Manufacturers	Service	Overall
CERE	-0.3740***	-0.3456***	-0.1957*	-0.5223***	-0.1795*	-0.0261
	(0.0937)	(0.1037)	(0.1016)	(0.1440)	(0.0964)	(0.1089)
Controls						
Inland City	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects						
Coastal City	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	774	774	652	576	610	718

Note: This table reports estimated results of CERE's impacts on first-differenced labor outmigration from inland to coast between 2010 and 2015 (Columns 1 to 5), and between 2005 to 2010 (Column 6), respectively. The key explanatory variable *CERE* is one if the inland city launched CERE services between 2010 and 2015, and zero otherwise. "Manufacture" and "Service" denote the subsample that includes only labor in the manufacturing sector and that in the service sector, respectively. "Male" and "Female" denote the subsample including only male labor and that including only female labor, respectively. Inland city level control variables include: (1) GDP per capita ($), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the inland city level, are in parentheses. *10%, **5%, ***1% significance levels.

4.5 Robustness Checks

Controlling for confounding policies. We provide a rich set of empirical evidence to examine whether our baseline results are robust to controlling for other confounding policies. First, in March 2015, China released the Vision and Action for the Belt and Road Initiative (BRI). 39 Chinese cities were selected as the BRI core cities in this action. These cities are responsible for enhancing regional connectivity with foreign countries along the belt and road, including strengthening economic, cultural, political, transportation and individual ties. If this action simultaneously leads to the initiation of the CERE and the increase in exports to Europe, our baseline results could be biased. To address this concern, we add to Equation 1 a variable representing whether the city is selected as one of the BRI core cities post year 2014. As shown in Column 1 of Table 7, the point estimate on *CERE* remains positive and statistically significant, and its magnitude is similar to the baseline estimate (Table 1 Column 2).

Table 7: Controlling for Confounding Policies

	(1)	(2)	(3)	(4)
Dep. Var.		Exports to Europe		
CERE	0.0140**	0.0150**	0.0163**	0.0144**
	(0.0058)	(0.0050)	(0.0062)	(0.0072)
BRI core city	0.0028			
	(0.0049)			
HSR initation		-0.0001		
		(0.0022)		
$CERE \times Age54-58$			-0.0073	
			(0.0077)	
$CERE \times Prom.Prob.$				0.0053
				(0.0234)
Controls				
Inland City	Yes	Yes	Yes	Yes
Fixed Effects				
Grid	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs.	559,769	559,769	559,769	559,769

Note: This table reports robustness checks on Equation 1 with exports to Europe as the outcome variable. Refer to the main text for definitions of *BRI core city*, *HSR initiation*, $Age54-58$, and *Prom.Prob.* The key explanatory variable *CERE* turns one after the rail station initiates the CERE and zero otherwise. Inland city level control variables include: (1) GDP per capita ($), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the station level, are in parentheses. *10%, **5%, ***1% significance levels.

Second, China's High-Speed Railway (HSR) network has expanded considerably during 2005-2016. The prior literature shows that the HSR contributes to economic development (Yu et al., 2019; Qin, 2017), employment growth (Lin, 2017), and interregional investment flow (Lin et al., 2023). Because the period of the HSR expansion overlaps with that of the CERE initiation, omitting the HSR may lead to biased estimates of CERE's impacts. To address this concern, we add a variable representing whether a freight rail station is within 100 kilometers of HSR stations.[25] The point estimate on *CERE*, after including this additional variable, remains almost intact (Table 7 Column 2).

Third, since the CERE is a critical logistic component of the country's ambitious BRI plan, a city leader could be incentivized to provide CERE services to accumulate political achievement. For instance, local leaders could issue complementary policies to expand the volume of cargos transported by the CERE, or they could issue other policies to promote local industrial production and export. The incentive for political promotion, therefore, could bias the baseline estimate through imposing confounding policies.

We conjecture that the political incentive should be different across cities depending on the likelihood that a city leader gets politically promoted. We follow two approaches to measuring how likely a city secretary is on a political promoting track in China. One approach is to generate

[25] HSR stations and CERE stations are different because the HSR is a passenger dedicated transportation infrastructure.

a dummy representing, in the year a rail station initiated the CERE, whether the associated city secretary's age is between 54 and 58. As argued by Shi & Xi (2018), this age range is the last and most critical time window for a city leader to advance before retirement in the hierarchical system. Hence, city leaders that fall into this age range have a strong incentive for career promotion. The second approach, first introduced in Wang et al. (2020) and later augmented by Fang et al. (2022), regresses the *ex-post* promotion outcomes of city secretaries against their age, hierarchical rank at the beginning of office, and a set of personal and city characteristics, and then uses the estimated coefficients to predict the *ex-ante* promotion likelihood. The idea is that many characteristics such as the city leader's personality, expertise, age, political loyalty, educational qualifications, and the economic performance of their ruling regions come into play for career advancement.

