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A spatiotemporal analysis of comparative advantage in tea production in China

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Abstract: Tea is one of the most important cash crops and widely consumed beverages worldwide and plays a significant role in rural development, poverty reduction, and food security in many developing countries. Nevertheless, very few empirical studies have analysed the comparative advantage of the tea industry in developing countries. Taking Fujian Province, China, as the object of a case study, we carried out a spatiotemporal analysis of the determinants of the tea industry's revealed comparative advantage (RCA) during the period 2010–2018. The empirical analysis relied on a calculation of RCA and an estimation of a geographically and temporally weighted regression (GTWR) using data from 67 counties in Fujian. The results confirmed that the effect and significance of RCA determinants vary considerably across different spatial areas and over time. With the exception of 'disposable income', all other determinants had a positive and statistically significant effect on a region's RCA in the tea industry. Specifically, the results indicated that regional specialisation had the strongest positive effect on tea competitiveness. Local governments' sectoral strategies and institutional policies were essential elements in building and maintaining regional tea competitiveness. Infrastructure development, which traditionally went hand-in-hand with urbanisation processes, had a significant impact on tea competitiveness. These findings imply that competitiveness of the tea sector can be improved by adopting local polices that support producers and processors through fiscal investment, technology provision, and capacity building as well as measures to improve rural road infrastructure and link small farmers to other actors along tea supply chains.

Keywords: geographically and temporally weighted regression; regional specialisation; revealed comparative advantage; spatial analysis; temporal analysis

Tea is one of the most important cash crops and widely consumed beverages worldwide, and plays a significant role in rural development, poverty reduction and food security in many developing countries (Chen and Li 2019). Over the past decade, global tea production and exports have increased annually by around 4.4% and 1.5%, respectively (FAO 2018). China is the world's largest tea producer, with around half of the world's total area dedicated to tea cultivation and close to 40% of the global tea production (FAOSTAT 2020) [Table S1 in electronic supplementary material (ESM); for ESM see the electronic version].

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It is estimated that 20 million rural labourers in China are involved in tea production and processing (Ahmed et al. 2018), making the beverage a major contributor to employment and livelihoods in rural Chinese communities. Between 2006 and 2016, Chinese tea production more than doubled from 1.2 million tonnes to nearly 2.5 million tonnes. Over the same period, tea consumption in China grew spectacularly at an annual rate of 10%, reaching around two million tonnes in 2016 or about 39% of the world's total tea consumption (FAO 2018). The expansion of tea production and consumption in China was driven mainly by rapid per-capita income growth, increased consumer awareness of the health benefits of tea consumption, and rapid development of the tea industry in a country with a long-standing tradition of tea consumption.

The increasing supply and demand for tea, which are projected to continue rising over the next decade (FAO 2018), have intensified competition on both the global and domestic tea markets (Ahmed et al. 2018; Xiao et al. 2018). A deeper understanding of the determinants of competitiveness on the global and domestic tea markets is therefore crucial to exploiting the market opportunities that expanding demand for tea can create for small farmers, which could improve food security and nutrition outcomes. Nevertheless, very few empirical studies have analysed the comparative advantage of the tea industry in China and developing countries. In this respect, Hong and Song (2015) point out that despite the importance of tea as a high-value cash crop for millions of people in developing countries, there are few quantitative studies that examine the determinants of tea competitiveness and the impacts on actors along the tea supply chains.

Another gap in the literature is that existing studies largely ignore the role of spatial and temporal factors in determining the competitiveness of tea-supplying regions at the international, national and sub-national levels. According to Liu et al. (2018), there is considerable spatial heterogeneity among tea-producing provinces in China, and the pace of development of the tea industry differs widely across these regions. For instance, Xiao et al. (2018) demonstrate that geographical and environmental characteristics and local support policies represent influential determinants for development and competitiveness of the tea industry. Therefore, an analysis of the comparative advantage of the tea industry should capture the spatial and temporal dimensions of the production and development process that influence regional comparative advantage and competitiveness.

Against this background, the present study aims to examine the role of spatiotemporal factors in determining the comparative advantage of the tea industry in China. More specifically, the study uses Fujian Province in China as a case study to investigate the spatiotemporal determinants of the revealed comparative advantage (RCA) of the tea industry in 67 counties within the province between 2010 and 2018.

Fujian is located on the southeast coast of China [Figure S1 in electronic supplementary material (ESM); for ESM see the electronic version] and is the country's top tea-producing province. With a total production of around 420 000 tonnes, the province accounts for about 16% of China's total tea production in 2018 [Figure S2 in the electronic supplementary material (ESM); for ESM see the electronic version]. The province has a humid subtropical monsoon climate. Together, the unique geographical location and climate conditions provide favourable natural conditions for development of the tea industry. Therefore, the empirical results from this paper provide a better understanding of the driving forces of RCA and help design regional and national strategies to promote tea production and competitiveness to capture the emerging opportunities that the Chinese tea sector can gain from such a growing market.

