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RESEARCH ARTICLE

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Regional and Sectoral Patterns and Determinants of Comparative Advantage in China

Abstract China's export performance is marked by large regional disparities which affect trade patterns at the national level. This paper uses data from input-output tables to estimate the comparative advantage of Chinese provinces in the three main economic sectors over the period 1992–2007. In contrast to existing studies, we include the services sector in the analysis and construct not only indices of revealed comparative advantage for overall trade, but also bilateral indices for interprovincial trade. The results indicate that West and Central China have a comparative advantage in agriculture/mining, coastal provinces in manufacturing, and metropolitan provinces in services. However, interprovincial trade exhibits a more complex pattern. Regression analysis identifies labor endowments as the key determinant of comparative advantage in total trade, while physical capital is the driving force in domestic trade. Human capital and government spending have a positive effect, whereas industrial loans and taxes, along with provincial trade barriers, impair comparative advantage.

Keywords comparative advantage, trade, sectors, regional disparities, China

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1 Introduction

Over the past two decades, China has emerged as a major participant in global trade, currently ranking as the world's largest exporter and second largest importer. A comparative advantage in labor-intensive products has enabled China to claim a growing share of world trade and benefit from large trade surpluses. However, the regional dimension of this global success is often obscured by treating China as a single monolithic entity. In fact, the exports of a single Chinese province (Guangdong) have accounted for between 30% and 40% of China's total exports over the past decade, while the share of exports from four coastal provinces (Guangdong, Zhejiang, Jiangsu, and Shanghai) in the national total was close to 70% in 2012. In addition, three metropolitan areas (Shenzhen, Shanghai, and Beijing) contributed more than 30% of China's exports in 2012, with Shenzhen's share alone amounting to almost one-seventh. Due to their advantageous geographical position along the coast and preferential treatment by the central government, these provinces, cities, and special economic zones have become magnets of foreign direct investment (FDI) and major manufacturing hubs of global significance.

The disproportionate share of coastal provinces in China's international trade is also a reflection of the regional specialization that has taken place within the country. While coastal provinces have focused on expanding their export-oriented manufacturing sectors, interior provinces, especially those in West China, have concentrated on the extraction of raw materials and energy production destined for the coastal region. Comparative advantage, which, to a certain extent, is determined by differences in factor endowments, was the main driving force behind this specialization (Huang and Li 2007; Liang and Xu, 2004). As Courant and Deardorff (1992) have shown, the uneven distribution of factor endowments across regions within a country has implications not only for domestic trade but also for aggregate trade flows at the national level. In fact, the heterogeneity in factor endowments across provinces has been found to affect China's patterns of specialization and international trade in manufactured goods (Lu et al., 2012). This further underscores the importance of exploring comparative advantage and trade at the regional level in China.

The goal of this paper is to examine the sectoral comparative advantage of Chinese provinces in domestic and international trade over the 1990s and 2000s. In particular, we use data from input-output tables to calculate two indices of revealed comparative advantage in each of the three main sectors (agriculture/mining, manufacturing, and services). Moreover, kernel densities are employed to study changes in the shape of the distribution of comparative advantage indices over time. Furthermore, we use a new and unique dataset of bilateral trade among Chinese provinces to calculate bilateral comparative advantage indices for domestic trade, which allows us to detect patterns of sectoral specialization across regions. Lastly, we apply regression analysis to identify the determinants of regional comparative advantage in interprovincial and total trade for each of the three main sectors.

Most of the existing literature focuses on China's foreign trade at the national level. The findings suggest that over the past decade China's manufacturing had a significant and increasing comparative advantage in labor-intensive low-technology products (Hao and Zhao, 2012). The share of skill- and technology-intensive goods is relatively small but is on the rise (Zhang and Li, 2004). Although China's export mix overlaps considerably with that of developed countries, it sells at a substantial discount (Schott, 2008). In agriculture, China lacks comparative advantage in most product categories, and the situation has further deteriorated since the accession to the World Trade Organization in 2001 (He, 2010). Similarly, China exhibits a comparative disadvantage in services despite the rapid growth in services exports (He, 2009).

Only two studies have explored China's comparative advantage at the sub-national level.[1] Yue and Hua (2002) use customs data to calculate provincial comparative advantage indices in primary and manufactured products over the period 1990–1998. The results of their regression analysis indicate that, on average, comparative advantage concurred with export patterns in China. Bao and Yang (2009) investigate the effects of financial development on the comparative advantage of Chinese provinces in manufactured goods over the period 1990–2004. They find that the effects depend on the measure of financial development used. Both studies employ Balassa's (1965) revealed comparative advantage index without adjusting for the asymmetry of its values, which has been shown to produce biased results when the index is applied in regression analysis (Laursen, 1998). Moreover, in contrast to our paper, these works do not analyze regional specialization across provinces and leave out both exports of services and trade within China.

Interprovincial trade in China has been the focus of a number of papers. Poncet (2005) explores the degree of domestic market integration by estimating province- and industry-level trade barriers over the 1990s. Her results suggest that local protec-

[1] Besides China, regional comparative advantage has been estimated for US states (Clark et al., 2005), Italian regions (De Benedictis, 2005), and Brazilian regions (Feistel and Hidalgo, 2010).

tionism has led to a decline in interprovincial trade flows. In a similar analysis, Xu and Fan (2012) also detect significant but smaller border effects across 8 Chinese regions. The Central Coastal Region, which includes Shanghai, Jiangsu, and Zhejiang, is found to exhibit the lowest border effects. He and Zhou (2010) use interprovincial imports of manufactured intermediate goods to measure productivity spillovers in 17 Chinese provinces. They report productivity improvements across all industries, whereby provinces in West China were the greatest beneficiaries. The three aforementioned papers do not take into account interprovincial trade in services. Moreover, due to lack of detailed data, the authors are compelled to either estimate trade flows across provinces or to use data aggregated by regions consisting of several provinces. In contrast, our unique dataset enables us to analyze bilateral trade among all Chinese provinces in all three main sectors.

The rest of the paper is organized as follows. The next two sections describe the methodology and data, respectively. Section 4 presents the results of the analysis and Section 5 concludes.

2 Methodology

2.1 Comparative Advantage Indices

Classical trade theory postulates that a country has a comparative advantage in a given good or service if it is able to produce that good or service more efficiently than another country. Under certain assumptions, both countries stand to gain from trade, if the country with the comparative advantage specializes in producing the given good or service and exports it to the country with the relative comparative disadvantage. Measuring comparative advantage would, therefore, require data on relative prices and production costs in autarky, which are not observable in practice. For this reason, empirical studies have traditionally relied on ex-post trade performance in an attempt to reveal the underlying patterns of comparative advantage.

The most widely-used measure in this context has been Balassa's (1965) revealed comparative advantage (RCA) index, which examines the share of a given good in a country's total exports relative to the share of this good in total world exports. A country is said to have a comparative advantage, if the exports of the good occupy a larger share in the country's total exports than the share of this good in total world exports. In other words, a country has a comparative advantage (disadvantage) in that good if RCA is larger (smaller) than one.

For the purposes of our analysis and given the specifics of the data obtained from input-output tables of Chinese provinces, we adapt the RCA index as follows:

$$RCA_{ij} = \frac{X_{ij}/\sum_{j=1}^{m} X_{ij}}{\sum_{i=1}^{n} X_{ij}/\sum_{i=1}^{n}\sum_{j=1}^{m} X_{ij}}, \quad (1)$$

where X_{ij} stands for the exports of industry j ($j = 1, ..., m$) in province i ($i = 1, ..., n$). The RCA index in Eq. 1 thus sets industry j's share in a province's total exports in relation to industry j's share in the total exports of all provinces. Accordingly, a province has a revealed comparative advantage in industry j, if the share of this industry in provincial exports is larger than industry j's share in the exports of all provinces, i.e. when $RCA > 1$. In contrast, a province has a revealed comparative disadvantage if $0 \leqslant RCA < 1$.

