Journal of Destination Marketing & Management 19 (2021) 100544

Contents lists available at ScienceDirect

Journal of Destination Marketing & Management

journal homepage: www.elsevier.com/locate/jdmm

What drives international tourism development in the Belt and Road Initiative?

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A R T I C L E I N F O

JEL classification:
F11
F59
F74
F064.1

Keywords:
Economic growth
International tourism income
Belt and road initiative
GVAR
Spillover effect

A B S T R A C T

As an important part of modern service, international tourism has created possibilities for employment and improvement in the balance of payments in receiving countries. This has also strengthened the degree of economic dependence among regions. In the context of international economic diversification, industrial integration, and globalization, the development of a domestic international tourism industry for a given country is inevitably affected by the performance of foreign economies. Therefore, the relationship between economic growth and tourism development has always been of primary interest in tourism economics. In order to study the dynamic relationship between regional economic growth and international tourism revenue along the Belt and Road Initiative, this study examines the annual country-level data from 1995 to 2017. A global vector autoregressive model (GVAR) is estimated, along with the impulse response and variance decomposition, to explain the interaction effect between China and other regions. The impulse response analysis shows that local economic growth has significant shock and spillover effects on international tourism revenue in the other regions, but these effects are heterogeneous across regions and do not always show positive cyclical synchronization. Results of the variance decomposition show that China's economic growth has increasingly contributed to international tourism revenue in other regions, and that the interdependence of countries' tourism demand has become stronger. Therefore, countries along the Belt and Road Initiative should strengthen their economic cooperation, reduce barriers to tourism trade, and dynamically adjust the regulatory policies of the international tourism industry. Additionally, these countries should jointly promote the interactive development of regional economies and the international tourism industry.

1. Introduction

With increasing global economic integration and the continuous advancement of trade liberalization, global tourism trade has flourished. International tourism has become one of the most important industries in the open economy, adding vitality to local economic development, and bringing a large amount of foreign exchange income. Shan and Wilson (2001) proposed the tourism-led economic growth hypothesis, which states that tourism development plays a significant role in promoting economic growth.

As an important strategic component of economic growth, international tourism has positive spillover effects on economic growth, primarily through increasing foreign exchange earnings (Henry & Deane, 1997; Noriko & Mototsugu, 2007), leading external investment (Law, 1992; Sinclair, 1998), stimulating local consumption (Divisekera, 2010; Lee & Hung, 2010), expanding tax revenue (Archer, 1995; Hughes, 1981), and creating employment (Janta et al., 2012). Meanwhile, economic growth has a reverse spillover effect on international tourism, in that it has increased investments in the tourism trade between countries and further promoted the development of international tourism. The 2019 Report on World Tourism Economy Trends pointed out that international tourism accounted for seven percent of global exports of goods and services, becoming the world's third largest export industry, generating USD 1.59 trillion in revenue, and providing approximately 6.9 percent of overall employment. Since the proposal of the Belt and Road regional economic construction initiative in 2013, there have been more than 70 countries and organizations participating worldwide (Cui & Song, 2019; Feng et al., 2019; Liu & Xin, 2019; Lv et al., 2019). The initiative comprises the Silk Road Economic Belt and the 21st Century Maritime Silk Road and is expected to operate through policy

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https://doi.org/10.1016/j.jdmm.2020.100544
Received 2 April 2020; Received in revised form 21 December 2020; Accepted 23 December 2020
Available online 21 January 2021
2212-571X/

coordination, infrastructure development, lifting trade restrictions, financial integration, and cultural cooperation (Li et al., 2020). An interested reader may refer to Dunford and Liu (2019) or Mamirkulova et al. (2020) for details. The countries in the Belt and Road Initiative have become the fastest growing segment in terms of tourism revenue; the number of international tourists in these countries is approximately 582 million annually, accounting for 44.02 percent of the world's international tourists, and generating USD 385.1 billion in international tourism revenue.

One can assume that economic growth has prompted the development of international tourism, making it an emerging industry and significantly increasing local tourism revenue. However, Cao et al. (2017) found that the impact of economic growth on international tourism varies significantly by region and does not always present positive cycle synchronization. In this light, the present article attempts to ascertain whether there are country-wide differences in the impact of the Belt and Road Initiative regional economies on international tourism. In order to explain the complex impact of economic growth on tourism revenue, this study focuses on the countries of the Belt and Road Initiative to construct a global vector autoregressive (GVAR) model. The impulse response analysis and variance decomposition analysis are then applied to measure the heterogeneity of the dynamic relationship between countries.