In two separate regressions, we interact these two variables—age dummy and promotion likelihood—with our key variable *CERE* to examine whether there exists heterogeneity across cities whose city secretaries are with different likelihood of career advancement. Table 7 Columns 3 and 4 present the findings. In neither case do we detect any significant coefficient on the interactions between *CERE* and the likelihood of promotion. In addition, the point estimates of *CERE* remain largely intact after including the interactions. These results are inconsistent with political promotion being a driving factor behind the CERE initiation and local export expansion.

Endogeneity. Finally, we address the possible endogeneity of the CERE initiation. It should be noted that several of our previous results help alleviate the endogeneity concern. First, we find the effects are specific to exports to Europe but not to the U.S. This partially address the concern that a station initiates the CERE because it foresees the station's exports to increase in the future. For example, there may be a positive, destination-neutral demand shock unobservable to the econometrician, or local governments may implement certain place-based industrial policy. If this is the case, we should observe an increase in exports to all countries, not just Europe.

The endogeneity issue becomes more subtle if the local government initiates the CERE based on a station's anticipated future exports to Europe. If this is the case, finding zero effects for exports to the U.S. cannot address this issue. However, our interview with a senior manager of China Railway suggests that launching the CERE is not a decision made by local governments. In addition, our findings of heterogeneous export impacts with respect to the distance to the station substantially alleviates this endogeneity concern. Specifically, if our estimated export impacts are purely because the central government picks a city where there is an unobserved demand shock in exports to Europe, then we should expect all places within this city to have identical increases in exports after the CERE initiation, because the unobserved demand is the same for all places in the city. In other words, places closer to rail stations should not be affected differentially than places further away. On the contrary, we observe a stronger impact for places more proximate to the CERE station. Such a geographic localization is unlikely to arise from anticipated demand shocks over exports to Europe.[26]

To directly address the endogeneity concern, we use an instrumental variable (IV) approach, with the CERE being instrumented by historical transportation routes predominantly built with non-economic goals (e.g., Duranton & Turner, 2012; Agrawal et al., 2017). The historical data we utilize to generate the instrument are the post routes (*yilu* in Chinese) and the post stations (*yizhan* in Chinese) on the routes constructed in the Ming dynasty (year 1368-1644), as shown in Appendix Figure C.1. The Ming post routes were largely built to convey military information and transport military supplies. Because the delivery efficiency was the utmost concern and information was carried by horses, the post roads were selected at places with the best geological conditions to provide smooth and convenient transportation. On the other hand, the construction of modern railroads is also affected by the same geological conditions. As the CERE utilizes existing railroads and China Railway takes into consideration the transportation cost when building the railroads, places with better geological conditions are more likely to have historical post routes and to launch the CERE. As post routes were constructed for military purposes hundreds of years ago, their construction is less likely to be correlated with modern economic conditions or government policies that may confound empirical estimations.

We construct two instruments based on the above argument. For each rail station, we calculate its distance to the Ming post route network and to the nearest Ming post station. Because the two instruments are stable over time, they cannot be directly applied to the baseline Equation 1. We therefore transform the difference-in-differences specification to the following long-difference specification:

$$\Delta Y_{ij,2016-2010} = \alpha + \beta CERE_{j,2010-2015} + \Delta X_{j,2016-2010} + \epsilon_{ij} \tag{4}$$

where i represents a 5km-by-5km grid within 100 kilometers from inland rail stations j. $\Delta Y_{ij,2016-2010}$ is the difference in exports to Europe between 2010 and 2016 in grid i, and $\Delta X_{j,2016-2010}$ are the differences in control variables during the same period, including the differences in log GDP per capita, log population, and log government expenditure. The key explanatory variable, $CERE_{j,2010-2015}$, is a dummy that equals one if station j initiated CERE services between 2010 and 2015.