A major shortcoming of the RCA index is the asymmetry of its values, as they range from one to infinity for the comparative advantage but are limited to between 0 and 1 for the comparative disadvantage. As a result, values above one are given more weight relative to those below one, which creates problems for regression analysis because it violates the assumption that the error terms are normally distributed (Laursen, 1998). We address this issue by following Dalum et al. (1998), who suggested transforming the RCA index into:

$$RSCA_{ij} = \frac{RCA_{ij} - 1}{RCA_{ij} + 1}. \quad (2)$$

The revealed symmetric comparative advantage (RSCA) ranges between -1 and 1 and is now symmetric around 0 with positive (negative) values indicating a comparative advantage (disadvantage). [2]

A second problem of the RCA index is its focus on exports and disregard for imports, which can introduce a bias in the presence of intra-industry trade. To correct for this potential bias, we employ an alternative measure based on net exports. It was developed by Vollrath (1991) and defined as follows:

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[2] We also calculated the additive RCA (Hoen and Oosterhaven, 2006) and the normalized RCA (Yu et al., 2009). These more recently developed indexes offer some important advantages but ultimatley proved unsuitable in the context of our dataset because they did not allow for the aggregation across sectors into the three main categories as done in this paper.

$$RTA_{ij} = RXA_{ij} - RMA_{ij} = RCA_{ij} - \frac{M_{ij} \Big/ \sum_{j=1}^{m} M_{ij}}{\sum_{i=1}^{n} M_{ij} \Big/ \sum_{i=1}^{n} \sum_{j=1}^{m} M_{ij}}. \quad (3)$$

The relative trade advantage (RTA) is the difference between the relative export and relative import advantages (RXA and RMA, respectively), whereby the former is equivalent to the RCA index from Eq. 1. The RTA index is symmetric around zero but has no lower or upper bounds. Similarly to the RSCA index, positive (negative) values signify that a province has a comparative advantage (disadvantage), which means that its relative export advantage is larger (smaller) than its relative import advantage.

To make full use of our very detailed data on interprovincial trade, we further compute the following bilateral RCA (BRCA) index:

$$BRCA^{AB} = \frac{X_s^A \Big/ \sum_{s=1}^{m} X_s^A}{X_s^B \Big/ \sum_{s=1}^{m} X_s^B}, \quad (4)$$

where X_s^A stands for province A's exports of sector s ($s = 1, 2, 3$) to province B, while X_s^B denotes province B's exports of the same sector to province A. BRCA sets the share sector s in province A's total exports to province B in relation to the share sector s in province B's total exports to province A. Accordingly, the measure in Eq. 4 is largely equivalent to the net exports of province A to province B in a given sector. Province A has a comparative advantage, if it exports more to B than it imports from B, and vice versa. BRCA is transformed into a symmetric index using the formula in Eq. 2. Consequently, positive (negative) values of BRCA indicate comparative advantage (disadvantage).

2.2 Kernel Density Distributions

Once the comparative advantage indices have been calculated, we estimate their probability density functions within a given sector using a kernel function. Let $X_1, \ldots, X_n$ be a sample of n independent and identically distributed observations on a random variable X. The density value $f(x)$ at a given point x is estimated by the following kernel density estimator:

$$\hat{f}(x) = \frac{1}{nh} \sum_{i=1}^{n} K\left(\frac{x - X_i}{h}\right), \quad (5)$$

where h denotes the bandwidth of the interval around x, and K is the kernel function. [3] The kernel estimator assigns a weight to each observation in the interval around x with the weight being inversely proportional to the distance between the observation and x. The density estimate consists of the vertical sum of frequencies at each observation. The resulting smooth curve allows us to visualize the shape of the distribution of RCA and RTA indices across provinces in a given sector and to study the distributional dynamics over time.

2.3 Regression Analysis

The last step of the analysis involves estimating regression models to identify the determinants of comparative advantage in each sector. The specification of the regression model takes the following form:

$$\begin{aligned} RSCA_{is} = &\alpha_i + \gamma_t + \beta_1 KL + \beta_2 IN + \beta_3 HK + \beta_4 INV + \beta_5 GOV \\ &+ \beta_6 FIN + \varepsilon_{is}, \end{aligned} \tag{6}$$

where the dependent variable is the RSCA index of province i ($i = 1, ..., n$) in sector s ($s = 1, 2, 3$) and γ_t and α_i are time- and province-fixed effects, respectively. The right-hand side of Eq. 6 includes four categories of independent variables. The first focuses on the factor endowments of provinces that according to the Heckscher-Ohlin model determine input costs and thus comparative advantage. In particular, these variables consist of the sector-specific capital-labor ratio (KL) and a group of other inputs (IN) specific to a given sector and described in more detail in the next section. The second category takes into account the endowment with human capital (HK) and innovation (INV). The third category controls for the effects of government policies (GOV), such as price controls and subsidies for a given sector, that could distort the endowment-based comparative advantage. The last category of variables explores the effect of financial factors (FIN), such as sector-specific loans, which have been shown to have a significant effect on comparative advantage in manufacturing at the provincial level in China (Bao and Yang, 2009).

Given that the RSCA index is limited to values between -1 and 1, estimation via OLS would result in inconsistent estimates. For this reason, we employ a Tobit specification for panel data, which captures the lower and upper censoring of the dependent variable and produces consistent maximum likelihood estimates. Lastly, we also esti-

[3] We use data-driven bandwidth selection (likelihood cross validation) and a Gaussian kernel.

mate the model in Eq. 6 with RTA as the dependent variable to test the robustness of the results when comparative advantage is measured in terms of net exports.

3 Data

The analysis relies on data from China's provincial input-output tables, which are compiled in five-year intervals and are available for the years 1992, 1997, 2002, and 2007.[4] The 2002 and 2007 input-output tables cover 42 industries in all Chinese provinces with the exception of Tibet ($n = 30$) and have been used in sectoral and regional analysis in recent studies (Ren et al., 2014; Jiang et al., 2014). The 1992 and 1997 tables report data on 30 industries in 25 provinces and 40 industries in 24 provinces, respectively. The variables of interest obtained from the input-output tables are the trade inflows and outflows by industry and province. The major advantage of the input-output tables over other data sources, such as customs statistics, is that these trade flows include not only exports to and imports from the rest of the world but also trade with other Chinese provinces. Unfortunately, the breakdown into domestic and foreign trade components is rarely reported, compelling researchers to apply various methods in an attempt to estimate the corresponding shares (see, for instance, Poncet, 2005). Recently, Li (2010) calculated expanded provincial input-output tables for 2002 that include data on bilateral interprovincial trade by industry, allowing us to analyze comparative advantage in domestic trade.

A further benefit of the input-output tables is the inclusion of trade in services in addition to primary industries and manufacturing. This enables us to focus our analysis on the three main sectors in the economy. Although we calculate the comparative advantage indices for each province and industry, we report the results as averages across each sector and use these averages as dependent variables in the regression analysis. However, it is also important to point out that we use the gross value of trade flows rather than value-added data. Given the deepening fragmentation of production across countries, it is likely that value-added data would provide a more realistic picture of the comparative advantage of Chinese provinces. Unfortunately, the regional data does not allow us to explore this aspect in more detail and as a result the comparative advantage may be biased upward, especially in the case of provinces participating in the global value chain.

The sectoral regressions contain two types of independent variables that were col-

[4] The 1987 provincial input-output tables were excluded due to data limitations.

lected primarily from the *China Compendium of Statistics, 1949–2008* (National Bureau of Statistion, 2009). The first consists of sector-specific variables that are either only relevant for a single sector or are reported by sector and province in the data sources. Data for the second type of variables are available by province but not by sector. Nevertheless, we include the latter regressors in the model because they represent important provincial characteristics that are relevant for all sectors, albeit to various degrees. In general, the independent variables focus on the role of factor endowments, government policies, and financial factors.

The factor endowment is accounted for by including the capital-labor ratio in each regression, which is calculated by dividing the capital stock in each sector by the corresponding sector-specific labor. Province-level capital stock values were obtained from Wu (2009) and have the advantage of being computed for each of the three main sectors using province-specific depreciation rates and sector-specific deflators.

For the primary sector, we also estimate an alternative specification in which capital per worker is replaced by two components, namely agricultural machinery (power of machinery in kilowatts per agricultural worker) and fertilizers (chemical fertilizers in tons per hectare of sown area). Other input variables in the model that are specific to agriculture include land (sown area in hectares per agricultural worker) and average temperature (in degrees Celsius). Financial aspects are controlled for by including agricultural loans (in yuan per agricultural worker), while the role of the government in the sector is taken into account via its spending on agriculture (as a percentage of total provincial government spending).