The contribution of this study can be defined in the following aspects. Firstly, it helps to clarify the extent of the impact of economic growth (including that of other countries) on the international tourism revenue of the host country, so that the country can formulate a reasonable international tourism management policy to compensate for the negative impact of the volatility of economic growth in the countries concerned. Secondly, this dynamic analysis is helpful in explaining the heterogeneity of the impact of China's Gross Domestic Product (GDP) on the scale of international tourism revenues of relevant countries. This understanding, in turn, will help countries along the Belt and Road Initiative formulate differentiated tourism policies and ensure the harmonious development of the tourism industry. Finally, the impact of the volatility of economic growth along the Belt and Road Initiative countries on China's international tourism revenue can be analyzed through the inverse effect, and this can provide a basis for the Chinese government to formulate more targeted policies for these countries and promote their common development.

The rest of this paper is organized as follows. A brief literature review is provided in Section 2. Section 3 presents the GVAR model and discusses the channels of the spillover effect for international tourism revenue along with the variables used in the model. The bilateral trade matrix is also discussed. Section 4 focuses on the analysis of the results, including generalized impulse response analysis and generalized variance decomposition analysis. Section 5 presents the conclusions and recommendations.

2. Literature review

In the context of economic globalization and economic development across many countries, the development of international tourism has been observed due to direct and indirect factors. International tourism has become a central element of international trade. With the increasing importance of international tourism in economic development, the relationship between economic growth and international tourism flows has become an important research avenue. Indeed, many studies have shown a positive interaction between the two phenomena. However, as far as the current literature is concerned, most of research focuses on inbound tourism, with less attention paid to the two-way tourism relationships among countries or regions. Table 1 summarizes the methods used in empirical studies on the tourism-economy nexus.

Jafari et al. (2000) and Stabler et al. (2010) argued that the development of international tourism would attract more foreign tourists, and inbound tourists' consumption would bring income to the local tourism industry. The economic benefits would increase exponentially through inter-industrial linkages and income redistribution. Brida et al. (2016) argued that, with the development of the tourism industry, the income level of the domestic population and the economy in general enjoys substantial growth. The causal relationship between inbound tourism and domestic economic growth is represented by the tourism-led growth hypothesis, which contends that the flow of inbound tourism is affected by various economic factors abroad. Thus, the development of tourism in a country to some extent depends on the external macroeconomic environment.

Table 1
Methods and empirical studies on the tourism-economy nexus.

Method	Reference	Research area
Questionnaire survey	Hussain et al. (2019)	Gilgit-Baltistan, Pakistan
Structural equation modeling	Al-Talabani et al. (2019)	Dubai
Error correction model	Durbarry (2002)	Mauritius
	Kim et al. (2006)	Taiwan
	Torraleja et al. (2010); Balaguer and Cantavella-Jorda (2002)	Spain
	Cortés-Jiménez and Pulina (2006); Dritsakis (2004); Katircioglu (2009)	Turkey
	Demiroz and Ongan (2005)	Malta
Panel models	Narayan et al. (2010)	Fiji, Tonga, Solomon Islands, Papua New Guinea
	BenJebli et al. (2019)	Central America and South America
	Eleftheriou and Sambracos (2019); Proenca and Soukiazis (2008)	Southern European countries (including Italy, Greece, Spain, and Portugal)
	Ren et al. (2019)	Mediterranean countries
	Danish and Wang (2018); Zhang and Cheng (2019)	China, Brazil, Russia, India, South Africa
	Cannonier and Burke (2019)	Caribbean countries
	Neuts (2020)	89 German cities
	Dogru, McGinley, and Kim (2020)	United States
	Yalçinkaya et al. (2018)	Countries with a developed tourism sector (WTR-20)
GVAR	Cao et al. (2017)	24 countries
Shift-share analysis	Dogru, Suess, and Sirakaya-Turk (2020)	150 countries

