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Impacts of the emissions policies on tourism: An important but neglected aspect of sustainable tourism

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ABSTRACT

According with a growing sense of climate change in recent decades, an increasing number of works have focused on the impacts of climate on tourism. However, few studies to date have investigated the impacts of various emissions policies on tourism, leading to an ambiguous understanding of tourism adaption to emissions policy change. Here this study attempted to provide a framework to guide future research on tourism change under the leading emissions policies worldwide (i.e. the carbon tax and emissions trading scheme). Regarding the policy setting, this study suggests both the policy diversification within the emissions trading scheme or carbon tax and their comprehensive study. Regarding the research subject, this study recommends taking into account overall or sectoral impacts on different tourism economic and environmental variables. Moreover, future efforts should be devoted to not only simulating future change but also quantifying the actual impacts on tourism based on existing data. Regarding the methodology, this study strongly recommends four methods for assessing the impacts of emissions policies on tourism, including the augmented computable general equilibrium model, dynamic stochastic general equilibrium model, difference-in-differences method, and regression discontinuity method.

1. Introduction

Sustainability has always been one of the most important tourism research fields (Liu, 2003). Extensive prior studies have focused on tourism's economic, environmental and social effects (e.g. Hall, 2019; Harris, Williams and Griffin, 2012; Sharpley, 2020; Xiao, Wang, & Gao, 2021; Zhang, Ji, & Zhang, 2015). At the same time, also a large number of studies have explored the influence of economic, environmental and social factors on tourism, such as Tang and Jang (2009), Buckley (2011), Churchill, Pan, and Paramati (2020) and Zhang and Zhu (2020). Climate change has become a paramount factor hindering global sustainable development (Bäckstrand & Lövbrand, 2016; Cole, 2015; Nordhaus, 2015). Tourism, a key driver of economic growth, inclusive development and sustainability on the earth, is also increasingly affected by climate change (Buzinde, Manuel-Navarrete, Kerstetter, & Redclift, 2010; Hoogendoorn & Fitchett, 2018; Kaján, Tervo-Kankare, & Saarinen, 2015; Kaján & Saarinen, 2013; Scott, 2011; Steiger, Scott, Abegg, Pons, & Aall, 2019). Consequently, numerous studies have focused on the impacts of climate change on tourism during the past decade (e.g. Amelung & Nicholls, 2014; Becken & Hay, 2012; Dogru, Marchio, Bulut, & Suess, 2019; Goh, 2012; Liu, Cheng, Jiang, & Huang, 2019; Michailidou, Vlachokostas, & Moussiopoulos, 2016; Moyle et al., 2018; Scott, Hall, & Gössling, 2019; Seetanah & Fauzel, 2019).

In order to mitigate climate change, diversified emissions policies have been formulated or are being developed in various jurisdictions. However, few studies to date have investigated their impacts on tourism, though the development of tourism will inevitably be affected by the emissions policy (Dwyer, Forsyth, Spurr, & Hoque, 2013; Zhang & Zhang, 2020a). Given this background, this study aims to fill this existing gap by analyzing tourism change under the emissions policy, drawing on the experience of the broader economy. Unlike many studies including some critical review articles that focus on climate change and tourism, this study explores the tourism change in the case of the emissions policy to curb climate change. Compared with the effects of climate change on tourism at the environmental level, emissions policy is to regulate tourism through direct regulation and pricing at the governing level, thereby immediately affecting tourism's economic and environmental performance. Therefore, although emissions policy is generated from climate change, its effects on tourism are quite different from those of climate change.

The question is, how do different emissions policies affect the tourism industry? What economic and environmental changes will

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various tourism industries face under the impact of these emissions policies? Only by recognizing and clarifying these problems can tourism industries actively integrate into the global low-carbon development strategy and promote the realization of global, regional and local low-carbon transitions while maintaining their own sustainable development. Therefore, examining emissions policy and tourism has a high theoretical and practical significance. Unfortunately, this topic has been largely ignored by the scientific community. The possible reasons for this phenomenon lie in that first, emission policies are not directly aimed at tourism at many times, thereby reducing the attention of the academic community to their impacts on tourism. For example, emissions trading scheme (ETS) focuses mainly on energy-intensive industries such as electricity, oil, and steel (Lin & Jia, 2017; Villoria-Sáez, Tam, del Río Merino, Arrebola, & Wang, 2016). Second, the analysis on the impacts of emissions policy has a strong technical dependence, especially relying on some econometric analysis methods, which is significantly different from the current research paradigms of climate change and tourism such as questionnaire survey (e.g. Bujosa, Riera, & Torres, 2015; Gössling, Scott, Hall, Ceron, & Dubois, 2012).

It should be emphasized that the emissions policy in this paper is limited to the carbon tax and ETS because first, they are currently the most effective emissions policies worldwide (Haites, 2018). Second, both carbon tax and ETS play the most vital role in reducing carbon dioxide (CO_2) emissions and curbing climate change. They are all full national or local governmental actions and thus are highly binding. Third, the impacts of the carbon tax and ETS have been extensively researched (e.g. Calderón et al., 2016; Chen & Nie, 2016; Dong et al., 2017; Moore, Großkurth, & Themann, 2019; Sandoff & Schaad, 2009; Scheelhaase, Maertens, Grimme, & Jung, 2018; Wakabayashi & Kimura, 2018). Investigating these impacts has become one of the mainstream directions for emissions policy research. Therefore, both the overall effects and specific impacts on tourism are subject to carbon tax and ETS in this study.