METHODS

Revealed comparative advantage (RCA)

The literature offers a wide range of approaches that can be applied to empirically assess the competitiveness of agricultural commodities. One of these is the RCA index, which measures the comparative advantage of an area (country, region or county) in the production and trade of a particular product according to the share of that product in the country's total exports relative to the product's share of total world exports (Balassa 1965). The RCA index has been employed in countless applications as a measure of the relative ability of a region to produce a good vis-à-vis its competitors. According to Abu Hatab and Romstad (2014), the RCA index identifies whether a region has a comparative advantage rather than specifying the underlying sources of the comparative advantage. Despite the limitations of RCA (Yu et al. 2009), it has been a widely used index in analyses of competitiveness of agricultural and food commodities. The RCA index can be defined as follows:

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$$RCA_{it} = \frac{\left(\frac{\frac{TY_{it}}{CY_{it}}}{\frac{\sum_{i=1}^{67} TY_{it}}{\sum_{i=1}^{67} CY_{it}}} \right) - 1}{\left(\frac{\frac{TY_{it}}{CY_{it}}}{\frac{\sum_{i=1}^{67} TY_{it}}{\sum_{i=1}^{67} CY_{it}}} \right) + 1} \quad (1)$$

where: RCA_{it} – the revealed comparative advantage of the county i in year t; TY_{it} – tea yield; CY_{it} – crop yield in the respective county in year t.

As shown in Equation (1), tea and crop yields are taken into consideration for calculating *RCA* because comparative advantage depends largely on the comparative advantage of agricultural production. Counties with a comparative advantage can obtain higher comparative factor productivity or lower opportunity costs, thereby focusing on the production of a certain product. An *RCA* value of less than 0 occurs when the tea industry has a comparative disadvantage in the corresponding county. That is to say, the opportunity cost of tea production in these counties is significantly higher than that of other counties, indicating that these counties have no advantage in tea production. The reason for the comparative disadvantage may be that these counties have no advantages in terms of possession, distribution, and utilisation of the resources required for tea production. Moreover, the comparative disadvantages of tea production are mainly manifested in the low degree of industrialisation and the low added value of tea products and tea derivatives. In contrast, if the *RCA* ranges between 0 and 1, this implies that the tea industry in the respective county has a revealed comparative advantage.

Geographically and temporally weighted regression (GTWR)

Traditional regression models do not effectively capture the spatial heterogeneity of regression, which may result in biased estimates. According to the OECD, CDRF (2010), regional competitiveness is determined by both national and regional factors. That is, macroeconomic environment and structural reforms at the national level have a significant impact on a region's economic performance and competitiveness. However, the competitiveness of agricultural commodities in particular chiefly depends on factors related to the regional business and production environment, such as agronomic conditions, local regulations, and tax environment, which are crucial elements to ensure agricultural productivity and growth. Thus, geographically weighted regression (GWR) can capture the spatial heterogeneity and variations among different geographical locations and socioeconomic environments (Brunsdon et al. 1999). Nevertheless, a disadvantage of the GWR model is that it does not account for time effects. To address this issue, the geographically and temporally weighted regression (GTWR) has been introduced as an extension of the GWR model to incorporate and capture both time and space effects (He and Huang 2018). In this paper, the following GTWR model is employed:

$$RCA_{it} = \beta_0(u_i, v_i, t_i) + \sum_{k=1}^{6} \beta_k(u_i, v_i, t_i)\, x_{kit} + \varepsilon_{it} \quad (2)$$

where: RCA_{it} – the revealed comparative advantage; x_{kit} – a set of *RCA* determinants; u_i – the longitude coordinate; v_i – the latitude coordinate; t_i – the specific time; β_0 – the constant; β_k – the unknown parameter; ε_{it} – the error term.

To estimate our GTWR model, a number of *RCA* determinants have been identified in light of the related literature (Li et al. 2017; Liu et al. 2018). Figure 1 summarizes our theoretical framework of the determinants of the tea industry's *RCA*, where we consider four main determinants: institutional policies, physical infrastructure, tea industry characteristics, and socioeconomic characteristics of the investigated counties. These determinants interact with each other and result in a flow of activities that generate *RCA*, namely tea production activities with a certain level of relative factor endowments and costs, with relative productivity that results in a flow of skill-based activities, and with a relative capability for trading tea. The following paragraphs provide brief description of each of these determinants.