Webber (2001) studied the spillover effect of the source market on the foreign economy from the perspective of market forces, concluding that large fluctuations in the GDP or exchange rate in the source market will lead to a decrease in the number of inbound tourists and tourism revenue. Hussain et al. (2019) confirmed that there is a significant positive relationship between economic growth and sustainable tourism development, based on 43 interviews with different tourism operators and a survey of 576 inbound tourists from Gilgit-Baltistan, Pakistan. Al-Talabani et al. (2019) used health-related planning behavior theory and financial systemic connectivity models to analyze medical tourism. The results showed that financial and other related factors contributed to the number of inbound tourists in Dubai. They also reported that an improvement in the economic situation of the Dubai government will greatly promote the development of local medical tourism. Fonseca and Sánchez-Rivero (2020), based on the Granger causality test and meta-regression analysis, found that the impact of economic growth on tourism flows varies across income levels and degrees of tourism specialization. Lim and Won (2020) confirmed that the rapid growth of inbound tourists' income has made tourism income more elastic in the Las Vegas area and enhanced the diversification of tourism products. Based on an analysis of the spatial structure, time evolution, and market structure of tourist destinations in Madrid, Garin-Munoz (2004) proved that the income status of inbound tourists and the cost of tourism in

Madrid are the main factors affecting the intensity of the inbound tourism flow in the city.

With the development of econometric models and increasing data availability, empirical studies have been carried out in the international tourism industry. The error correction model (ECM) and panel data models have been widely used. Based on the ECM, which included capital stock, human capital, actual manufactured exports, actual sugar exports, and actual tourism revenue, Durbarry (2002) studied the relationship between economic development and tourism in Mauritius from 1952 to 1999. The results supported the tourism-led growth hypothesis.

By constructing a bivariate ECM, Kim et al. (2006) analyzed the relationship between tourism and economic development in Taiwan using quarterly data from 1971 to 2003. The results showed that there was a two-way causal relationship between tourism development and economic growth. Torraleja et al. (2010) constructed an ECM and confirmed that Granger causality exists in inbound tourism flows in Spain's five major coastal regions. Based on the ECM and the autoregressive distribution lag (ADL) model, Ohlan (2017) studied the relationship between India's inbound tourism and economic growth. The study showed that the two processes were directly interrelated in both the long and the short term. Similarly, using the same methods, Amaghionyeodiwe (2012), Balaguer and Cantavella-Jorda (2002), Cortés--Jiménez and Pulina (2006), Demiroz and Ongan (2005), Dritsakis (2004), and Katircioglu (2009) arrived at the same conclusion in their studies of Jamaica, Spain, Malta, and Turkey.

Panel models for tourism flows in multiple countries have also been employed to test the relationship between economic growth and tourism development. Narayan et al. (2010) used panel data for four Pacific island countries (Fiji, Tonga, the Solomon Islands, and Papua New Guinea) from 1980 to 2008 and found that tourism development played a significant role in promoting economic growth. Specifically, a 1 percent increase in tourism exports rendered economic growth of 0.24 percent in the short term and 0.72 percent in the long term. Similarly, Proenca and Soukiazis (2008) used panel data for Southern European countries (including Italy, Greece, Spain, and Portugal) from 1990 to 2004, and found that tourism improved the standard of living in these countries.

Based on a panel model for 22 countries in Central America and South America from 1995 to 2010, Ben Jebli et al. (2019) studied the causal relationship between the number of tourists and economic growth. A long-term cointegration relationship between the variables was identified. Meanwhile, in the short term, economic development has a one-way causal relationship with the number of tourists. Based on panel data for 89 German cities, Neuts (2020) verified that there is a long-term relationship between real GDP and tourism flow—that is, there is a two-way causal relationship between the two. Ren et al. (2019) studied the relationship between the development of tourism and the national economies of 113 countries around the world from 1995 to 2012 by means of panel modified ordinary least squares. The study showed that there was a significant long-term equilibrium relationship between economic development and tourism in various countries. Yalçinkaya et al. (2018) applied the panel model to assess the effects of tourism receipts in tourism countries (WTR-20).