In the regression for the industrial sector, the role of the government is assessed by including state ownership (percent share of state-owned enterprises (SOEs) in gross industrial output) and budgetary revenue from the enterprise income tax (per thousand yuan of gross industrial output). Electricity consumption (in thousand kilowatt hours per industrial worker) represents an additional input besides capital per worker, while financial aspects enter the model in the form of industrial loans (in million yuan per industrial enterprise).

In the services sector, the government presence is controlled for by budgetary spending on culture, health, and other services (in percent of total provincial spending). Additional sector-specific factors consist of loans to the tertiary sector (in thousand yuan per service employee) and telecommunications (mobile telephone subscribers per 1000 people).

In the regressions for interprovincial trade, we further include sector- and province-specific domestic trade barriers expressed in ad valorem tariff equivalent terms and obtained from Wong (2012).

Variables that could not be broken down by sector at the provincial level include education (average years of schooling), technological innovation (spending on research and development (R&D) as a share of provincial GDP), and infrastructure (in billion tons of freight per kilometer). The average years of schooling were calculated as follows:

$$e_{it} = \frac{(6G_{1it} + 9G_{2it} + 12G_{3it} + 15.5G_{4it})}{G_{it}}, \quad (7)$$

where G_{qit} is the number of individuals aged 6 and above in province i in year t, with q being the highest level of education attained (q =1 for primary, 2 for junior secondary, 3 for senior secondary, and 4 for tertiary level). The weights in the formula represent the length of the respective schooling cycles in years.[5] G_{it} is the total population aged 6 and above.[6]

The descriptive statistics in Table 1 illustrate some of the differences across sectors with regards to a selected number of regressors. On average, employees in manufacturing and services have 13 and 10 times more capital, respectively, than a worker in the primary sector. Furthermore, primary industries receive the lowest amount of loans per worker and the lowest share of government spending. In interprovincial trade, the primary and tertiary sector exhibit similar levels of trade barriers, which are higher than in manufacturing.

Table 1 Descriptive Statistics of Selected Regressors by Sector, 1992–2007

	Primary	Secondary	Tertiary
Capital/worker (yuan)	3157.3	42959.4	30872.5
	(2752.7)	(30637.9)	(19286.6)
Land/worker (hectares)	0.51	-	-
	(0.22)		
Loans/worker (yuan)	3556.8	8.17[a]	9710.0
	(8612.6)	(6.30)	(5442.9)
Gov. spending (% of total)	7.03	-	20.04
	(2.88)		(7.21)

(To be continued)

[5] The number of individuals with a tertiary education includes those with a junior college degree (15 years of schooling) and those with a university degree (16 years of schooling). Because the data did not allow us to separate these two groups, the average number of years was adopted as the length of the tertiary education.

[6] The data were obtained from China's 0.1% population sample survey.

(Continued)

	Primary	Secondary	Tertiary
Domestic tariff (% in 2002)	86.27	49.01	87.40
	(21.67)	(10.21)	(23.27)
SOE (% of gross ind. output)	-	49.67	-
		(19.58)	
Infrastructure (bn tons freight/km)		142.73 (209.30)	
Education (years)		7.64 (0.94)	
R&D (% of GDP)		1.11 (1.45)	

Note: The reported numbers are mean levels of the variables described in Section 3 with standard deviations in parenthesis. [a] in million yuan per industrial enterprise.

4 Results

4.1 Revealed Comparative Advantage

The provincial RSCA and RTA indices for the three main sectors are shown in Tables 2 through 4.[7] The results are reported for two geographical regions (coastal and interior) and four economic regions used by the Chinese government for policy-making purposes (East, Northeast, Central, and West).[8] In addition, we create a separate category for the metropolitan areas with provincial status (Beijing, Tianjin, Shanghai, and Chongqing), excluding them from the other groups. We also display the indices for a few major provinces in each economic region.

The results in Table 2 suggest that on average Chinese provinces had a comparative disadvantage in the primary sector in the early 1990s, but in 1997 they obtained a comparative advantage that they successfully maintained over the 2000s. Metropolitan areas along with coastal provinces (which mostly overlap with East China) have

[7] Given the large number of industries and the focus of the paper on sectoral differences, the reported comparative advantage indices are averaged across the industries in each of the three main sectors.

[8] Provinces were grouped as follows: Coastal (Hebei, Liaoning, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan, and Guangxi), interior (Heilongjiang, Jilin, Inner Mongolia, Henan, Hunan, Hubei, Shanxi, Shaanxi, Anhui, Jiangxi, Gansu, Ningxia, Sichuan, Xinjiang, Qinghai, Yunnan, and Guizhou), East (Hebei, Shandong, Jiangsu, Fujian, Zhejiang, Guangdong, and Hainan), Central (Shanxi, Henan, Hunan, Hubei, Jiangxi, and Anhui), Northeast (Liaoning, Jilin, and Heilongjiang), and West (Inner Mongolia, Shaanxi, Ningxia, Gansu, Xinjiang, Sichuan, Yunnan, Guizhou, Qinghai, and Guangxi).

Table 2 Revealed Comparative Advantage in the Primary Sector, 1992–2007

	1992		1997		2002		2007	
	RSCA	RTA	RSCA	RTA	RSCA	RTA	RSCA	RTA
Total	**−0.25**	**−0.44**	**0.06**	**0.68**	**0.04**	**0.61**	**0.06**	**0.62**
Coastal	**−0.39**	**−0.74**	**−0.10**	**−0.26**	**−0.13**	**−0.06**	**−0.17**	**−0.08**
Guangdong	−0.70	−0.72	−0.53	−0.66	−0.62	−0.26	−0.51	−0.61
Jiangsu	−0.59	−0.97	−0.69	−0.88	−0.78	−0.70	−0.63	−0.79
Zhejiang	−0.74	−1.95	−0.44	−2.82	−0.82	−0.93	−0.65	−0.72
Interior	**−0.06**	**−0.16**	**0.31**	**1.49**	**0.24**	**1.13**	**0.27**	**1.18**
Jiangxi	0.11	−0.46	0.39	0.75	0.22	0.29	0.30	0.93
Henan	0.08	0.52	0.20	−0.04	0.30	−0.27	−0.03	−0.11
Hubei	−0.36	−1.35	−0.09	−1.11	−0.24	−1.31	0.31	1.04
Hunan	−0.17	−1.08	0.68	3.48	0.22	−0.32	0.31	0.96
Metropolitan	**−0.77**	**−0.96**	**−0.10**	**−0.91**	**−0.55**	**−0.42**	**−0.53**	**−0.68**
Beijing	−0.84	−1.21	−0.85	−1.06	−0.83	−0.63	−0.73	−0.99
Shanghai	−0.79	−1.22	−0.83	−1.12	−0.94	−0.96	−0.98	−0.96
East	**−0.58**	**−0.76**	**−0.34**	**−0.50**	**−0.17**	**0.10**	**−0.20**	**−0.11**
Northeast	**−0.43**	**−1.71**	**0.31**	**−0.39**	**0.11**	**0.62**	**0.24**	**1.42**
Liaoning	−0.69	−3.14	0.26	−1.28	−0.18	−1.76	−0.31	−0.53
Jilin	−0.16	−0.27	0.36	0.50	−0.13	−0.46	0.38	1.15
Central	**0.04**	**0.08**	**0.40**	**2.56**	**0.26**	**0.87**	**0.30**	**1.63**
West	**−0.13**	**−0.30**	**0.27**	**1.06**	**0.22**	**1.10**	**0.20**	**0.66**
Guangxi	−0.31	−0.31	0.42	1.97	0.15	0.54	0.23	0.60
Sichuan	−0.64	−0.44	0.00	−0.06	0.58	2.44	0.11	−0.70
Shaanxi	0.22	1.06	0.22	0.93	0.48	2.24	0.38	0.79
Xinjiang	0.23	0.81	0.40	1.39	0.58	3.43	0.62	3.20

Note: The reported numbers for a given province are averages across industries in the primary sector.

consistently negative RSCA indices that are also the lowest in magnitude over the entire sample period. The high degree of urbanization in province-level cities, such as Beijing and Shanghai, and their rapid expansion have increased the opportunity cost of agricultural land. In addition, most of the agricultural activity in these areas is oriented towards supplying the city with fresh produce rather than destined for trade with the rest of China or the world. In fact, Shanghai had the highest comparative disadvantage in the primary sector with an RSCA index of −0.98 in 2007. Coastal provinces, on the other hand, profited from reform policies, government incentives, and their ideal geographical location to specialize away from primary products and turn into global manufacturing hubs.