Institutional policies. As illustrated by Zheng et al. (2019), fiscal investment from the local government can influence the pace of development in the tea industry,

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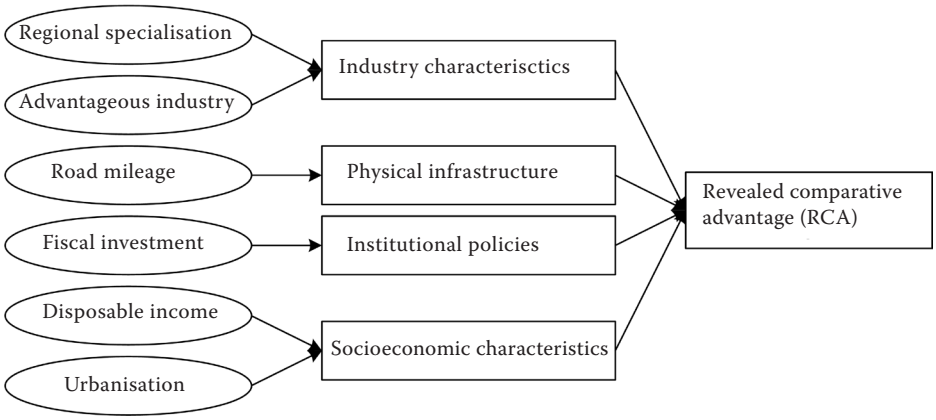

Figure 1. An analytical framework for the determinants of RCA

Source: Compiled by the authors

as subsidies to small-scale tea farmers and processors can help them adopt technologies and farming practices that promote the sustainable development of the tea industry. To capture the role of local regulatory and institutional policies, we included the variable (*FIS*), which represents the share of the local government's expenditure on agriculture as a proportion of the total fiscal expenditure of the respective county.

Physical infrastructure. To account for the effect of infrastructure on the *RCA* of the tea industry in Fujian's counties, we included the variable road mileage (*ROAD*), which is defined as the length of all highways in operation within a county in kilometres. To avoid the heteroscedasticity problem, the logarithmic form of road mileage was used.

Industry characteristics. Two variables were included in the GTWR model to capture the role that region-specific characteristics play in determining a county's *RCA* in the tea industry. A dummy variable (*ADV*), which takes the value 1 if tea is officially recognised as an advantageous industry by the local government and 0 otherwise, was included in the GTWR model. As noted by Liu et al. (2018), a recognition of tea as an advantageous industry is expected to facilitate the upgrading of the tea supply chains and to enhance tea yield, quality, and the efficiency of tea production, and therefore enhances the *RCA* of the county's tea industry (Liu et al. 2018). In addition, we included the variable (*SPE*) to assess the regional specialisation in the production of tea. According to the "new economic geography" model, the interaction between transportation costs and economies of scale forms industrial agglomeration (Commendatore and Kubin 2016). Therefore, *SPE* can greatly affect the spatial distribution of tea production (Liu et al. 2018). An *SPE*'s index value equal to 1 indicates that the specialisation of tea production in the county is equal to the provincial average. A value greater than 1 occurs when the specialisation of the county is higher than that of the provincial average and *vice versa*. Following Li et al. (2017), the location quotient was used to measure the degree of *SPE* as follows:

$$SPE_{it} = \frac{\frac{TPA_{it}}{CPA_{it}}}{\frac{\sum_{i=1}^{67} TPA_{it}}{\sum_{i=1}^{67} CPA_{it}}} \quad (3)$$

where: SPE_{it} – the regional specialisation; TPA_{it} – the tea planting area in hectares in the specific county i in year t; CPA_{it} – the total crop planting area under agricultural production in hectares in the specific county i in year t.

Obviously, the tea planting area is part of the agricultural cash crop planting area and a part of the total crop planting area. Specifically, *TPA* is an integral component of *CPA*.

Socioeconomic characteristics. Two further variables were included in the GTWR model as proxies for the socioeconomic characteristics of the surveyed counties: urbanisation (*URB*) and disposable income (*DIS*). Urbanisation is customarily associated with infrastructure development as well as the mechanisation and modernisation of agricultural production (Liu et al. 2018). This can improve production efficiency and raise the quality standards of tea production. In our analysis, the level of urbanisation is measured as the proportion of the total population of a county living in urban areas.

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Moreover, the level of disposable household income reflects the level of regional economic development. Furthermore, increased disposable household income is likely to increase tea consumption and have a spillover effect on the regional *RCA* of the tea industry. In this analysis, the per capita net disposable income of rural residents in a specific county was used to capture the income and economic development effects on tea's *RCA*. The logarithmic form of disposable income was used in order to eliminate the heteroscedasticity issue.