Carbon tax refers to a tax levied on carbon dioxide emissions. Strictly speaking, ETS is a trading system. Subject to the cap and quota allocation management, the administrators formulate and allocate emission quota to participants and combine environmental performance with policy flexibility through market-based trading methods. ETS is committed to reducing participants' economic costs and carbon emissions. Carbon pricing and quota allocation are the two fundamental characteristics of ETS. Carbon tax and ETS are implemented in very different ways. The former is a form of taxation; the latter is a market. Therefore, their influence mechanism varies significantly. Concretely, the effectiveness of carbon tax is manifested in different tax prices, and it covers almost all industries. However, generally, only the covered sectors will be directly affected by the ETS. Carbon pricing and quota allocation determine the effectiveness of the ETS (Zhang & Zhang, 2020c).

The carbon tax is the most comfortable and most effective tool for reducing CO_2 emissions and achieving low-carbon transformation (Calderón et al., 2016; Pereira, Pereira, & Rodrigues, 2016; Zou et al., 2016). As early as in 1990, Finland began to impose the first carbon tax worldwide, successively followed by Poland (1990), Norway (1991) and Denmark (1992). In recent years, the number of countries levying carbon tax has increased gradually. These countries include Japan (2012), Australia (2012), Britain (2013), France (2014), Portugal (2015) and South Africa (2019). The ETS was first implemented in 2002 in New South Wales, Australia. However, this ETS was replaced by Australia's carbon pricing scheme since 2012. The earliest ETS still in operation is the European Union Greenhouse Gas Emission Trading Scheme (EU ETS), which is so far the world's largest carbon emission control and trading system. By the end of 2015, ETS had been established in various countries and regions outside the EU, including Alberta and Quebec (Canada), New Zealand, Switzerland, Tokyo and Saitama (Japan), California (the United States), Beijing, Guangdong, Shanghai, Shenzhen, Tianjin, Chongqing, Hubei (China), South Korea and Australia.

2. Methods

This study first searches the literature on the impacts of the carbon tax or ETS and then examines the research on a carbon tax or ETS and tourism. As indicated by Mongeon and Paul-Hus (2016), most literature analyses have common data sources: Clarivate's Web of Science and Elsevier's Scopus. Therefore, these two databases are also selected to search for the relevant literature in the current study. Due to many studies on the carbon tax and/or ETS, this study limits the search terms to *carbon tax* and *impact* or *effect* and *emissions trading scheme* or *ETS* and *impact* or *effect* to search the articles, so as to tightly fit the research topics. The literature search deadline is December 2020, and only journal articles are included in the samples. This study excludes book reviews, letters, research notes, and short communications. Finally, 343 papers and 480 papers are found if the search terms are respectively related to the carbon tax and ETS in the title. Regarding the impacts of emissions policy on tourism, only nine papers are found when the search terms are limited to the *carbon tax* and *tourism* or *travel* or *tourist* in the title by December 2020. Meanwhile, only one article is found if the search terms are limited to the *emissions trading scheme* or *ETS* and *tourism* or *travel* or *tourist* in the title. These ten articles are listed in Table 1.

The limited search results prove that the vital aspect of sustainable tourism, namely the impacts of the carbon tax and ETS, has been largely neglected by the scientific community. Therefore this article could not follow the research paradigm of general review articles that use systematic reviews or meta-analyses or other methods. Differently, this study draws on a descriptive analysis method. Furthermore, it is well known that air transport is an essential field of tourism research (Duval, 2013; Seetanah, Sannassee, Teeroovengadum, & Nunkoo, 2019; Spasojevic, Lohmann, & Scott, 2019); this study thus additionally retrieves the literature on ETS and air transport. The search terms are limited to *ETS* or *emissions trading scheme* and *aviation* or *air* or *airline* in the title. By doing so, a total of 87 papers are found. This paper briefly analyzes these relevant studies as an alternative to ETS and tourism.

Fig. 1 illustrates the annual numbers of published articles on the carbon tax and ETS's general impacts on the broader economy and specific impacts on tourism. As shown in Fig. 1, two significant results can be concluded. On the one hand, generally, the research on the broad impact of the carbon tax has been increasingly growing from 1991 to 2020. Moreover, with the increasingly severe climate problems in recent years and the development and implementation of various emission policies in multiple jurisdictions, relevant research's growth is hugely significant. Compared with the carbon tax, ETS related research shows a similar growth trend, although its start is slower than that of the carbon tax. On the other hand, the research on carbon tax (especially the ETS)

Table 1
Studies of the effects of the carbon tax and/or ETS on tourism.