Central China is the only region that exhibited a comparative advantage in the primary sector in all four years of the sample period, along with several provinces in West China. Central China is one of the most fertile areas of the country, while some Western provinces like Inner Mongolia and Xinjiang that are rich in oil, gas, and other natural resources have benefited from strong demand for these products from the rest of China. Shanxi, one of the largest producers and exporters of coal in China, had the highest comparative advantage in the primary sector with an RSCA index of 0.83 in 1997.

The results for the secondary sector in Table 3 show a different trend. In 1992, more than 60% of provinces had a comparative advantage in manufacturing, but five years later less than 30% were in a similar position. This was most likely caused by the deep institutional reforms of the 1990s that saw a dramatic decline in the number of SOEs. Smaller SOEs were privatized or shut down, while larger ones were restructured into joint-stock companies and corporations and turned into globally competitive firms. While SOEs accounted for between 70% and 80% of industrial output in China over the 1980s, this share dropped dramatically over the 1990s to reach levels below 30% in the late 2000s.

Table 3 Revealed Comparative Advantage in the Secondary Sector, 1992–2007

	1992		1997		2002		2007	
	RSCA	RTA	RSCA	RTA	RSCA	RTA	RSCA	RTA
Total	**0.05**	**0.11**	**−0.06**	**−0.18**	**−0.01**	**−0.02**	**−0.03**	**−0.40**
Coastal	**0.06**	**0.20**	**−0.05**	**0.04**	**−0.02**	**0.05**	**−0.02**	**0.06**
Guangdong	0.07	−0.19	0.08	0.14	0.01	0.12	0.04	−0.52
Jiangsu	0.16	0.53	0.21	0.55	0.08	0.07	−0.05	0.38
Zhejiang	0.08	0.31	0.08	0.28	0.03	0.24	0.09	0.09
Interior	**0.05**	**0.11**	**−0.07**	**−0.15**	**0.01**	**0.00**	**0.00**	**−0.49**
Jiangxi	−0.05	−0.03	−0.11	−0.51	0.03	0.18	−0.09	−0.03
Henan	−0.13	−0.28	−0.08	0.06	−0.04	0.09	0.03	−0.04
Hubei	0.13	0.49	−0.08	0.20	0.10	0.54	0.31	1.55
Hunan	0.03	0.08	−0.29	−0.33	0.02	−0.21	−0.16	−0.06

(To be continued)

(Continued)

	1992		1997		2002		2007	
	RSCA	RTA	RSCA	RTA	RSCA	RTA	RSCA	RTA
Metropolitan	**0.02**	**−0.17**	**−0.10**	**−0.82**	**−0.10**	**−0.33**	**−0.10**	**−0.85**
Beijing	−0.15	−0.42	−0.15	−0.41	−0.30	−0.58	−0.44	−1.42
Shanghai	0.17	0.10	−0.02	−1.00	−0.08	−0.17	−0.18	−0.27
East	**0.03**	**0.00**	**−0.04**	**−0.26**	**−0.04**	**0.00**	**−0.01**	**0.03**
Northeast	**0.26**	**0.68**	**−0.09**	**0.08**	**0.01**	**0.09**	**−0.07**	**−0.45**
Liaoning	0.30	0.96	−0.13	0.17	0.09	0.26	−0.03	0.53
Jilin	0.23	0.40	−0.04	−0.01	−0.06	−0.09	−0.19	−1.34
Central	**0.04**	**0.12**	**−0.11**	**−0.12**	**0.03**	**0.13**	**0.06**	**0.27**
West	**0.03**	**0.06**	**−0.06**	**−0.21**	**0.01**	**−0.06**	**−0.03**	**−0.79**
Guangxi	−0.05	−0.08	−0.23	−0.46	0.00	0.18	−0.11	−0.22
Sichuan	0.00	−0.06	−0.01	−0.04	−0.04	0.10	−0.16	−0.31
Shaanxi	0.37	1.00	−0.04	−0.96	−0.07	−0.74	0.15	−0.23
Xinjiang	−0.19	−0.65	0.10	0.98	−0.02	0.16	−0.44	−3.21

Note: The reported numbers for a given province are averages across industries in the secondary sector.

The Northeast, which has been traditionally the industrial heartland of China, was affected disproportionately by the industrial reforms, as evidenced by the numbers in Table 3. While Northeast provinces, such as Liaoning, had some of the highest levels of comparative advantage in 1992, they had lost it by the end of the decade. In contrast, coastal provinces, such as Guangdong and Zhejiang, were able to maintain their lead.[9]

The results for the tertiary sector in Table 4 indicate the complete and consistent dominance of metropolitan areas. While a few other provinces exhibit a comparative advantage in single years, they do not match the levels of cities with provincial status. Shanghai and Beijing have a high concentration of service sectors, which is further helped by the fact that the former has traditionally been the financial hub of China,

[9] The reason for the negative overall numbers for the coastal and East China regions is the island province of Hainan that recorded the highest comparative disadvantage with an RSCA index of −0.53 in 2002. This reduced the average for the entire region.

while the latter is the capital. In contrast, some provinces, such as Inner Mongolia and Shanxi in 1997, exhibited complete comparative disadvantage with an RSCA index of −1 because they did not export any services.

Table 4 Revealed Comparative Advantage in the Tertiary Sector, 1992–2007

	1992		1997		2002		2007	
	RSCA	RTA	RSCA	RTA	RSCA	RTA	RSCA	RTA
Total	**−0.13**	**0.10**	**−0.25**	**−0.13**	**−0.07**	**0.02**	**−0.07**	**−0.77**
Coastal	**−0.08**	**0.14**	**−0.26**	**−0.39**	**−0.20**	**−0.64**	**−0.23**	**−0.08**
Guangdong	0.00	0.82	−0.64	0.08	−0.56	0.06	−0.68	0.13
Jiangsu	0.01	0.11	−0.04	−0.19	−0.43	−0.15	−0.68	−0.29
Zhejiang	0.17	0.93	−0.55	−0.22	−0.25	0.11	−0.33	0.01
Interior	**−0.32**	**−0.33**	**−0.41**	**−0.60**	**−0.07**	**0.19**	**−0.07**	**−1.22**
Jiangxi	−0.35	−3.14	−0.58	−0.81	0.26	0.79	−0.12	−0.66
Henan	−0.68	0.05	−0.21	−0.09	−0.54	−0.16	−0.61	−1.67
Hubei	−0.14	−0.14	0.05	0.51	−0.19	0.21	−0.14	0.21
Hunan	−0.45	0.13	−0.71	−0.04	−0.48	0.32	0.27	1.60
Metropolitan	**0.61**	**2.01**	**0.54**	**2.69**	**0.35**	**0.74**	**0.39**	**0.36**
Beijing	0.58	2.38	0.83	10.37	0.63	2.95	0.65	0.38
Shanghai	0.48	−3.33	0.42	−3.39	0.22	0.81	0.16	0.05
East	**0.26**	**0.95**	**−0.06**	**0.81**	**−0.23**	**−0.45**	**−0.20**	**0.02**
Northeast	**−0.37**	**−0.18**	**−0.03**	**0.48**	**−0.14**	**−0.01**	**−0.39**	**−1.62**
Liaoning	−0.55	−0.04	−0.42	−0.28	−0.26	0.33	−0.52	0.22
Jilin	−0.19	−0.32	0.35	1.24	0.38	0.95	−0.34	−0.43
Central	**−0.39**	**−0.72**	**−0.36**	**−0.10**	**−0.32**	**0.13**	**−0.23**	**−0.11**
West	**−0.26**	**−0.10**	**−0.47**	**−1.28**	**0.09**	**−0.01**	**0.05**	**−1.58**
Guangxi	0.03	−0.26	0.12	−2.46	0.05	−2.96	−0.16	−1.05
Sichuan	−0.50	−0.06	−1.00	−0.09	−0.02	0.63	−0.32	0.35
Shaanxi	0.19	0.13	−1.00	−2.17	0.04	−0.13	0.52	1.35
Xinjiang	−0.25	−0.87	−0.01	−4.81	−0.02	−1.29	−0.28	−8.87

Note: The reported numbers for a given province are averages across industries in the tertiary sector.