DATA AND DATA SOURCES

Data used to calculate *RCA* indices and estimate the GTWR model (*SPE*, *FIS*, *URB*, *DIS* and *ROAD*) were compiled from various issues of Fujian Statistical Yearbook (2019) between 2010 and 2018. Information regarding whether tea is classified as an advantageous industry within each county (*ADV*) was collected from the official Agricultural Development Plan of Fujian (2018). The data covered 67 cities of which 58 belong to county-level cities and 9 belong to prefecture-level cities. Table 1 provides more details regarding the variables' definitions and measurement units. The descriptive statistics of *SPE* are shown in Table S2 in electronic supplementary material (ESM); for ESM see the electronic version. Additionally, the descriptive statistics and correlation coefficients of all variables are presented in Table S3 and Table S4 in electronic supplementary material (ESM); for ESM see the electronic version. Table S3 shows that the average *RCA* is less than 0, indicating that tea production in most counties has a comparative disadvantage. The average *SPE* is greater than the unity, and the average *ADV* is lower than 0.4. Together, these results indicate that there are large variations between the counties in relation to their revealed comparative advantage in the tea industry, despite the fact that Fujian is China's top tea producer. Table S4 reveals that all variables included in the econometric analysis have significant impacts on *RCA*, which provides a justification for further analysis by applying the GTWR model.

RESULTS AND DISCUSSION

Determinants of tea industry's *RCA*. Figure 2 portrays the trends in the *RCA* of the tea industry across the different counties in Fujian in the years 2010, 2014, and 2018. The results show that *RCA*s have experienced little variations over time and that spatially, variations have been highly concentrated in north Fujian, where Oolong tea is produced, and in south Fujian, where Oolong, Jasmine, and other teas are cultivated. The tea production in these counties has a long history, forming geographical indication brands, and contributes the largest proportion to Fujian's tea production.

Table 2 presents the estimation results of the GTWR model. The results show that an increase in a county's specialisation would be associated with an increase in the *RCA* of the tea industry in the corresponding

Table 1. Definition and description of independent variables included in geographically and temporally weighted regression (GTWR) model

Variable*	Label	Operational definition	Measurement unit	Data source
Regional specialisation	*SPE*	location quotient of regional tea industry	index	Fujian Statistical Yearbook (2019)
Fiscal investment	*FIS*	the proportion of total financial expenditure dedicated to agriculture	%	Fujian Statistical Yearbook (2019)
Urbanisation	*URB*	the proportion of a county living in urban settings	%	Fujian Statistical Yearbook (2019)
Disposable income	*DIS*	*per capita* net income of rural residents	Chinese yuan	Fujian Statistical Yearbook (2019)
Advantageous industry	*ADV*	whether the area is officially recognised as a dominant tea producing area	dummy variable	Agricultural Development Plan of Fujian (2018)
Road mileage	*ROAD*	length of highways in operation	km	Fujian Statistical Yearbook (2019)

*Coefficients of these variables are expected to have positive effects on the revealed comparative advantage of the tea industry in the respective county

Source: Own processing

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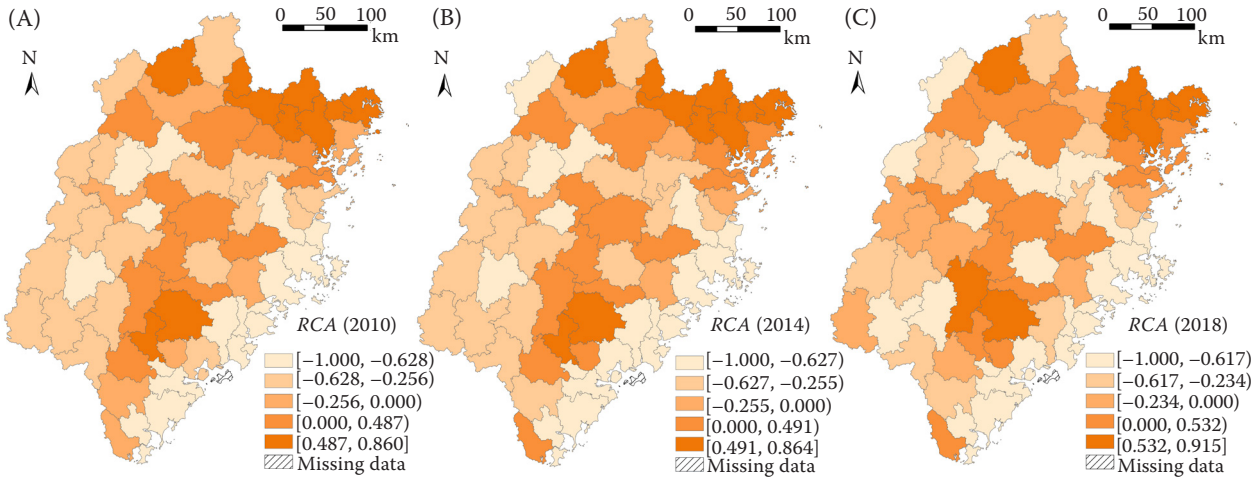

Figure 2. The revealed comparative advantage (*RCA*) of tea production in (A) 2010, (B) 2014 and (C) 2018

Source: Authors' results based on data from the Fujian Statistical Yearbook (2019)

county. On average, when *SPE* increases by 1, *RCA* would be increased by 0.338 in the same direction. This can be attributed to the "industrial agglomeration" effect, referring to a geographic concentration of industries which results in increasing returns to scale through competitive externalities, monetary externalities, and technological externalities. That is, a larger pool of producers and processors lowers production and transaction costs, improves variety through competition and specialisation, and subsequently enhances tea's *RCA* (Han et al. 2019).