Author(s)	Year	Emissions policy	Tourism variables
Tol	2007	Carbon tax	International tourist
Mayor and Tol	2010	Carbon tax	International tourist
Van Cranenburgh et al.	2014	Carbon tax	International tourist
Dwyer et al.	2012	Carbon tax	Competitiveness, profitability, and employment
Dwyer et al.	2013	Carbon tax	Added value, output, and employment
Meng and Pham	2017	Carbon tax	Output, employment, and profitability
Zhang and Zhang	2018	Carbon tax	Carbon emissions, carbon intensity
Zhang and Zhang	2019	Carbon tax	Energy consumption, energy intensity
Zhang and Zhang	2020	Carbon tax	Output, employment, production price, and demand
Zhang and Zhang	2020	ETS	Carbon emissions, carbon intensity

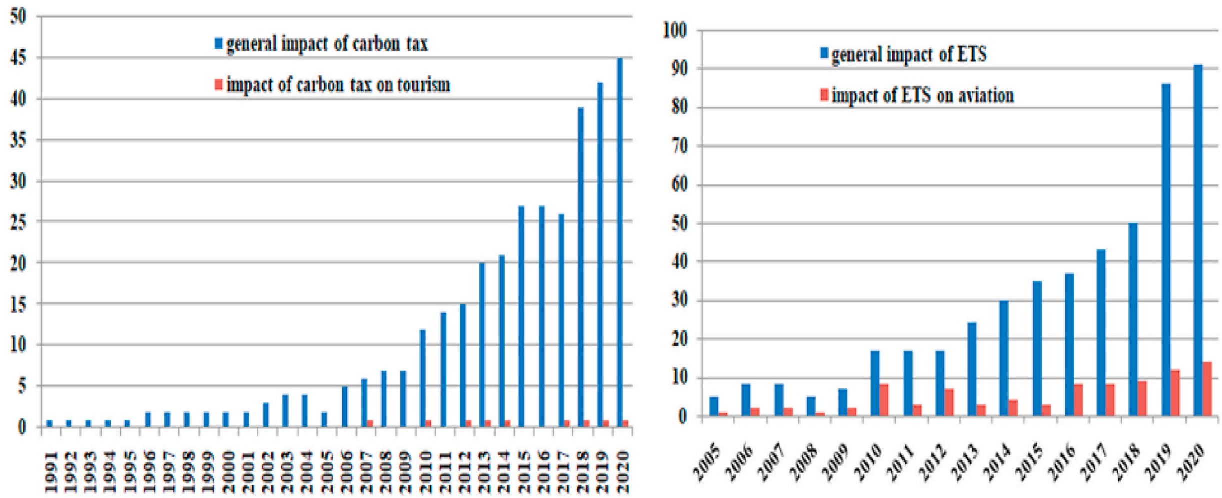

Fig. 1. Time distribution of published articles.

and tourism is still in its infancy, which is reflected in the short history (just beginning since 2007) and a handful of publications (a total number of ten). From the earliest 2007 to 2020, there are some sporadic researches, and the growth trend is not apparent, which might be due to the emission policies themselves and the research expertise and technology of the tourism scholars. Therefore, this study may play an enlightening role in this important but neglected sustainable tourism field. On the contrary, the impacts of ETS on air transport have attracted scholars' attention for a long time, which may be directly related to the high emissions of air transport.

3. Summary of the relevant literature

As mentioned above, numerous studies are focusing on the impacts of the carbon tax or ETS. This section briefly summarizes these studies and then presents a detailed review of the impacts of the carbon tax or ETS on tourism.

3.1. General impacts of the carbon tax and emission trading scheme

3.1.1. Impacts of the carbon tax

Whether at the global or national or regional scales, levying a carbon tax will increase oil prices while reducing CO_2 emissions, which in turn restrains economic growth (Pearce, 1991). Later related studies, for example, Calderón et al. (2016), Chen and Nie (2016), Dong et al. (2017), Frey (2017), Guo, Zhang, Zheng, and Rao (2014), Lin and Jia (2018a), Li et al. (2018), Liu, Huang, Huang, Baetz, and Pittendrigh (2018), Liu and Lu (2015), Mardones and Flores (2018), and Zhang (2017), though in different cases, have mostly reached similar conclusions. Besides, Sen and Vollebergh (2018) concluded that increasing tax will reduce carbon emissions from fossil fuel consumption in the long run. Duan and Wang (2018) argued that a carbon tax policy is conducive to reducing energy intensity, energy expenditures and per capita energy consumption. Given the importance of reducing energy consumption and improving energy efficiency for sustainable development (Golpîra, Bahramara, Khan, & Zhang, 2019; Golpîra & Khan, 2019; Li, Koo, Cha, Lai, & Lee, 2019), the environmental protection effect of the carbon tax is extremely precious. Yamazaki (2017) examined the employment impacts of the carbon tax on different sectors and indicated that the most carbon-intensive and trade-sensitive sectors will see employment fall, while clean service sectors will see employment rise. In addition to these studies at the national level, some other scholars have explored the carbon tax's impacts on a particular industry or group. For instance, Floros and Vlachou (2005) asserted that levying carbon tax could significantly reduce CO_2 emissions from Greek manufacturing; Renner, Lay, and Greve (2018) concluded that carbon tax is a preferred mitigation instrument for CO_2 emissions at the household level.

Given the contradiction between the economic and environmental impacts of the carbon tax policy, the reform of carbon taxation to achieve the dual dividend of economic and environmental performance has captured scholars' attention. A new carbon tax compensation plan to mitigate the negative impacts of the carbon tax on the Australian economic growth was proposed by Meng, Siriwardana, and McNeill (2013). Furthermore, the redistribution of carbon tax revenue can help achieve both CO_2 emission reduction and economic growth (Allan, Lecca, McGregor, & Swales, 2014; Pereira et al., 2016; Rivera, Reynès, Cortes, Bellocq, & Grazi, 2016).