The comparative advantage indices for interprovincial trade in Table 5 reveal broadly the same regional patterns as total trade. In the primary sector, interior provinces in

Central and West China had a comparative advantage while metropolitan areas had the strongest comparative disadvantage, followed by the industrial powerhouses of the coastal region and the traditional industrial heartland in the Northeast. In the secondary sector, coastal provinces had again a larger share of industrial products in their domestic exports relative to the corresponding share in total interprovincial exports. However, the magnitude of domestic trade indices is much higher than for total trade, especially in the case of Guangdong, Zhejiang, and Jiangsu. In the tertiary sector, the cities with provincial status were among the few regions with a comparative advantage.

Table 5 Revealed Comparative Advantage in Interprovincial Trade, 2002

	Primary sector		Secondary sector		Tertiary sector	
	RSCA	RTA	RSCA	RTA	RSCA	RTA
Total	**−0.04**	**0.38**	**−0.03**	**−0.04**	**−0.09**	**0.07**
Coastal	**−0.19**	**−0.10**	**0.07**	**0.16**	**−0.18**	**−0.50**
Guangdong	−0.46	−0.15	0.07	0.27	−0.57	−0.16
Jiangsu	−0.73	−0.77	0.18	0.14	−0.29	−0.17
Zhejiang	−0.90	−0.99	0.17	0.60	−0.26	0.20
Interior	**0.14**	**0.80**	**−0.05**	**−0.09**	**−0.12**	**0.22**
Jiangxi	0.12	0.15	−0.02	0.12	0.18	0.70
Henan	0.20	−0.83	−0.08	0.01	−0.60	−0.14
Hubei	−0.37	−1.03	0.07	0.51	−0.24	0.19
Hunan	0.13	−0.40	0.04	−0.14	−0.56	0.25
Metropolitan	**−0.60**	**−0.51**	**−0.13**	**−0.38**	**0.32**	**0.67**
Beijing	−0.91	−0.60	−0.27	−0.59	0.55	2.37
Shanghai	−0.93	−1.35	−0.09	−0.19	0.24	1.06
East	**−0.16**	**0.15**	**0.08**	**0.13**	**−0.17**	**−0.34**
Northeast	**−0.12**	**0.15**	**−0.05**	**0.01**	**−0.21**	**−0.03**
Liaoning	−0.61	−2.27	0.04	0.23	−0.34	0.27
Jilin	−0.31	−0.59	−0.14	−0.14	0.28	0.73
Central	**0.17**	**0.64**	**0.00**	**0.07**	**−0.37**	**0.13**
West	**0.11**	**0.74**	**−0.06**	**−0.14**	**0.03**	**0.10**
Guangxi	0.01	0.35	0.03	0.34	−0.03	−2.36
Sichuan	0.57	2.30	−0.14	−0.11	−0.05	0.61
Shaanxi	0.36	1.57	−0.07	−0.53	−0.06	−0.09
Xinjiang	0.51	2.80	−0.10	−0.08	−0.10	−1.01

Note: The reported numbers are averages across industries in each sector of a given province.

The bilateral indices of comparative advantage in Table 6 provide more detailed insights into interprovincial trade. When metropolitan areas trade among themselves, Beijing and Shanghai maintain their comparative advantage in services, while Tianjin and Chongqing dominate trade in the primary sector. Trade among the manufacturing hubs of East China shows that no province has a clear comparative advantage in the secondary sector. However, Guangdong has the upper hand in the primary sector, while Zhejiang and Jiangsu benefit from trade in services. Similarly, Xinjiang, with its enormous endowment of natural resources, has a strong comparative advantage in the primary sector for trade within West China, much like Sichuan appears to hold

Table 6 Bilateral Comparative Advantage Indices in Interprovincial Trade, 2002

	Primary	Secondary	Tertiary		Primary	Secondary	Tertiary
East/East				**Central/Central**			
Guangdong/Zhejiang	0.78	0.02	−0.31	Henan/Hunan	−0.02	0.00	0.17
Guangdong/Jiangsu	0.90	0.00	−0.54	Hunan/Hubei	0.66	−0.09	−0.17
Zhejiang/Jiangsu	0.25	−0.01	0.17	Shanxi/Hubei	0.72	−0.76	−0.23
Jiangsu/Fujian	−0.20	0.01	0.01	Anhui/Jiangxi	−0.39	0.18	0.08
East/Central				**Central/West**			
Jiangsu/Henan	−0.91	0.15	0.14	Henan/Xinjiang	−0.94	0.56	0.50
Zhejiang/Jiangxi	−0.88	0.22	0.07	Hunan/Sichuan	−0.22	0.09	−0.19
Guangdong/Hubei	−0.20	0.08	−0.44	Hubei/Shaanxi	−0.81	0.24	−0.12
Guangdong/Hunan	−0.05	0.01	−0.23	Shanxi/Sichuan	−0.80	0.12	0.05
Fujian/Shanxi	−0.80	0.90	−0.02	Jiangxi/Xinjiang	−0.88	0.08	0.48
East/West				**West/West**			
Guangdong/Sichuan	−0.63	0.14	−0.48	Sichuan/Xinjiang	−0.69	0.10	0.53
Guangdong/Xinjiang	−0.94	0.27	0.03	Sichuan/Shaanxi	−0.05	−0.01	0.25
Jiangsu/Xinjiang	−0.95	0.29	0.28	Shaanxi/Xinjiang	−0.70	0.09	0.15
Zhejiang/Shaanxi	−0.86	0.16	−0.15	Guangxi/Yunnan	−0.18	0.15	−0.36
Fujian/Sichuan	−0.41	0.25	−0.30	Yunnan/Xinjiang	−0.90	0.05	0.45
East/Metro				**Central/Metro**			
Guangdong/Beijing	0.80	0.10	−0.79	Hubei/Beijing	0.84	0.05	−0.33
Zhejiang/Shanghai	−0.06	0.03	−0.21	Shanxi/Shanghai	0.99	−0.54	−0.44
Jiangsu/Chongqing	−0.78	0.14	−0.41	Henan/Chongqing	−0.61	0.12	−0.53
Fujian/Tianjin	0.65	0.09	−0.18	Anhui/Tianjin	−0.03	0.08	−0.13
Metro/Metro				**West/Metro**			
Beijing/Shanghai	0.80	−0.14	0.17	Sichuan/Beijing	0.97	−0.13	−0.09
Beijing/Tianjin	−0.74	−0.19	0.55	Xinjiang/Shanghai	1.00	0.03	−0.73
Shanghai/Chongqing	−0.98	0.06	0.16	Guangxi/Tianjin	0.51	0.27	−0.27

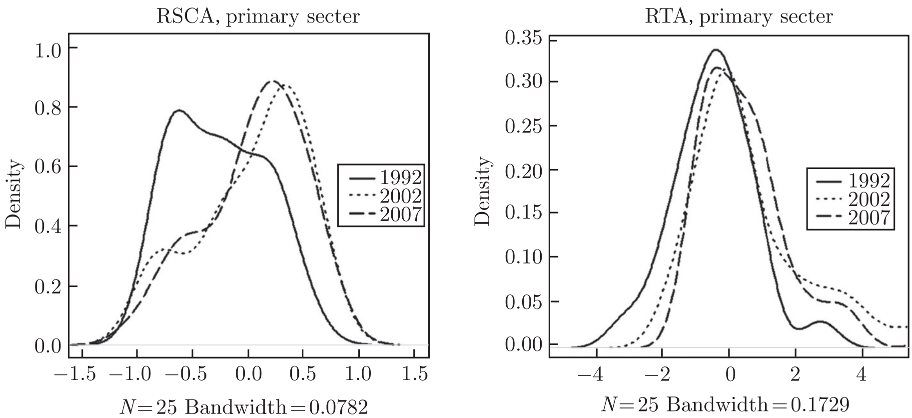
Note: The reported numbers are averages across industries in each sector of a given province.

sway in the tertiary sector. Despite their strong comparative advantage in manufacturing, provinces in East China occasionally also seem to have an advantage in the primary sector when trading with metropolitan areas, and in services when trading with Central China. Provinces in Central China dominate over East China but are at a disadvantage relative to West China when trading in primary goods. In addition, provinces in Central China have a comparative disadvantage in the secondary sector relative to East China, but benefit from exports of manufactured goods to West China.