The results reveal that an increase in regional financial investment was found to improve the *RCA* of the tea industry. *RCA* will increase by 0.005 when *FIS* increases by 1%. This finding is in line with the findings of Zheng et al. (2019) and Liu et al. (2020), which implies that the government's fiscal investment and financial subsidies to tea producers and processors effectively promote improved technological adoption and enhance the competitiveness of the tea industry. In connection with this finding, the estimated coefficient of the variable "advantageous industry" indicates that if a local government recognises tea as an advantageous industry, the tea industry in the respective county would achieve a higher *RCA*. In this regard, Li and Ma (2015) illustrate that advantageous industries in China receive special support from local governments that nurtures and builds their regional competitiveness.

Furthermore, the results suggest that urbanisation and the competitiveness of the tea industry are closely intertwined. This finding is consistent with findings of Henderson (2010) which show that urbanisation raises the efficiency of urban industries and makes it harder for similar industries in surrounding areas to compete with them. Likewise, Jiang and Shen (2010) point out that urbanisation intensifies competition and motivates

Table 2. Descriptive statistics of regression coefficients of the revealed comparative advantage (*RCA*) influencing factors

Variables	Mean	Min	Median	Max	SE	*t*-value	*P*-value
Intercept	0.058	−7.655	−0.026	6.329	59.613	0.586	0.558
SPE	0.338	−0.656	0.237	1.883	8.605	23.708	0.000
FIS	0.005	−0.056	0.004	0.064	0.321	9.852	0.000
URB	0.004	−0.035	0.003	0.046	0.257	9.904	0.000
DIS	−0.103	−0.744	−0.097	0.526	5.725	−10.832	0.000
ADV	0.193	−11.077	0.163	0.879	12.482	9.299	0.000
ROAD	0.008	−0.715	0.023	0.897	5.902	0.828	0.408

ADV – advantageous industry; *DIS* – disposable income; *FIS* – fiscal investment; *ROAD* – road mileage; *SPE* – regional specialisation; *URB* – urbanisation

Source: Authors' results based on data from the Fujian Statistical Yearbook (2019)

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local governments in China to actively establish policies conducive to enhancing the competitiveness of their main industries and economic sectors. While urbanisation involves infrastructure development, the results unsurprisingly show that a change in the road mileage of a county would lead to an analogous change in *RCA*. This finding is in accordance with Huang and Yang (2017) who indicate that investment in infrastructure, rural roads, and agricultural wholesale markets in China fosters market integration that links small farmers to processors, retailers, and consumers, and thus improves competitiveness.

Concerning income, the results highlight a negative effect of disposable income and regional *RCA* on the tea industry. That is, as disposable income increases, the focus of the economic development agenda within a county is likely to shift to manufacturing and non-agricultural sectors, which in turn weakens the *RCA* of the tea industry.

Moreover, compared with the impacts of other variables, the impacts of *FIS*, *URB* and *ROAD* on *RCA* are relatively weak. Additionally, *SPE* has the strongest positive impact on *RCA* in terms of intensity, while *ADV* follows closely behind. In contrast, *DIS* is the only variable that has a negative effect on *RCA* of the tea industry.

Spatiotemporal analysis of the determinants of the tea industry's *RCA*.The results indicate the goodness-of-fit of the GTWR model with an adjusted *R*-squared of 0.935. Figure 3 presents the estimated coefficients of the determinants of the tea industry's *RCA* in Fujian counties for the years 2010, 2014, and 2018. According to Figure 3A, the effect of regional specialisation (*SPE*) on the *RCA* of the tea industry shows a wide spatiotemporal heterogeneity among the counties of Fujian. The results indicate that during the period between 2010 and 2018 the impact of *SPE* on *RCA* took a downward trend. From a spatial perspective, the main areas where *SPE* strongly influenced *RCA* in 2010 were located in the northern areas of Fujian. In 2014 and 2018, these areas tended to gradually concentrate more in the southeast and northwest of the province. A possible explanation for this shift could be that the *RCA* of the tea industry in the northern areas has already been formed due to rapid economic growth, whereas southern areas have not exploited the maximum benefits that regional specialisation can have on the *RCA* of the tea industry (Liu et al. 2018).