3.1.2. Impacts of emissions trading scheme

Numerous studies focus on the EU ETS due to its earlier implementation and enormous influence. Those refer to the impacts of EU ETS on output, market share and corporate profit (Smale, Hartley, Hepburn, Ward, & Grubb, 2006), CO_2 emissions (Sandoff & Schaad, 2009; Scheelhaase et al., 2018), innovation ability (Löfgren, Wråke, Hagberg, & Roth, 2014; Rogge, Schneider, & Hoffmann, 2011), corporate value (Mo, Zhu, & Fan, 2012), and investment attraction (Löfgren et al., 2014; Westner & Madlener, 2012). The EU ETS will also lead to an increase in treated firms' fixed assets and induce a shift in investment priorities (Moore et al., 2019). Besides the EU, Choi, Liu, and Lee (2017) examined the economic impacts of Korean ETS; Wakabayashi and Kimura (2018) quantified the impacts of Tokyo-to's ETS on greenhouse gas emissions; Zhange, Wang , Tan (2015), Li and Jia (2016), Mo, Agnolucci, Jiang, and Fan (2016), Li, Yang, Chen, and Hu (2017), Lin and Jia (2017) and Lin and Jia (2018a) respectively investigated the economic or environmental impacts of China's ETS.

Apart from these above studies that focused on the policy simulation, several studies have recently focused on the actual net impacts of the ETS through a quasi-natural experiment approach, namely the difference-in-differences method. For example, Wang, Gao, and Dai (2019) calculated the impacts on national CO_2 emissions and carbon intensity; Zhang and Zhang (2019b) investigated the impacts of ETS on the CO_2 emissions, carbon intensity, energy consumption and energy intensity. Besides, Zhang et al. (2017) quantified the impacts on CO_2 emissions per capita, and Wang, Chen, Wu, and Nie (2019) explored the impacts on carbon productivity.

Similar to the diversity of carbon tax policies, the ETS policies, as shown in Table 2, are also constantly changing and display significant differences in various countries and regions with respect to covered sectors. Although almost every ETS market covers all the energy-intensive sectors such as electricity, coal, steel, and transportation, the

Table 2
The covered sectors of the major ETS markets according to Lin and Jia (2017) and Villoria-Sáez et al. (2016).

Region	Covered sectors
EU	2005–2012: electricity, oil, steel, cement, glass, paper, etc.; 2012-now, adding aviation sector and almost all the sectors
The United Kingdom (U.K.)	Voluntary
The United States (U. S.)	Electricity, steel, cement, commercial
Australia	Energy sector, transport
Japan	Voluntary
India	Cement, chemical fertilizer, steel, paper, railway, aluminum
China	2013–2017: carbon-intensive industries in the seven pilot areas; 2018-now: electricity nationwide
New Zealand	Forestry, transport fuels, electricity production, industrial processes, synthetic gases, agriculture and waste

specific covered sectors are frequently different in different jurisdictions.

3.2. Impacts of the carbon tax and emission trading scheme on tourism

As is well known, tourism depends largely on energy-intensive industries, including power, petroleum processing, steel, and construction. The construction of natural or human tourism scenic spots and the development of tourism transportation largely rely on these industries. Previous studies have indicated that both the carbon tax and ETS have significant direct impacts on these tourism-dependent industries. Moreover, currently, there is hardly any industry that can exist independently of other ones. There is numerous interdependence between tourism and other industries, which determines various economic and even environmental linkages. Therefore, the changes in the above-mentioned industries will theoretically of course affect the development of tourism with respect to price, technology, CO_2 emissions, and energy consumption. That is, the impacts of the carbon tax and/or ETS on tourism exist objectively. However, in spite of those aforementioned studies focusing on emissions policies' global impacts, few studies to date focus on the impacts on tourism that require further investigation. The only exceptions mainly concentrated on the impacts of the carbon tax on tourism. Regarding the ETS, scholars have hardly investigated its impacts on tourism in addition to the tourism-related aviation sector.

3.2.1. Carbon tax and tourism

Tol (2007) argued that the negative impacts of the carbon tax on international tourist flows will be small. Notably, the negative impacts on tourist destinations relying on long-haul flights or short-haul flights are greater than those relying on moderate-haul flights. Next, Mayor and Tol (2010) also found that all climate policies reduce visitor numbers in Europe. Van Cranenburgh, Chorus, and van Wee (2014) also explored the impacts of an aviator carbon tax on tourist behavior. The authors found that this carbon tax will reduce tourism travel-related carbon emissions while increasing the choice probability of nearby destinations and short vacations. These studies focused mainly on the impacts of the carbon tax and other emissions policies from the tourist's perspective, which significantly differs from those investigating the economic or environmental impacts of emissions policy summarized in the previous section. Afterward, scholars have respectively taken Australia and China as examples to explore the impacts of the carbon tax on tourism, especially in terms of the economic impacts.