The robustness of the RSCA indices was tested by juxtaposing them with the corresponding RTA measures in Tables 2 through 5. The results suggest that the signs and relative magnitude of the RTA index are largely in line with the RSCA index. The percentage of cases in which RSCA indicates a comparative advantage and RTA a disadvantage (11%) is identical to the share of cases where the reverse was true. In other words, the relative import advantage is equally effective in turning a comparative advantage based on export performance into a disadvantage, and vice versa. Additionally, such discrepancies are most pronounced in the tertiary sector and least pronounced in the primary sector. Our findings with regards to the patterns of comparative advantage across provinces and regions reported in this section remained robust, even when the cases of inconsistency between RSCA and RTA were excluded.

4.2 Kernel Density Distributions

Next, we explore the distribution of comparative advantage across provinces and its changes over time by displaying the kernel densities of the RSCA and RTA indices in Figure 1.



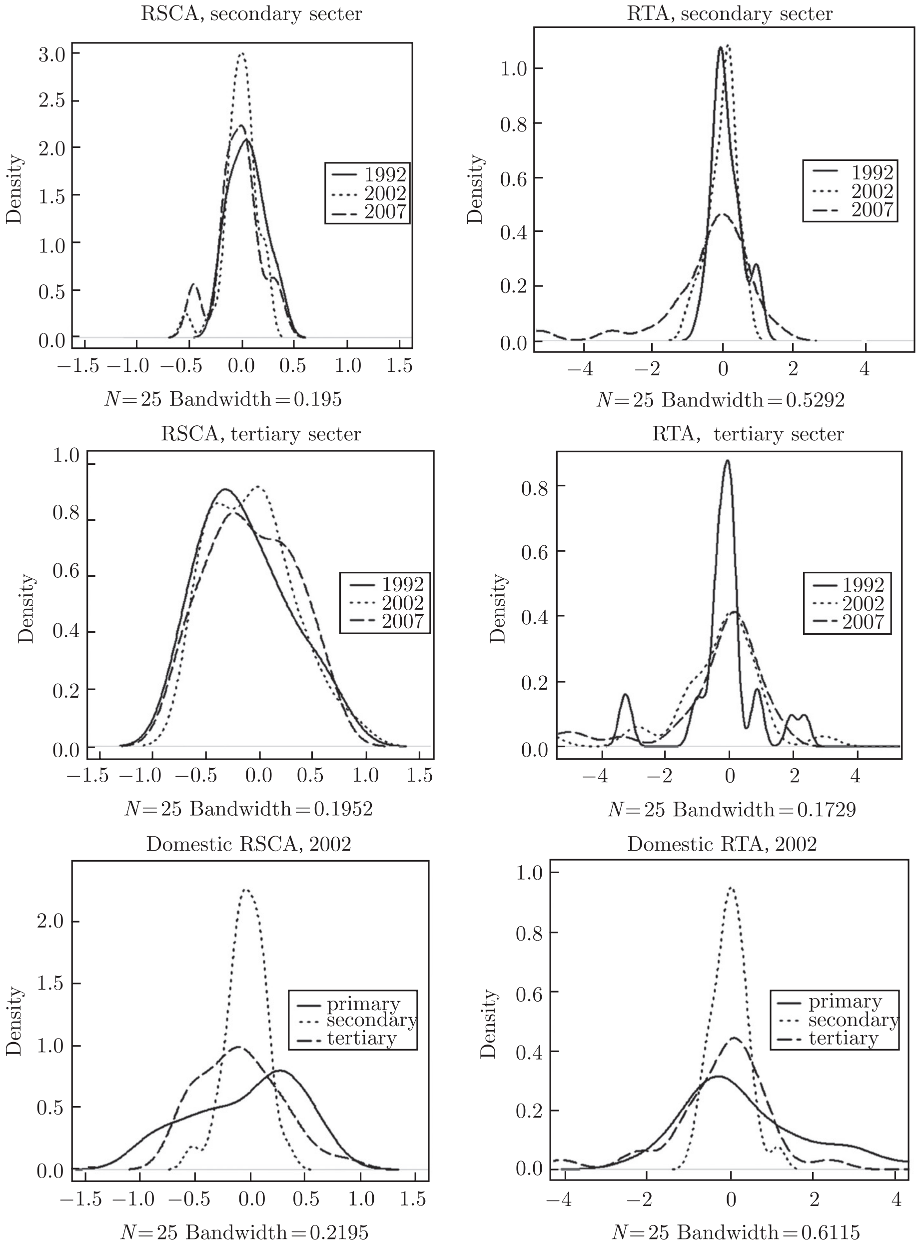


Figure 1 Kernel Density Distributions of Provincial RSCA and RTA Indices by Sector

In the primary sector, the initial distribution in 1992 is very wide-spread, indicating a high degree of variability across Chinese provinces, but it is also skewed with most of the probability mass being located in the area of comparative disadvantage to the left of the origin. A decade later, there has been a dramatic shift to the right. Although the distribution is still bimodal, the principal mode has become much more pronounced moving away from the area around the maximum comparative disadvantage and toward the range of values around 0.5. In other words, a number of provinces were able to obtain or strengthen their comparative advantage in primary products between 1992 and 2002. The hump in the left tail of the distribution suggests that a significant group of provinces remained at a comparative disadvantage. The differences between the 2002 and 2007 distributions are minimal. Furthermore, the corresponding RTA distribution for the primary sector reveals the same shift to the right between the early 1990s and the 2000s; however, the change in the shape of the distribution and the magnitude of the shift is more moderate due to the mitigating effect of RMA on RXA.

The probability density distribution in the secondary sector appears strikingly different from the one in the primary sector. The 1992 distribution is bell-shaped, symmetrical, and highly concentrated around the origin suggesting that a similar number of provinces had a comparative advantage and disadvantage. In the primary sector, climate, geography, and natural resource endowments play a crucial role, but they are less important for the production of manufactured goods. For this reason, the considerable geographic and climatic differences across provinces in a large country like China result in higher variability of RSCA indices in the primary sector that is not present in the secondary sector. Between 1992 and 2002, the indices converge even closer together, further increasing the density around the origin. At the same time, two lesser modes emerge in each of the tails of the distribution, indicating persistence in the comparative advantage or disadvantage in a certain group of provinces. By 2007, these modes have become much more pronounced due to an increasing divergence in comparative (dis)advantage across provinces. This divergence is illustrated in a significantly more dramatic fashion by the RTA distribution because the RTA index lacks bounds and, thus, is more prone to outliers.[10]

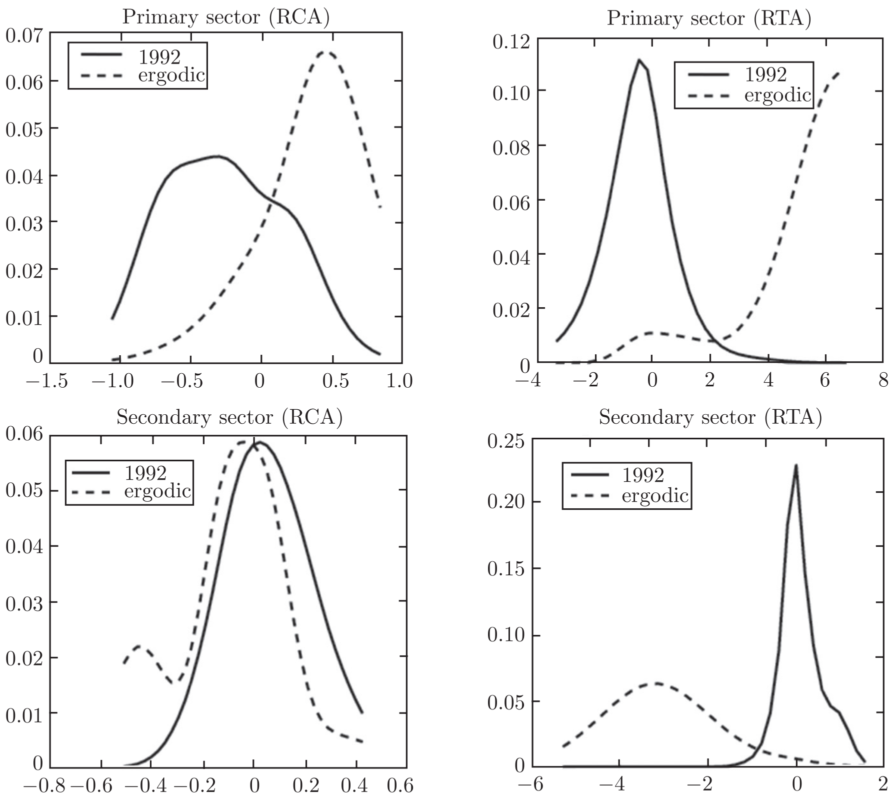
The distribution of the kernel densities in the tertiary sector in 1992 is bell-shaped but has a positive skew, suggesting that initially a large number of provinces had a comparative disadvantage in services. Ten years later, a bimodal distribution has emerged with the principal mode located above a positive range of values to the right of the origin. By 2007, an additional part of the probability mass has shifted to the

[10] In fact, it is the extreme RTA indices of Qinghai (-5.28) and Xinjiang (-3.21) that contribute to the long left tail of the distribution in Figure 1.

right, implying that the comparative advantage of Chinese provinces in services has been improving, albeit at a very gradual pace. The RTA distribution also reflects a general shift to the right, but it is much less obvious due to the presence of multiple modes in both tails of the distribution.