Table 8 presents the estimation results of Equation 4. Column 1 reports the OLS estimate, while Columns 2 to 5 report the IV estimates. The OLS estimate indicates that on average, the CERE initiation is associated with an increase of exports to Europe by $20,200 per square kilometer from 2010 to 2016. The long-difference estimate here captures the aggregate change in exports between 2010 and 2016, while the baseline estimate in Column 2 of Table 1 reflects the average annual change in exports during the same period. It is not surprising that the long-difference estimate is

[26] We also estimate Equation 1 with exports to Europe as the dependent variable, using only grids outside of the city in which a rail station is located. The results are still significantly positive, though with a smaller magnitude.

larger than the difference-in-differences estimate. Columns 2 and 4 display the results of the first stage using the distance to Ming post routes and that to Ming post stations as instruments, respectively. Both instruments are strongly negatively correlated with the CERE initiation (significant at the 1% level), implying that rail stations closer to historical post routes or post stations have a higher probability of initiating the CERE between 2010 and 2015. The second stage results, shown in Columns 3 and 5, indicate that the CERE significantly increases exports to Europe, which is in line with our baseline difference-in-differences estimate.

In terms of economic magnitudes, the IV estimates are larger than the OLS ones. However, the Durbin-Wu-Hausman test shows that we cannot reject the null hypothesis that the OLS estimator is consistent. We thus conclude that there are no statistically significant differences between OLS and IV estimates in the long-difference specification. Our difference-in-differences estimate is more efficient as it exploits the time-series variation of CERE initiations across hinterland cities. Therefore, under the assumption that our instrument is indeed exogenous, we may conclude that our baseline estimate is robust against potential endogeneities.

Table 8: Estimation Results Using Instrumental Variables

	OLS	IV			
		Ming Post Routes		Ming Post Stations	
	(1)	(2)	(3)	(4)	(5)
		1st stage	2nd stage	1st stage	2nd stage
Dep. Var.	Exports to Europe				
Distance		-0.0012***		-0.0013***	
		(0.00054)		(0.0003)	
CERE	0.0202**		0.0295**		0.0267**
	(0.0099)		(0.0128)		(0.0127)
Controls					
Inland City	Yes	Yes	Yes	Yes	Yes
F-statistics		16.51		16.46	
Durbin-Wu-Hausman		0.5086		0.3384	
Obs.	79,967	79,967	79,967	79,967	79,967

Note: This table reports OLS and IV estimation results of Equation 4. The two instruments, *Distance*, are the distance from the rail station to the Ming post routes and that to the Ming post stations, respectively. The key dependent variable is the difference in exports to Europe per square kilometer within 100 kilometers from inland freight railway stations. The key explanatory variable *CERE* turns one if the rail station initiated the CERE during 2010-2015 and zero otherwise. Inland city level control variables include: (1) GDP per capita ($), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the station level, are in parentheses. *10%, **5%, ***1% significance levels.

5 Conclusion

Transportation infrastructure plays a crucial role in shaping the geography of economic activities. Since the second half of the twentieth century, the dominant role of container shipping has led to imbalanced development between coastal and inland regions. Transcontinental railway, as an alternative mode for international freight, has the potential to boost hinterland development and reduce the coastal/inland gap.

This paper exploits the expansion of the China-Europe Railway Express to study the effect of transcontinental railway on China's hinterland development. Empirically, we employ a difference-in-differences identification strategy that compares locations in the neighborhood of CERE stations relative to those around non-CERE stations before and after the CERE initiation.

We document three sets of empirical evidence in support of CERE's impacts on hinterland development. First, we find that the CERE significantly contributes to local exports to Europe. Heterogeneity analyses show that the impact is more pronounced for locations adjacent to CERE stations and for high time value goods. Second, the CERE contributes to local manufacturing expansion along both the extensive and intensive margin. Finally, we present supportive evidence on the increase in producer services, freight agencies, nightlight intensity, capital inflow as well as the slowdown of outmigration.

The gigantic railway network across Eurasian countries makes transcontinental railway a low-cost and effective alternative in reducing the disparity between the coast and the hinterland. Modern transcontinental railway networks are also expanding in other continents where the railroad coverage is still low nowadays. In South America there is the Atlantic-Pacific Railway connecting Brazil and Peru, and in Africa the AfricaRail connecting Ivory Coast, Burkina Faso, Niger, Benin, and Togo.[27] Coordination right from the start, e.g., unifying the gauge, would make the transport efficiency even higher. Future research may pay special attention to the institutional features of transcontinental railways and their interactions with the domestic transportation network.

[27] https://www.wikiwand.com/en/Transcontinental_railroad, retrieved on March 12, 2024.