For instance, Dwyer, Forsyth, and Spurr (2012) and Dwyer et al. (2013) investigated Australian carbon tax's impacts on tourism competitiveness, profitability, and employment, as well as added value, output, and employment. The authors found that in the case of a carbon tax, most tourism industries will experience a contraction in output. A similar conclusion was supported by Meng and Pham (2017), who simultaneously found that relative to a carbon tax, carbon tax plus compensation is more beneficial to the tourism industry. Regarding Chinese tourism industries, Zhang and Zhang (2018) investigated the impacts on CO_2 emissions, carbon intensity, value added and employment; Zhang and Zhang (2020a) investigated the impacts on output, employment, production price, and demand; Zhang and Zhang (2019a) investigated the impacts on energy consumption and energy intensity. The authors also found that the carbon tax in China contributes to reducing tourism-related carbon emissions and energy consumption while also stunts tourism economic growth. It should be noted that in both Australia and China, relatively carbon-intensive tourism sectors, such as accommodation and transport, will be more adversely affected.

Nevertheless, according to the above studies, on the one hand, we should not emphasize too much the negative economic impact of the carbon tax on tourism. On the other hand, we should recognize the importance of environmental improvement caused by a carbon tax to sustainable tourism development. Moreover, tourism industries should actively implement the low-carbon transition strategy so as to achieve the dual goals of reducing the economic cost brought by the carbon tax and promoting carbon dioxide emission reduction. In summary, this recent burgeoning of research on the carbon tax and tourism is indicative of a growing conviction that it is of great importance for tourism industries to adapt to emissions policy change.

3.2.2. Emissions trading scheme and tourism

Compared with the carbon tax policy, the emissions trading scheme's impacts on tourism have hardly attracted scholars to engage in. Exceptionally, Zhang and Zhang (2020b) found that ETS contributes to reducing tourism-related carbon emissions and carbon intensity. Moreover, these effects increase over time. This section also lists the studies on investigating the impacts of the ETS on air transport that has been regarded as an indispensable tourism characteristic industry. It should be noted that almost all these relevant studies are limited to the EU ETS. As shown in Table 2, since 2012, air transport has been covered by the EU ETS due to the rapid growth of the aviation sector as well as its increasingly growing CO_2 emissions.

The EU ETS might change travel behavior and cause operational and technological changes in the aviation sector; however, these changes are little (e.g. Anger & Köhler, 2010; Cui, Wei, & Li, 2016; Malina et al., 2012; Nava, Meleo, Cassetta, & Morelli, 2018; Preston, Lee, & Hooper, 2012; Scheelhaase et al., 2018). Particularly, the possible impacts on airfares, air travel demand, the supply of airline services and competitiveness summarized by Anger and Köhler (2010) are insignificant. Preston et al. (2012) pointed out that the inclusion of aviation within the EU ETS will reduce 35% of global aviation CO_2 emissions and is a critical step towards elaborating policy to address the sectoral climate impacts. Nava et al. (2018) found the negative impacts on output, profits and emission reduction of the Italian aviation sector. Scheelhaase et al. (2018) indicated that the EU should adjust the ETS for aviation. Outside the EU, Malina et al. (2012) found the small economic and emissions impacts on US airlines in the inclusion of aviation in the EU ETS. They confirmed the falling profits under increased allowances auctioned. Cui et al. (2016) indicated that airlines can adapt by themselves to meet the requirements of the EU ETS in the long run.

4. Discussion

Abundant achievements on the overall impacts of the carbon tax or ETS mainly refer to multidimensional policies (e.g. the carbon tax and ETS), diverse spatial scales (e.g. the European Union, a single country or even a state/province), different temporal scales (e.g. a single year and dynamic simulation) and different impact dimensions (e.g. economic growth and/or environmental quality). Specific to tourism, only several studies are found and focus mainly on the carbon tax. The following is a detailed discussion on the emissions policy, dependent variables and research approaches.

4.1. Policy

Those studies that have been performed on the impacts of the emissions policy nearly focus exclusively on a single policy. Concretely, in terms of the carbon tax, scholars preferred to fixed or different tax rates (e.g. Calderón et al., 2016; Li et al., 2018), tax revenue recycling (e.g. Liu & Lu, 2015) and different levying links of production and consumption (e.g. Pereira et al., 2016). As regards the ETS, the dominant settings are different quota allocation (e.g. Lin & Jia, 2018a; Westner & Madlener, 2012), carbon pricing (e.g. Baranzini et al., 2017; Yang, Liu, Gou, Man, & Su, 2018) and industries coverage (e.g. Lin & Jia, 2017). However, these studies focus hardly on the comparison or composite policy setting of the carbon tax and ETS. As Haites (2018) argued, regarding carbon tax and ETS as components of a portfolio of climate policies rather than optimal alternative policies is more appropriate in various jurisdictions. Besides, more static studies rather than the dynamic simulation regarding the emissions policy settings are found. Previous studies mostly limit policies to be static, yet in fact, both the carbon tax and ETS are changing in practice with respect to the tax rate and ETS-covered enterprises and regions. Thus dynamic policy should be fully considered in future research.

Compared with the carbon tax, direct empirical examinations of the impacts of the ETS on tourism remain absent. Though the carbon tax has not been implemented so far, Chinese scholars have investigated the impacts of possible carbon taxation on tourism-related economic growth, CO_2 emissions and energy consumption (see Zhang & Zhang, 2018; Zhang & Zhang, 2019b; Zhang & Zhang, 2020a). By contrast, few studies focus on the impacts of the ETS on tourism implemented since 2013. Similarly, how the ETS affects tourism is still a gap as well in another tourism power, Australia, whose ETS was launched on July 1, 2015. Similar problems exist in numerous tourist destinations worldwide. In addition, either a carbon tax or the ETS with better economic or environmental performance is still controversial. Lontzek, Cai, Judd, and Lenton (2015) and Markandya et al. (2015) acknowledged the superiority of carbon tax over an ETS in delaying climate tipping grows. On the contrary, Shinkuma and Sugeta (2016) challenged the superiority of a tax over an ETS. They asserted that the ETS is superior to a tax scheme, especially when the size of the output market is enormous. Therefore, it is also necessary to comprehensively compare the impacts of these two critical emissions policies on tourism.