The bottom two plots in Figure 1 show the interprovincial RSCA and RTA kernel densities for the three main sectors in 2002. Similar to the patterns in total trade, the distribution for the secondary sector is highly concentrated around the origin, while the one for the primary sector is wide-spread with the principal mode located in the range of comparative advantage. In contrast, a larger part of the probability mass in the tertiary sector seems to be in the area of comparative disadvantage. As for the kernel densities of the RTA indices, they mostly mirror those for the RSCA, except that the distributions of the primary and tertiary sectors are more symmetric around the origin.

The ergodic distributions in Figure 2 show the evolution of comparative advantage if the distributional dynamics of the period 1992–2007 continue in the long run. The



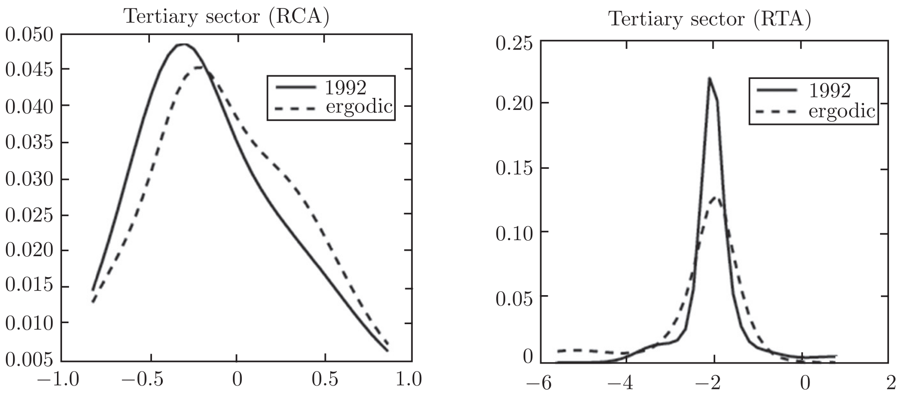


Figure 2 Initial and Ergodic Distributions of RSCA and RTA Indices by Sector

results are largely in line with the conclusions from Figure 1, except that they appear more drastic because the dynamics extend over longer periods of time. The primary sector would exhibit the largest improvement in comparative advantage followed by the tertiary sector where the shifts to the right are less pronounced. By comparison, the comparative advantage in the secondary sector would deteriorate on average. These fndings need to be interpreted with caution given that the underlying distributional dynamics were specific to the economic situation in Chinese provinces in the 1990s and 2000s.

4.3 Determinants of Comparative Advantage

After quantifying the comparative advantage and exploring its distribution across provinces, we sought to identify its determinants by estimating the regression model in Eq. 6. The results for the primary, secondary, and tertiary sectors are shown in Tables 7 through 9, respectively.

In the primary sector (Table 7), endowment variables were found to play a central role in explaining the variation in RSCA across provinces and time. More land per agricultural worker, better infrastructure, and a higher average temperature contributed to improvements in comparative advantage. The coefficients of the capital-labor ratio and its components, machinery and irrigation, were negative indicating that primary products are very labor-intensive. Keeping capital constant, a larger endowment of agricultural labor thus enhanced comparative advantage in the sector. Government support for agriculture along with agricultural loans also led to a decline in relative exports. Furthermore, it is not surprising that education was not significantly related to comparative advantage in sectors like agriculture and mining where formal schooling is less important. Similarly, R&D spending benefited other sectors at the expense of the primary sector, as evidenced by the negative sign of the corresponding coefficient.

With RTA as the dependent variable, the land-labor ratio retained its positive and significant effect, while R&D spending continued to have a negative impact. Government spending promoted comparative advantage in terms of net exports, but the significance of the coefficient was not robust across specifications.

Table 7 Determinants of Comparative Advantage in the Primary Sector

	RSCA			RTA		
	(1)	(2)	(3)	(1)	(2)	(3)
Capital/labor ratio	-0.064^{**}		-0.054^{**}	0.068		0.0636
	(0.029)		(0.027)	(0.093)		(0.092)
Machinery		-0.016			0.453^{***}	
		(0.043)			(0.164)	
Irrigation		-0.006			-0.008	
		(0.008)			(0.012)	
Land/labor ratio	1.491^{**}		1.426^{**}	3.149^{***}		2.489^{***}
	(0.583)		(0.576)	(1.181)		(0.802)
Temperature	0.088^{**}	0.075^{*}	0.092^{**}	-0.017	-0.037	-0.045^{*}
	(0.042)	(0.040)	(0.041)	(0.043)	(0.025)	(0.023)
Infrastructure	0.079^{***}	0.032	0.078^{***}	-0.060	-0.053	-0.084
	(0.029)	(0.026)	(0.028)	(0.107)	(0.092)	(0.099)
Government	-0.028^{*}	-0.029^{**}	-0.030^{**}	0.035	0.125^{***}	0.020
spending	(0.014)	(0.014)	(0.014)	(0.056)	(0.046)	(0.052)
Loans	-0.006^{**}	-0.001	-0.005^{**}	-0.013	-0.019	-0.014
	(0.003)	(0.003)	(0.003)	(0.019)	(0.021)	(0.019)
Education	0.055			-0.127		
	(0.065)			(0.166)		
R&D	-0.254^{**}		-0.215^{**}	-0.316^{**}	-0.407^{***}	-0.363^{***}
	(0.117)		(0.107)	(0.138)	(0.137)	(0.123)
Log likel.	10.10	4.03	15.00	-136.93	-136.64	-136.98
Obs.	109	109	109	109	109	109

Note: Time- and province-fixed effects are included in all models. Standard errors are in parenthesis. *** $p < 0.01$. ** $p < 0.05$. * $p < 0.10$.

In the secondary sector (Table 8), the consistently negative and significant coefficient of the capital-labor ratio indicates that in China manufacturing comparative advantage is based on labor-intensive industries. Similarly, the robustly positive effect of electricity consumption means that energy-intensive industries represented another key driving force. In contrast to the primary sector, human capital and R&D spending enhanced the relative export performance of manufacturing. The coefficients for industrial loans and enterprise taxes exhibit a negative sign but are not statistically significant. Last but not least, a larger share of SOEs ensured a higher level of comparative advantage. This can be explained by the fact that industrial policies in China have been aimed at grooming large SOEs as national champions that can compete in the global economy.

Table 8 Determinants of Comparative Advantage in the Secondary Sector

	RSCA			RTA		
	(1)	(2)	(3)	(1)	(2)	(3)
Capital/ labor ratio	-0.003^{*}	-0.003^{**}	-0.003^{**}	-0.008^{***}	-0.008^{***}	
	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)	
SOE	0.006^{***}	0.005^{**}	0.005^{**}	−0.004	−0.004	−0.002
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
Loans	−0.005	-0.007^{*}	−0.005	−0.004	−0.005	−0.004
	(0.004)	(0.004)	(0.004)	(0.015)	(0.015)	(0.016)
Tax	−0.004	−0.005	−0.006	0.002	0.005	0.008
	(0.007)	(0.007)	(0.007)	(0.017)	(0.018)	(0.018)
Infrastructure	0.019					−0.018
	(0.014)					(0.044)
Electricity consumption	0.007^{***}	0.005^{**}	0.006^{**}			-0.022^{**}
	(0.003)	(0.003)	(0.003)			(0.009)
Education		0.122^{**}		0.058^{*}	0.064^{**}	0.047
		(0.052)		(0.032)	(0.040)	(0.036)
R&D			0.159^{***}		−0.064	−0.081
			(0.057)		(0.065)	(0.066)
Log likel.	11.99	14.04	15.27	−104.27	−102.83	−102.87
Obs.	109	109	109	109	109	109

Note: Time- and province-fixed effects are included in all models. Standard errors are in parenthesis. $^{***}\ p < 0.01$. $^{**}\ p < 0.05$. $^{*}\ p < 0.10$.