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A Appendix: Tables and Figures

A.1 CERE Stations in the Sample

Table A.1: CERE Rail Stations and Opening Years

Province	City	CERE Station	Open Year
Sichuan	Chengdu	Chengxiang	2013
Hunan	Changsha	Changshabei	2013
Hubei	Wuhan	Wujiashan	2013
Hunan	Hengyang	Hengyangnan	2013
Anhui	Hefei	Hefeidong	2014
Henan	Luoyang	Luoyangguojigang	2014
Henan	Zhengzhou	Zhengzhoubei	2014
Gansu	Wuwei	Wuweinan	2015
Heilongjiang	Ha'erbin	Xinxiangfang	2015
Jilin	Changchun	Changchunbei	2015
Heilongjiang	Daqing	Ranghulu	2015
Jiangxi	Nanchang	Xiangtang	2016
Jiangxi	Yingtan	Yingtan	2016
Gansu	Lanzhou	Lanzhoubei	2016
Jiangxi	Jingdezhen	Jingdezhendong	2016
Yunnan	Kunming	Kunming	2016
Shaanxi	Xi'an	Xi'anguojigang	2017
Shaanxi	Baoji	Yangping	2017
Shanxi	Taiyuan	Zhongdingwuliuyuan	2017
Heilongjiang	Qiqiha'er	Sanjianfang	2017
Jiangxi	Ganzhou	Ganzhouguojigang	2018
Jiangxi	Shangrao	Shangraozhan	2018

Note: This table lists the 22 CERE stations in our sample and their opening years.

A.2 Definition of Capital Flow from Coastal Listed Manufacturing Firms

Capital flow is proxied by the number of newly established subsidiaries within 100 kilometers from inland freight rail stations by publicly listed manufacturing firms based in the coastal region. Here we focus on the top ten cities in terms of their 2010 exports in the coastal provinces: (1) Shenzhen, (2) Shanghai, (3) Suzhou, (4) Dongguan, (5) Beijing, (6) Ningbo, (7) Guangzhou, (8) Tianjin, (9) Wuxi, and (10) Hangzhou.[1] Though there are more than 100 cities in the coastal provinces, these cities are exceptionally large and represent the majority of economic activities along the east coast. In 2010, they accounted for 62.4% of exports, 60.3% of industrial output, 39% of GDP, and hosted 53.2% of labor. We therefore focus on the publicly listed manufacturing firms in these cities as a representative group of origins of capital flow. Here capital flow is calculated at the firm-rail station level. In other words, we calculates the total number of subsidiaries established by these

[1]Beijing, though not having a coastal line, is added here given its economic importance.

firms within 100 kilometers from the inland railway stations. This design avoids the issue of too many zeros in the dependent variable.

A.3 Definition of Labor Migration between Pairs of Inland City and Coastal City

We rely on two waves of population census in 2010 and 2015 conducted by the National Bureau of Statistics of China to track the change in labor migration between 2010 and 2015. One technical issue is that the 2010 census covers the entire population whereas the 2015 census covers only 1% of the population. We employ the following standardization procedure to construct labor migration.

Specifically, for a pair of coastal destination city i and inland origin city j, we count the total number of labors with permanent residence in inland city j and workplace in coastal city i in year t from the two waves of census in 2010 and 2015, respectively. This number is referred to as labor outflow from city j to city i in year t. To compare labor outflow between the 2010 and 2015 censuses, we divide outmigrants by coastal city i's sampling ratio to obtain the total number of outmigrants from j to i in year t. The sampling ratio is the number of surveyed individuals divided by the population for city i in year t. This step rescales the labor outflow in the censuses to that in the population. For each inland city j, we divide the labor outflow by the population of city j in year t and multiply it by 10,000. In doing so, we construct a standardized measure representing the number of people (out of 10,000) who have permanent residence in inland city j and work in coastal city i in year t. We can now compare this standardized measure across the 2010 and 2015 censuses and examine whether the CERE changed an inland individual's intention to migrate to the coastal region.

Since there are only two time periods for each inland-coastal city pair, we take the difference of the log labor migration between the two censuses to generate the change in log labor migration from inland city j to coastal city i from 2010 to 2015.