4.2. Variables

Scholars have centered more on the tourism economic change in the case of the emissions policy. For instance, Dwyer et al. (2012), Dwyer et al. (2013) and Meng and Pham (2017) respectively investigated the impacts on the Australian tourism economy; Zhang and Zhang (2020a) investigated the impacts on China's tourism economy. In addition to the economic variables, few studies focus on the environmental impacts of an emissions policy on tourism. Exceptionally, Zhang and Zhang (2018) and Zhang and Zhang (2019a) quantified the carbon tax's impacts on CO_2 emissions and energy consumption, respectively. Aside from the findings of these studies, more improvements still need to be addressed.

First, a comprehensive assessment of the impacts on the tourism economy should be considered. Prior research mostly selected some specific economic variables (e.g. the added value, output, and employment of Dwyer et al. (2013); output, employment and profitability of Meng & Pham (2017); output, employment, production price and demand of Zhang and Zhang, (2020a). However, a more comprehensive understanding of these impacts requires us to consider the economic variables as many as possible. Second, the environmental impacts of the emissions policy on tourism should also be examined in more tourist destinations. The impacts on tourism environmental behavior, especially energy consumption and CO_2 emissions in different jurisdictions beyond China, deserve further research. This will help recognize the environmental changes of tourism under the emissions policy from a broader spatial perspective. Third, the actual impacts of the emissions policy on tourism should be investigated as well. Prior empirical studies focus mainly on future simulated impacts on the tourism economy or environment rather than the actual impacts of policy implementation. Research on not simulated but actual impacts may be of greater practical significance to figure out policy performance, thereby being conductive to formulating and implementing the emissions policy.

4.3. Approaches

Dwyer (2015) highlighted the applicability of the computable general equilibrium (CGE) model in tourism-related policy assessment. As a powerful tool for policy analysis, the CGE model has been widely employed and gradually developed into an important branch of applied economics. The main strength of the CGE model lies in that it establishes a quantitative relationship among the various economic sectors, thus contributing to examining the impacts of disturbances from one part of the economic system on the other parts. Therefore, the studies on general impacts or specific impacts on tourism mainly draw on the CGE model.

These studies include the comparative analysis of the emissions policies (Markandya et al., 2015), impacts of the carbon tax (e.g. Allan et al., 2014; Frey, 2017; Lin & Jia, 2018b), impacts of ETS (e.g. Choi et al., 2017; Li & Jia, 2016; Lin & Jia, 2018a), impacts on pan-industries (e.g. Liu et al., 2018; Liu & Lu, 2015; Lu, Tong, & Liu, 2010), impacts on the single tourism (e.g. Dwyer et al., 2012; Dwyer et al., 2013; Meng & Pham, 2017; Zhang & Zhang, 2018; Zhang & Zhang, 2019a; Zhang and Zhang, 2020a), impacts in different cases such as Australia (Meng et al., 2013), Portugal (Pereira et al., 2016), Mexico (Rivera et al., 2016) and China (Dong et al., 2017; Guo et al., 2014; Li et al., 2018; Lin & Jia, 2017; Zou, Xue, Fox, & Meng, 2018), which fully demonstrates the applicability and advantages of the CGE model in the emissions policy impact assessment.

Nevertheless, as indicated by Moore and Diaz (2015), due to lacking a robust empirical basis for their damage functions, the evaluation results of various climate models have been widely criticized. This is especially reflected in the CGE model which makes the results less comparable. This incomparability can be typically found in the same or different cases such as Dwyer et al. (2013), Meng and Pham (2017) and Zhang and Zhang (2018). Taking this into account, an urgent multi-regional CGE model is required to grasp the spatial differences better. Furthermore, the process of the CGE model depends on a multitude of equations and sophisticated data processing, namely conducting the social accounting matrix (SAM), which makes the application of the CGE model a daunting road. Given this background, this study suggests another equilibrium model, namely the dynamic stochastic general equilibrium (DSGE) model, that has better recyclability (Iacoviello & Neri, 2010; Stähler & Thomas, 2012). As long as the model structure is determined, the steady-state solution of the DSGE model is basically determined. Besides, compared with the CGE model, the DSGE model could better deal with the uncertainty and dynamics of an emissions policy. Therefore, the DSGE model can be used as an excellent complementary tool for the CGE model.

Additionally, some scholars have explored the actual net impacts of the ETS using a quasi-natural experiment approach (i.e. the difference-in-differences model) such as Wang, Chen, et al. (2019) and Zhang and Zhang (2019b). Through the comparative analysis of the experimental and control groups, the experimental method is of great significance for investigating the net impacts of policy implementation. However, there are two common major shortcomings in these studies that limit the robustness of the conclusions. First, the robustness tests of the difference-in-differences models in these studies are deficient or incomplete. All these studies did not involve the common trend hypothesis that is the precondition of using the difference-in-differences approach and the control variables. Second, none of these studies considered the dynamic changes in the impacts, thus limiting their practical value. Even so, with respect to the impacts of the emissions policy on tourism, thus far, there is no use of difference-in-differences or similar methods.