In contrast to regional specification, the effect of fiscal investment (*FIS*) on *RCA* increased in the period 2010–2018 (Figure 3B). Thus, increasing fiscal investment seems to be a feasible policy measure to enhance the regional advantage *RCA* of the tea industry. Spatially, the areas where *FIS* positively influenced *RCA* were located mainly in the eastern areas of Fujian and they evolved from concentrated to more dispersed and then back to concentrated. These economically developed counties in eastern Fujian have the financial resources needed to support the development of the tea industry and represent the main tea-producing areas in the province. On the contrary, areas where *FIS* showed a negative effect on *RCA* were located in the northeast and some counties in the southeast of Fujian. Tea production in these areas plays a less important role as a cash crop and an economic activity for the rural communities.

By and large, the positive influence of urbanisation on *RCA* did not show any significant changes during the study period. The results indicate that the number of counties where urbanisation had a positive effect on *RCA* took an inverse *N*-shaped trend. The plotted coefficients of the variable *URB* in Figure 3C reveal that the positive effect of urbanisation is gradually weakening and relatively concentrated. The areas where urbanisation showed a positive influence on *RCA* were mainly distributed in the northwest of Fujian in 2010 and 2014, and they expanded in 2018 to cover the entire northern region of the province. Such a spatial distribution could be explained by the fact that these counties are currently in a stage of rapid agricultural and economic development, and the positive spillover effect of urbanisation on the *RCA* of the tea industry has not yet been fully exploited.

With respect to disposable income (*DIS*), the results reveal a strong-weak-strong evolution of the negative effect of income on the *RCA* of the tea industry. However, the number of areas where *DIS* showed a negative influence is much larger than it is for areas where it had a positive effect. Particularly in 2018, the negative effect of *DIS* on *RCA* became more significant than in earlier years of the study period. The spatial distribution in Figure 3D shows that the counties where *DIS* had a positive effect on *RCA* were distributed in the northwest part of Fujian, whereas areas where a negative effect was observed were mainly distributed in the east and south. This finding supports the findings of Liu et al. (2020) indicating that economic growth and increased disposable income in China shift employment from riskier agricultural sectors, including tea production, to less risky and more economically beneficial industries. Increased disposable income may have also increased labour costs, which adversely affected the development of labour-intensive industries, such

(B)

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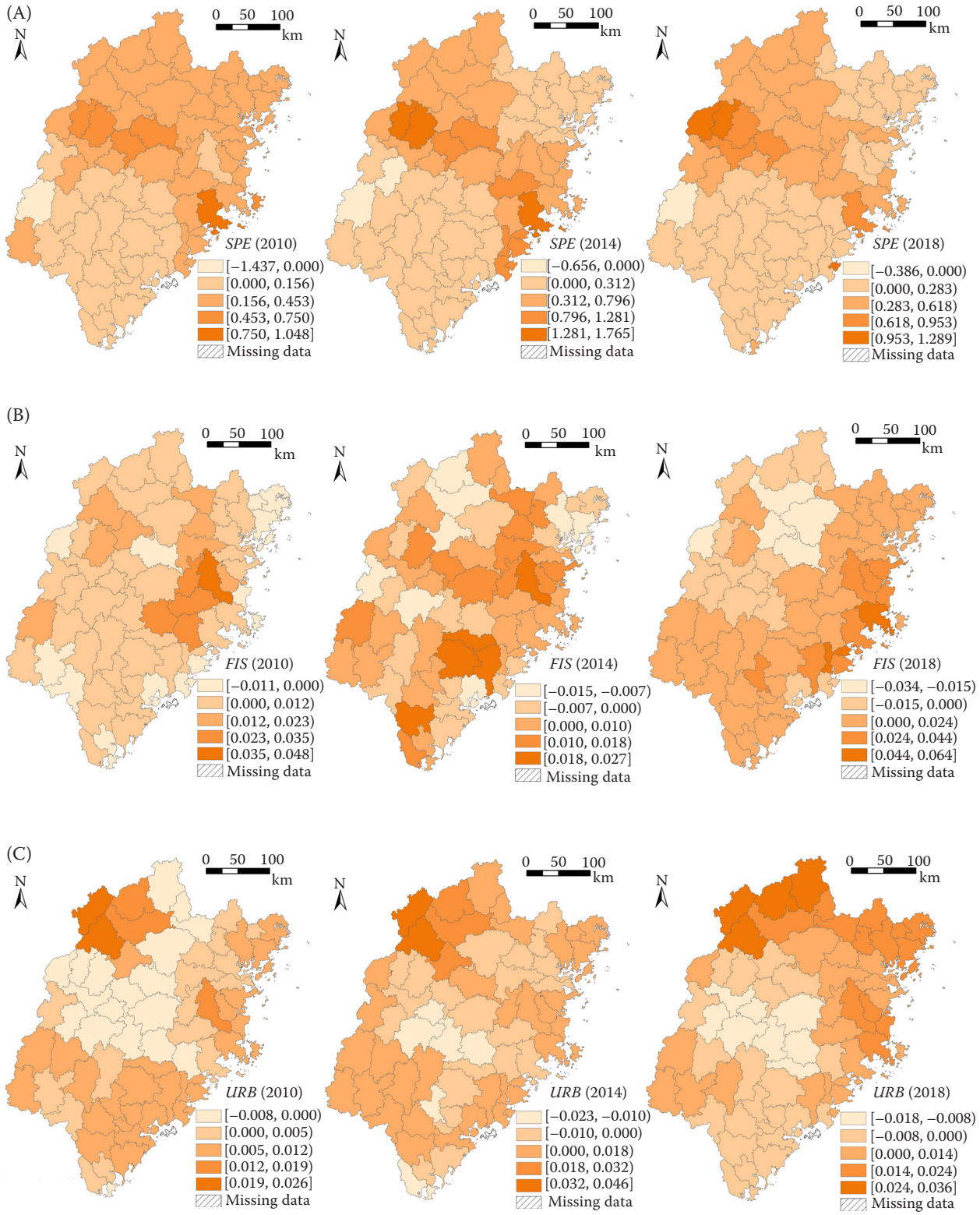