Using the spatial panel econometric model, Eleftheriou and Sambracos (2019) studied the spillover effect between tourism development and economic growth in 49 Greek counties from 2010 to 2014. Their study indicated that there was a short-term and long-term positive spillover effect between tourism development and national economic growth. Danish and Wang (2018) studied the interrelationship between the economic growth, tourism, and environmental quality of BRICS countries based on a panel model, confirming that there was a significant two-way positive correlation between tourism and economic growth. Zhang and Cheng (2019) studied the threshold effect between the economic growth and tourism development of 36 earthquake-affected counties from 2008 to 2016 using the panel threshold regression model. They found that tourism makes a significant contribution to the development of regional economies, and the threshold effect of tourism development depends on economic growth, while economic growth promotes the professionalization and industrial structure of the tourism industry. Similarly, Sahni et al. (2020) applied threshold regression and quantile regression techniques to study the linear relationship between tourism income and economic growth. They determined the threshold of tourism receipts as 3.82 percent of GDP (i.e. countries with tourism receipts below this limit would see a higher impact of tourism on economic growth compared to countries above the threshold). Dogru, McGinley, and Kim (2020), based on the panel autoregressive distribution lag model, verified that economic growth has caused an increase in hotel investment in the US. Cannonier and Burke (2019) studied the causal relationship between tourism and economic growth in the Caribbean, based on panel data spanning over 30 years. The aforementioned study concluded that an increase in tourism spending of 10 percent induces economic growth of 0.7 percent. Dogru, Suess, and Sirakaya-Turk (2020) looked into tourism development data for 150 countries around the world from 2000 to 2017. They applied the shift-share approach and found Japan, Thailand, and Turkey to be the most competitive in terms of tourism flows.

The literature review suggests several conclusions regarding links between the tourism industry and economic development. Firstly, much of the literature focuses on the relationship between inbound tourism and economic development, with little attention given to the linkages and spillover effects of economic growth among countries or regions in the context of international tourism development. A positive link between economic growth and tourism growth is confirmed in most of the studies, yet the direction of causality remains arbitrary. Secondly, most of the existing literature focuses on the development of tourism within a single region and few studies discuss the interaction between countries, particularly for countries along the Belt and Road Initiative. Finally, in terms of research methods, most of the studies apply the ECM or panel regression models to study the relationship between regional economic development and tourism. The existing literature pays less attention to the endogeneity of the variables, does not explain the transmission mechanism of tourism-led growth, and lacks systematic analysis of the spillover effect.

In view of the gaps in the existing research, this paper attempts to develop a more comprehensive framework for the economy-tourism interaction in the Belt and Road Initiative countries. The research seeks to verify the hypothesis that economic growth positively affects international tourism in the Belt and Road Initiative countries. The main contribution is that the GVAR is adapted to assess the impact of the economic growth of countries in the Belt and Road Initiative on the international tourism revenue of multiple other countries. Compared with the traditional vector autoregressive model, the GVAR fully considers the endogenous relationship between variables. Use of the weight matrix allows domestic and foreign variables to be linked at the country level and channels of interaction to be revealed.

3. Methods and data

3.1. Global vector autoregressive model

The GVAR was first proposed by Pesaran et al. (2004). The model allows the relation of multiple indicators observed for multiple countries, taking into account their interdependencies. These dependencies are defined by the weight matrix. Dees et al. (2007) extended the model to model the economic linkages and exogenous shocks of 33 countries. Zhang (2012) explained the basic principles of GVAR model construction and used the model to analyze the dynamic relationship between China and the global economy.

The GVAR comprises country-specific (local) and global models. Local, foreign, and global variables are applied in the models. The weight matrix ensures the linkage between the local and global models. This allows measurement of the spillover effects. Technical details on implementation of the GVAR are provided in Annex A.

The choice of the GVAR for modeling the spillover effects indicates that this study considers economic relationships to define the connections among the countries rather than physical distance. Spatial models (Beenstock & Felsenstein, 2019; Jiao et al., 2020) could alternatively be applied to model the spatial interdependence from the physical distance perspective. In this paper, trade flows (see section 3.3) are used as measures of the interrelationships among the countries. Indeed, tourism flows may not necessarily be dependent on the distance between any two given countries due to the expansion of low-cost carriers and other means of transportation.

3.2. Data

From a transmission channel perspective, international tourism trade and international financial transactions are the major ways for one country's economic growth to impact the international tourism revenue of other countries. This sub-section further discusses these two approaches and relates macroeconomic variables (alongside tourism revenue) to the corresponding transmission channels.

Classical tourism economics posits that the economy, tourism, and trade constitute an interconnected system. Thus, economic development promotes business activities, thereby promoting the expansion of business tourism; the development of business tourism and non-business tourism promotes the growth of international tourism trade, and the international tourism revenue of various countries will increase. On the other hand, with the development of the economy, domestic residents' disposable income level continues to increase, and households' consumption demand for overseas travel is further enhanced. Due to the existence of a bilateral tourism service trade between countries, the scale of each country's international tourism revenue will rise with the economic growth of other countries, that is, economic growth has a spillover effect on international tourism revenue.