5. Future directions

It is acknowledged that the impacts of climate change on sustainable tourism can be more able to draw the academic community's attention at an earlier time. However, this study stresses that the emissions policy as a legal tool should capture all the tourism industries' immediate attention. Exploring tourism change under emissions policy appears to be a fundamental construct for both scientists and practitioners. Based on the discussion, this study addresses the future directions (see Fig. 2) of the impacts of emissions policy on tourism from the perspective of setting policy, expanding research subject, and developing analytic techniques.

5.1. Policy setting

From the previous discussion, it can be seen that scholars have analyzed diversified emissions policies that should theoretically be fully considered in tourism research. However, it is worth noting that these diversified emissions policies are basically confined to isolated and static settings and lack overall and dynamic characteristics. As asserted by Meckling, Kelsey, Biber, and Zysman (2015), current and planned emissions policy remains weak. Thus both the existing policy framework and the simulated portfolio framework should be taken into account in future studies.

Hence, both the policy diversification within ETS or carbon tax and the comprehensive study of ETS and carbon tax are expected. Specifically speaking, the carbon tax policy should content different tax rates, various levying links, tax revenue recycling, and carbon tax plus compensation (see Fig. 2). ETS should involve different industries coverage, carbon pricing and quota allocation (see Fig. 2). On this basis, this study suggests further exploring the impacts on tourism under the combination of different climate policies and comparing tourism change under different policy scenarios. Moreover, as Ocko et al. (2017) argued, the time-scale choice of emissions policy setting is central to achieving specific objectives. Therefore, emissions policy settings should also consider the dynamic setting of the tax rate, the dynamic change of ETS-covered sectors and regions, and dynamic carbon pricing in a simulation interval.

5.2. Research subject

This study suggests the global investigation of tourism change under emissions policy. Future research should first focus on the overall impacts on tourism sectors, namely examining the overall tourism changes regarding a particular economic or environmental variable. Second, investigating sectoral tourism changes under emissions policy is also valuable. As shown in Fig. 2, the influenced variables mainly include added value, output, price, profit, employment and demand within the tourism economy, as well as energy consumption (including fossil energy consumption, electricity use, and new energy consumption), energy intensity, carbon intensity and CO_2 emissions within the tourism environment. Then the influence mechanism of different emissions policies on different tourism economic and environmental variables in different tourism-related sectors can be examined.

Besides, as regards overall or sectoral impacts on different tourism economic and environmental variables, future efforts should be devoted to not only simulating the future change following the current mainstream paradigm based on the general equilibrium theory such as the CGE model but also quantifying the actual impacts on tourism based on existing data, namely whether the implementation of emissions policy has changed tourism. The latter is currently largely neglected. This raises questions about how to analyze emissions policy's future and past effects on tourism. The corresponding research methods will be discussed in the following section.

5.3. Research methodology

As illustrated in Fig. 2, this paper strongly recommends four methods for assessing the impacts of emissions policies on tourism, including the augmented CGE model, DSGE model, difference-in-differences method, and regression discontinuity method.

The CGE model is a representative method for evaluating future

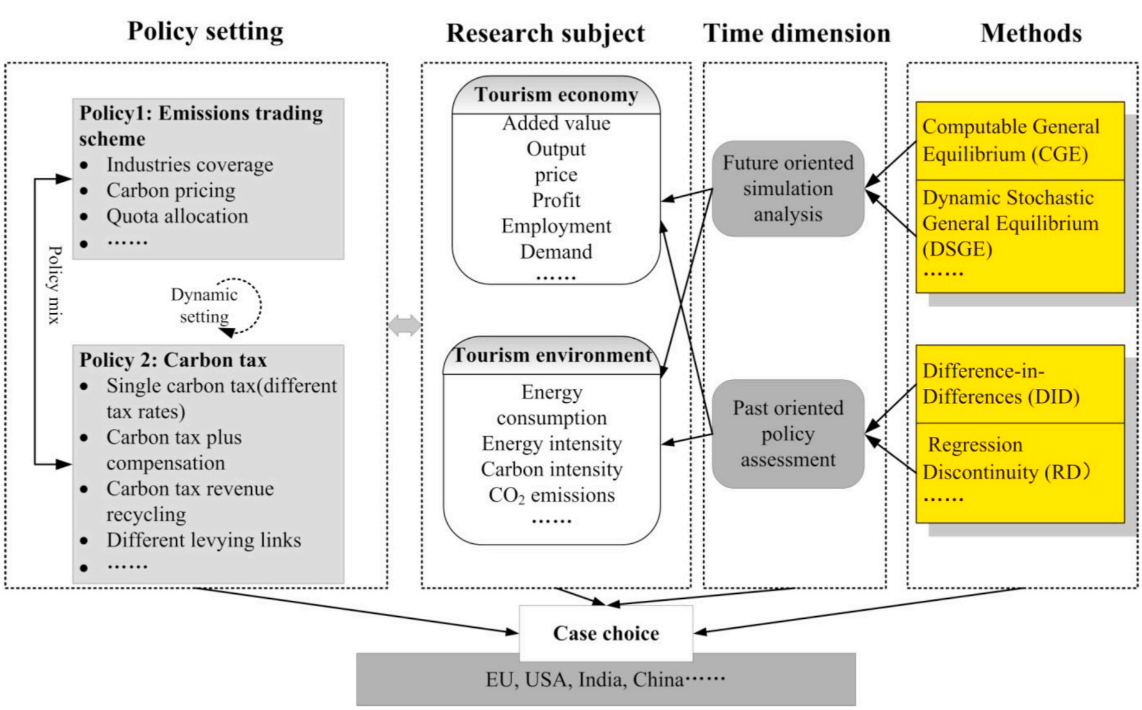

Fig. 2. Future research framework.