Figure 3. Spatial distribution of regression coefficients in (A) *SPE* 2010–2018, (B) *FIS* 2010–2018, (C) *URB* 2010–2018, (D) *DIS* 2010–2018, (E) *ADV* 2010–2018 and (F) *ROAD* 2010–2018

ADV – advantageous industry; *DIS* – disposable income; *FIS* – fiscal investment; *ROAD* – road mileage; *SPE* – regional specialisation; *URB* – urbanisation

Source: Authors' results based on data from the Fujian Statistical Yearbook (2019)

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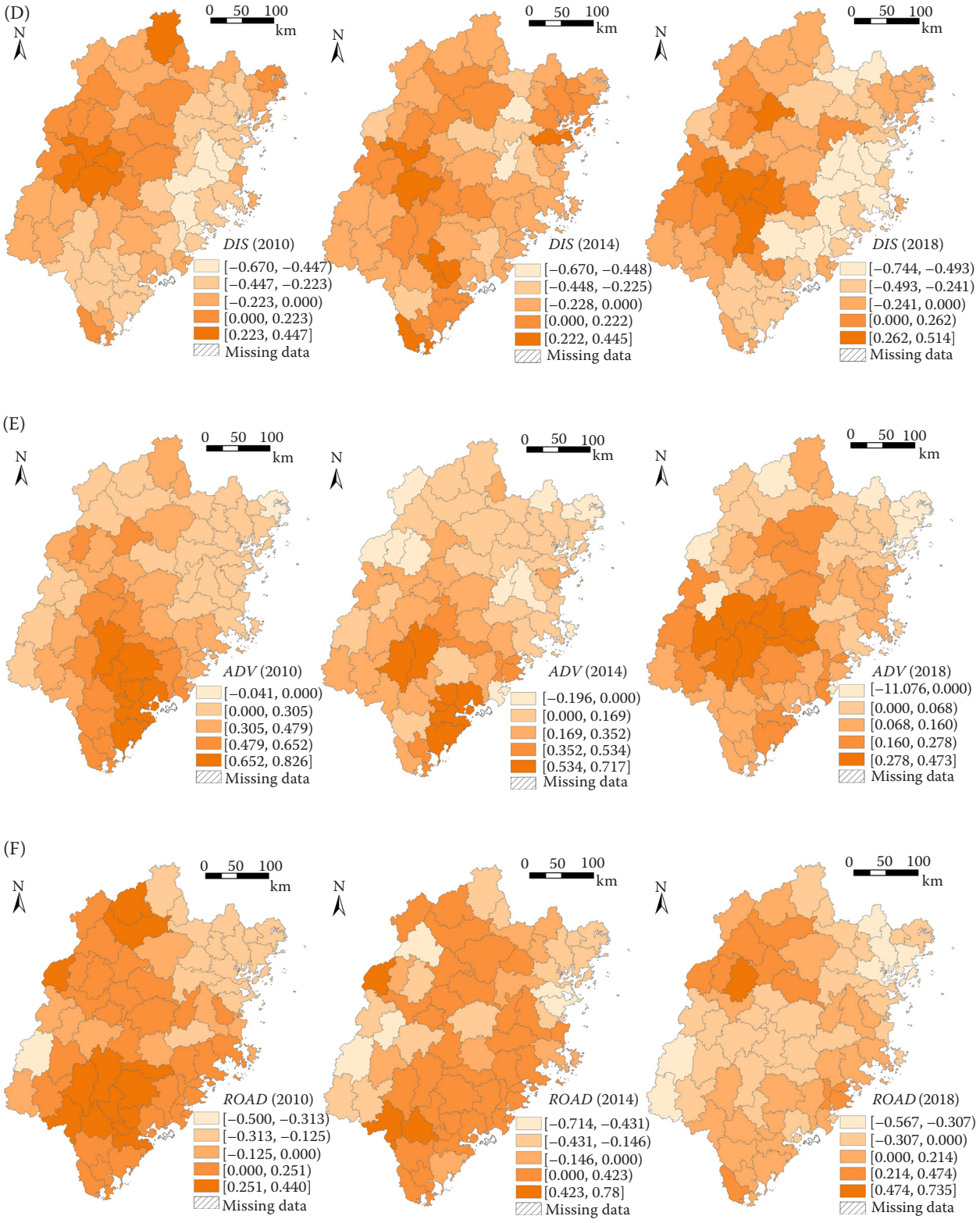