In the RTA regressions, a low capital-labor ratio and high levels of human capital were still favorable for comparative advantage. But the coefficients for electricity consumption and state ownership now turn negative, which suggests that energy-intensive industries and SOEs exhibit a strong relative import advantage that dominates net export performance.

The comparative advantage in the tertiary sector (Table 9) depends on increases in human capital and R&D spending rather than on labor intensity as the other two sectors. Accordingly, the estimated coefficient for the capital-labor ratio lacks statistical significance. Furthermore, sector-specific government spending has a positive and significant effect, suggesting that a strong government presence in certain industries, such as postal services, freight transport, education, health, and the media, enhanced relative export performance. In contrast, the impact of sector-specific financial loans has a negative sign, which might be due to borrowed funds being mostly used for

Table 9 Determinants of Comparative Advantage in the Tertiary Sector

	RSCA			RTA		
	(1)	(2)	(3)	(1)	(2)	(3)
Capital/labor ratio	0.006	0.005	0.005	0.026	0.019	0.017
	(0.004)	(0.004)	(0.004)	(0.025)	(0.025)	(0.023)
Loans	−0.007	−0.016*	−0.008	−0.013	−0.056	−0.016
	(0.008)	(0.009)	(0.008)	(0.050)	(0.056)	(0.047)
Government spending	0.001**	0.001**	0.001**	−0.002	−0.003	−0.004*
	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)	(0.002)
Mobile telephones	−0.001**	−0.001**	−0.001*	0.001	0.001	0.003
	(0.000)	(0.000)	(0.000)	(0.003)	(0.003)	(0.003)
Infrastructure	−0.055**	−0.063***	−0.047**	−0.121	−0.166	−0.041
	(0.023)	(0.023)	(0.023)	(0.149)	(0.149)	(0.140)
Education		0.145**			0.700*	
		(0.063)			(0.410)	
R&D			0.075**			0.736***
			(0.029)			(0.182)
Log likel.	−19.07	−17.89	−18.89	−228.88	−228.84	−227.87
Obs.	109	109	109	109	109	109

Note: Time- and province-fixed effects are included in all models. Standard errors are in parenthesis. *** $p < 0.01$. ** $p < 0.05$. * $p < 0.10$.

provision of services within a given province rather than for exports. The expansion in mobile telecommunication and improvements in the infrastructure weaken comparative advantage in the tertiary sector as they appear to benefit other sectors. When RSCA is replaced by RTA, the only variables with positive and significant coefficients are education and R&D spending.

The determinants of interprovincial trade are assessed using a regression model similar to the one in Eq. 6. BRCA serves as the dependent variable, while the fixed effects are dropped. Given the bilateral nature of the comparative advantage index, dependent variables are now expressed as a ratio of the level in the exporting province relative to the one in the importing province. The results in Table 10 are largely consistent with

Table 10 Determinants of Comparative Advantage in Interprovincial Trade

	Primary			Secondary			Tertiary	
	(1)	(2)		(1)	(2)		(1)	(2)
Cap./labor ratio	−0.003 (0.017)		Cap./labor ratio	0.028** (0.012)	0.026** (0.012)	Cap./labor o rati	0.004 (0.019)	−0.001 (0.019)
Machinery		0.078*** (0.021)	SOE	−0.014 (0.022)	−0.033 (0.022)	Mobile telephones	0.003 (0.003)	0.001 (0.003)
Irrigation		−0.225*** (0.052)						
Land/labor ratio	0.239*** (0.035)	0.382*** (0.041)	Electricity	0.034 (0.022)	0.029 (0.022)			
Domestic tariff	−0.367*** (0.054)	−0.083 (0.073)	Domestic tariff	0.044 (0.027)	0.043 (0.041)	Domestic tariff	−0.001 (0.001)	−0.002** (0.001)
Infrastr.	−0.013*** (0.004)	−0.005 (0.004)	Infrastr.	−0.002 (0.002)		Infrastr.	0.079** (0.032)	0.067** (0.032)
Gov. spending	0.095*** (0.036)	0.097*** (0.035)	Tax	−0.045*** (0.012)	−0.033*** (0.013)	Gov. spending	0.007*** (0.002)	0.006*** (0.002)
Loans	0.004 (0.007)	−0.006 (0.007)	Loans	−0.081*** (0.023)	−0.054** (0.024)	Loans	0.014*** (0.005)	0.005 (0.005)
Education		−0.468*** (0.099)	Education		0.012 (0.039)	Education		0.267*** (0.087)
R&D	−0.078*** (0.010)		R&D	0.019*** (0.004)		R&D		−0.090*** (0.028)
Log likel.	−319.76	−318.83		29.51	19.34		−204.70	−197.07
Obs.	435	435		435	435		403	403

Note: Standard errors are in parenthesis. *** $p < 0.01$. ** $p < 0.05$. * $p < 0.10$.

those for total trade with a few crucial exceptions. The coefficient for the capital-labor ratio exhibits a positive sign in the secondary sector, whereas it was found to be negative in Table 8. This suggests that more capital per worker relative to the importing province improves comparative advantage in domestic trade, while comparative advantage in total trade is dominated by the labor intensity of industrial exports to the rest of the world. In other words, higher labor intensity in manufacturing is crucial in obtaining comparative advantage on world markets, while capital intensity plays a larger role in domestic trade. Another finding that highlights the importance of relative capital endowment in interprovincial trade is the positive sign of the coefficient for machinery in the primary sector. Domestic trade barriers have the expected negative effect on comparative advantage, except in the secondary sector where they do not seem to matter. As the descriptive statistics in Table 1 show, the secondary sector is generally much less protected than the other two sectors. Furthermore, for interprovincial trade we find that taxes and loans in manufacturing impede comparative advantage, whereas government spending in the primary and tertiary sectors improves the trading position of provinces.

5 Conclusions

China's export performance is marked by large regional disparities, which reflect differences in regional specialization and global integration. This paper uses input-output tables to construct two indices of revealed comparative advantage for the three main sectors over the period 1992–2007. The results indicate that comparative advantage in the primary sector is dominated by provinces in Central and West China, which are known for fertile land and rich deposits of natural resources. More than half of all provinces in the early 1990s held a comparative advantage in manufacturing, but after the restructuring of SOEs, only coastal provinces remained in the lead. The comparative advantage in the tertiary sector is firmly in the hands of metropolitan areas with provincial status. These results remain largely robust across indices of relative exports and net exports. We also find that these patterns of specialization were generally confirmed for interprovincial trade. However, additional bilateral indices provide a more detailed picture of domestic trade that differs from total trade. For instance, some coastal provinces with a strong comparative advantage in manufacturing also exhibit a comparative advantage in the primary sector when trading domestically with metropolitan areas and other coastal provinces.

Kernel density distributions reveal that the variability of comparative advantage across provinces is most pronounced in the primary sector and least so in manufacturing. In the secondary sector, the deterioration in comparative advantage for a number of provinces causes the distribution to exhibit strong divergence tendencies over the 2000s. On the other hand, the shift in the main mode of the distribution in the primary and, to a lesser degree, in the tertiary sector suggests improvements in the comparative advantage for most provinces. Furthermore, our regression analysis reveals labor endowment to be positively associated with comparative advantage in the primary and secondary sectors, matching China's global specialization in labor-intensive goods. By contrast, physical capital endowment is the primary driver in these sectors in domestic trade. Other endowments that play a significant role are human capital in manufacturing and services, and land in the primary sector. In interprovincial trade, comparative advantage deteriorates in response to rising taxes and loans in manufacturing. Trade barriers have a similar effect in the primary and tertiary sectors. On the other hand, sector-specific government spending enhances comparative advantage in the primary and tertiary sectors.

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