development and is dominant in the emissions policy's economic and environmental assessment. A CGE model frequently consists of various supply and demand functions as well as various behavior parameters. Aiming at the shortcomings of the CGE model indicated above, an energy system optimization model can extend and supplement the traditional CGE model. The establishment of multi-regional models (including multi-country CGE models and multi-province CGE models) is indispensable in the regional comparison. Additionally, it is also essential to compile the SAM, the data foundation of a CGE model. For this purpose, economic and technological data such as economic (tourism) development, energy consumption, and CO_2 emissions should be collected extensively and thoroughly and then be sorted, entered, and corrected.

The DSGE model, which was first constructed by Kydland and Prescott (1982) and Plosser and Long (1983), has become an important tool for macroeconomic regulation and economic analysis worldwide. A DSGE model, also based on the general equilibrium theory, does better in the uncertain and dynamic macroeconomic environment than the CGE model. The dynamic analysis of the DSGE model is more powerful so that economic agents can rationally make optimal choices for their current and future behavioral decisions under the available information set. As a complement to the CGE model advocated by Dwyer (2015), this study additionally recommends extensive employment of the DSGE model to investigate the impacts of complex dynamic emissions policies on tourism.

The assessment of the actual impacts on tourism since the past implementation of the emissions policy is different from the future simulation. It is expected to obtain real information through analyzing the existing data. Doing so depends on several economic analysis methods such as the difference-in-differences method and regression discontinuity method. The difference-in-differences model calculates the impacts of an exogenous policy shock on economic or environmental outcomes by comparing the average change in the outcome variable for the experimental group to the average change for the control group. Given the nature of the difference-in-differences method, its application in the ETS policy assessment should be more extensive, because the ETS-covered areas or sectors are relatively fixed within a certain time, thus facilitating the determination of the experimental group and control group of a difference-in-differences model. All the ETSs in the EU, US and China satisfy this point very well. In the future, the difference-in-differences method can be lent to comparing and analyzing the actual tourism effects of emissions policy. It should be noted that some tests, such as the common trend hypothesis and the instrumental variable test, should be used to improve the model's robustness.

Regression discontinuity is another popular quasi-experimental pretest-posttest technique to assess various policies. It explores the causal impact of an exogenous policy by assigning a critical value above or below what an exogenous policy is assigned. By comparing observations lying closely on either side of the critical value, it is possible to estimate the average policy impact. Concretely, the prerequisite of regression discontinuity lies in a variable: if the variable is greater than a critical value, the individual accepts the treatment; if the variable is less than the critical value, the individual rejects the treatment. Most ETSs are in line with this setting. For tourism enterprises, if CO_2 emissions or energy consumption reaches a certain value, they will be included in the ETS. Otherwise, they will be excluded from the ETS. With regard to the carbon tax, the regression discontinuity method also has certain applicability, which, however, depends on the way of carbon taxation.

Of course, the choice of research methods depends on the research needs. Nevertheless, whether the CGE, DSGE, difference-in-differences, and regression discontinuity methods or their augmented models are extremely mature in evaluating various emissions policies, which undoubtedly could provide a perfect instrument of appreciating the impacts of emissions policy on tourism.

6. Conclusions

This study initially discusses an important research topic of great theoretical significance and practical value, namely the impacts of the carbon tax and ETS on tourism. Concretely, this study suggests how to explore the impacts of these two major emissions policies on tourism in the future. The theoretical contribution of this paper is to establish a research framework integrating the emissions policy with tourism. This proposed research framework consists of the setting of emissions policy (including ETS and carbon tax as well as their policy combination and dynamic setting), the selection of tourism variables (including tourism price, added value, output, employment, demand, energy consumption, CO_2 emissions, and other aspects), and the research methods (including the CGE model, DSGE model, difference-in-differences method and regression discontinuity method). Therefore, this study could provide insightful perspectives for future directions.

In addition to the findings discussed above, two main limitations of this study should be addressed. Firstly, in this paper, emissions policy was mainly limited to carbon tax and ETS, the world's two leading policies to reduce CO_2 emissions. They are also the main climate policies that scholars pay most attention to at present. However, in fact, apart from these two mitigation policy measures, there are also many adaptation policy measures to reduce CO_2 emissions, such as technical progress and low-carbon education, which also deserve academic attention in the future. Secondly, this study focuses on the economic and environmental impacts while ignoring the social impacts of emissions policy since the social impacts are difficult to quantify. Actually, there are hardly any studies involving the social impacts of a carbon tax or ETS. Nevertheless, the social impacts of emissions policy on tourism are theoretically objective, which is also worth investigating.

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