Figure 3 to be continued

ADV – advantageous industry; *DIS* – disposable income; *FIS* – fiscal investment; *ROAD* – road mileage; *SPE* – regional specialisation; *URB* – urbanisation

Source: Authors' results based on data from the Fujian Statistical Yearbook (2019)

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as the tea industry, and tea production has therefore shifted to areas with lower labour costs.

Unlike other variables, which experienced fluctuations over time, the positive effect of the recognition of tea as an advantageous industry (*ADV*) on the *RCA* of the county continuously declined during the study period (Figure 3E). This implies that the level and quality of governmental support to the tea industry gradually reduced. The results indicate that the areas where *ADV* had a significant positive impact on the *RCA* of the tea industry were mainly located in central and southern Fujian, where green tea and oolong tea are widely grown. Local governments in these areas have extensive experience in the development of the tea industry, and they therefore provide effective institutional and technical support that enhances the *RCA* of the tea industry.

Concerning the effect of infrastructure, expressed by the *ROAD* variable (Figure 3), on the *RCA* of the tea industry, the results reveal a positive-negative-positive evolution, where the years 2013 and 2018 represented the turning points. From a spatial perspective, the range in which infrastructure played a positive impact on *RCA* has gradually narrowed over time and become more concentrated. The areas where infrastructure had a positive influence on *RCA* are mainly located in the northwest and the south of Fujian. In these areas, black tea and oolong tea are widely cultivated and have a worldwide reputation. Moreover, several large-scale rural and urban development programmes and construction projects have been implemented in these areas, making the impact of road quality and infrastructure more visible on the *RCA* of the tea industry.

CONCLUSION AND POLICY RECOMMENDATIONS

This study addressed a gap in the literature around the determinants of the *RCA* of the tea industry in developing countries. Comprehensive understanding of these determinants is key for an effective and efficient resource allocation, and for promoting the competitiveness of the tea industry. The findings from this study highlight important policy implications for building and improving the *RCA* of the tea industry not only in China, but also in other tea-producing countries, particularly where governments play a significant role in the tea supply chain (e.g. Sri Lanka and to a lesser extent Kenya and India). In particular, the results showed that the effect and significance of the determinants of *RCA* vary across different spatial areas and over time. This implies that policies for promoting the comparative advantage of the tea industry should be adapted to local contexts and conditions, and should avoid centralised and one-size-fits-all policies.

Moreover, the results indicated that regional specialisation has the biggest positive effect on a county's *RCA* in the tea industry. This suggests that policies for upgrading in the tea value chain affect the competitiveness of the tea industry, which can be achieved by forms of support to tea producers and processors through fiscal investment, technology provision, and capacity building. As tea value chains are inherently complex, upgrading these chains required a shared vision among fragmented chain actors, and effective policy tools (e.g. taxes, subsidies, and outreach to farmers) and more research into development of the tea value chain. In this context, upgrading and modernising farming practices is essential to meet food safety and quality standards, improve productivity and quality of tea plucked, and achieve sustainability goals through adopting environmentally friendly practices. Success of such interventions depends on farmers' access to accompanying field-level technical advice and extension services, and on whether the standards improve market access and returns to farmers.

The results revealed that infrastructure development, which in most cases goes hand in hand with urbanisation processes, significantly determines regional tea competitiveness. That is, government investment in infrastructure, through implementing measures to connect distant markets across counties and link small farmers to processors, retailers, and consumers, can significantly improve the competitiveness of the tea industry.

Last, we acknowledge that some interesting variables that may influence the *RCA* of the tea industry may have not been included in the empirical analysis due to the data unavailability. For instance, several studies have shown that the quantity and quality of tea are greatly influenced by climatic parameters, particularly rainfall and temperature (Boehm et al. 2016; Gunathilaka et al. 2018), which can subsequently influence *RCA*. Therefore, future research should focus on identifying and quantifying the impact of climatic and environmental changes on the *RCA* of the tea industry in developing countries.

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