A.4 Summary Statistics

Table A.2: Descriptive Statistics

	Observations	Mean	Standard Deviation	Data Span
	Panel A. Exports (grid×year)			
Exports (Million \$/km^2)	559,769	0.020	0.800	2010-2016
Exporting Firms (Number/km^2)	559,769	0.004	0.142	2010-2016
Exports per Firm (Million \$/km^2)	559,769	0.186	2.687	2010-2016
	Panel B. Manufacturing Production (grid×year, firm×year)			
Manufacturers (Number/km^2)	711,501	0.030	0.1592	2010-2018
Log Industrial Output	262,122	9.343	2.299	2010-2016
Log Net Fixed Asset	251,527	7.893	2.696	2010-2016
Log Employment	264,831	3.931	1.533	2010-2016
	Panel C. Other Outcomes			
Producer Services (Number/km^2)	711,501	0.161	2.391	2010-2018
Consumer Services (Number/km^2)	711,501	0.135	1.480	2010-2018
Freight Agencies (Number/km^2)	711,501	0.022	0.401	2010-2018
Nightlight Intensity	559,769	0.416	2.158	2010-2018
Number of Subsidiaries	303,004	0.002	0.017	2010-2018
Log Labor Migration	718	-0.036	0.742	2010, 2015

Note: This table provides summary statistics for the key outcome variables used in our regressions.

B Robustness Checks using Alternative DD Estimators

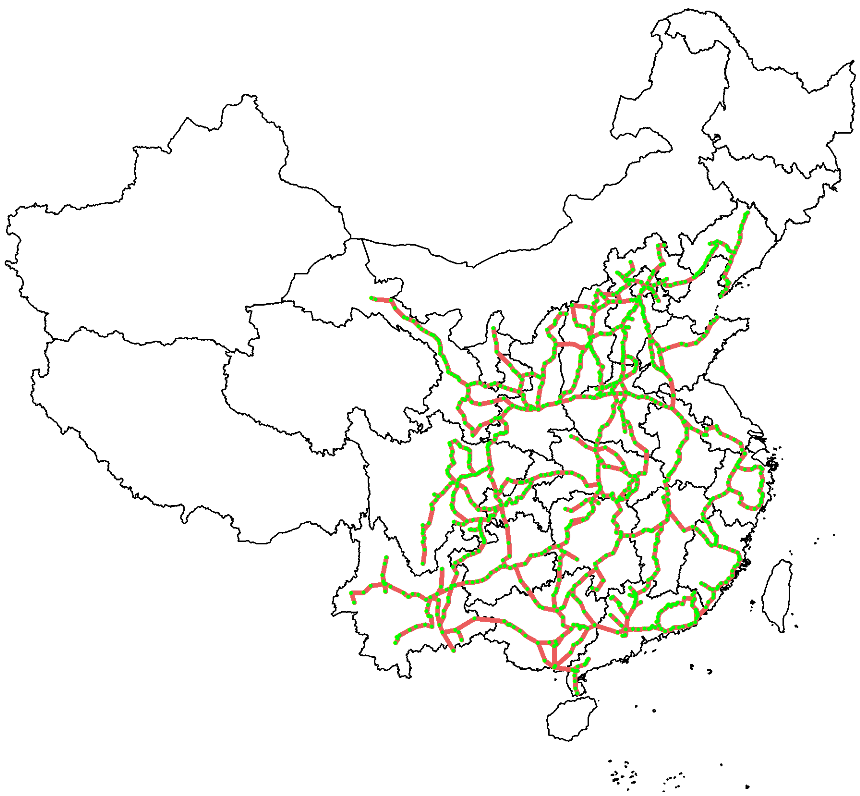
Table B.1: Alternative DD Estimates

	(1)	(2)	(3)	(4)
	CSDD		CDDD	
Dep. Var.	Exports to Europe			
CERE	0.0180***	0.0163***	0.0115***	0.0114***
	(0.0030)	(0.0031)	(0.0031)	(0.0029)
Controls	No	Yes	No	Yes
Inland City	No	Yes	No	Yes
Fixed Effects				
Grid	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Obs.	559,769	559,769	559,769	559,769

Note: This table reports estimated results of CERE's effects on inland exports using alternative estimators. Columns 1 and 2 show the CSDD estimates (Callaway & Sant'Anna, 2021), and Columns 3 and 4 the CDDD estimates (De Chaisemartin & d'Haultfoeuille, 2020). "Exports to Europe" is the exports to Europe per square kilometer in 5km-by-5km grids located within 100 kilometers from inland freight railway stations. The key explanatory variable *CERE* is one after the rail station initiates the CERE and zero otherwise. Inland city level control variables include: (1) GDP per capita (\$), (2) population (million), and (3) government expenditure (million US dollars), all in logs. Robust standard errors, clustered at the inland circle level, are in parentheses. *10%, **5%, ***1% significance levels.

C Ming Dynasty Post Routes and Post Stations

Figure C.1: Post Routes and Post Stations in Ming Dynasty



Note: This graph shows the Ming post routes (orange lines) and post stations (green dots).