The international finance market is another channel for the transmission of economic growth affecting international tourism revenue, and is primarily driven by interest rates and foreign direct investment. For example, when a country's economic growth fluctuates, then the interest rate also changes. This, in turn, affects the tourism trade and international tourism revenues among countries. At the same time, when a country's economic downturn leads to the outflow of international capital, other countries will reduce investment in the country's tourism industry and related industries, thereby affecting its international tourism revenue.

The exposition of the impact mechanisms above shows that the channels experiencing the spillover effects of international tourism revenue from economic shocks are primarily international tourism trade and international finance. Therefore, the construction of the GVAR model takes the following principles into account. International tourism revenue is a common indicator for tracking development of the tourism sector (Alola et al., 2019; Assaf et al., 2019): changes in the actual output directly indicate economic growth in a certain country. GDP is treated as an indicator of economic growth. The magnitude of bilateral trade (imports and exports) between countries should be included in the model, as economic fluctuations in a certain country will lead directly to changes in the magnitude of its imports and exports, which, in turn, will affect the tourism service trade and international tourism revenue. Finally, the exchange rate is included in the model as its fluctuations will directly or indirectly affect the international tourism revenue in the other countries.

Based on the considerations mentioned above, the following variables are included in the GVAR model: GDP, exchange rate, import, export, and international tourism revenue. In order to construct the model, it is worth noting that these variables are simultaneously set to foreign variables and domestic variables, while the international oil price is set as a global variable. Specifically, the foreign variables for each country are constructed based on the weight matrix. This paper covers 36 countries in the Belt and Road Initiative (along with the United States) as a sample. The period covered is 1995–2017. Annual data are used. The data come from multiple sources, such as the International Monetary Fund (IMF), the World Bank, and the UN Commodity Trading database. The data sources for the relevant variables are shown in Table 2.

The United States (US) is included in the analysis as the reference country as it provides the benchmark for economic growth at the global level. Indeed, the Belt and Road Initiative mostly covers developing countries, and their analysis in an isolated manner may render misleading results. What is more, monetary variables are measured in US dollars. The variables provided in Table 2 appear as either domestic or foreign variables, depending on the country considered (with the exception of oil price). The variables of each country are selected as follows:

$$\mathbf{X}_{0t} = (gdp_{0t}, poil_{0t}, imp_{0t}, exp_{0t}, itr_{0t})', \mathbf{X}_{it} = (gdp_{it}, er_{it}, imp_{it}, exp_{it}, itr_{it})',$$

$$\mathbf{X}^*_{0t} = (gdp^*_{0t}, poil^*_{0t}, imp^*_{0t}, exp^*_{0t}, itr^*_{0t})', \mathbf{X}^*_{it} = (gdp^*_{it}, er^*_{it}, imp^*_{it}, exp^*_{it}, itr^*_{it})',$$

where $\mathbf{X}_{0t}$ and $\mathbf{X}^*_{0t}$ represent the domestic variable vector and the foreign variable vector of the reference country, respectively; and $\mathbf{X}_{it}$ and $\mathbf{X}^*_{it}$ represent the corresponding variable vectors of the certain (non-reference) country. Note that oil price is included as a domestic and foreign variable for the reference country, whereas it is treated as a global variable for the rest of the countries. The exchange rate is not included in the model for the reference country.

The data used in the paper imply that the analysis looks at international tourism as a monolithic activity. Indeed, one could disaggregate it with respect to type of tourism, price level, duration etc. However, such data are not available at the international level. The use of highly aggregated data suggests that one may lose some information regarding the substitutability of different kinds of tourism. However, the model used in this paper is still able to track the macroeconomic effects of tourism development.

3.3. Construction of the weight matrix

In the GVAR model, the weight matrix for the countries included in the model is constructed on the basis of the magnitude of the bilateral trade flows or capital flows. Considering that international tourism is considered as the service trade, this paper assumes that bilateral trade can better reflect the trade links between regions. Therefore, this paper uses bilateral trade volume to construct the weight matrix.

The sample selected in this paper is 36 countries in the Belt and Road Initiative. Thus, the weight matrix is defined as $\mathbf{W} = [w_{ij}]_{36\times 36}$, where w_{ij}, $1 \le i, j \le 36$, represents the importance of bilateral trade between the i-th country and the j-th country. The average bilateral trade volumes are computed for each pair of countries over the research period. The weights are then obtained as $w_{ij} = \overline{L}_{ij}/\sum_{j=1}^{36}\overline{L}_{ij}$, where $\overline{L}_{ij}$ represents the average bilateral trade volume between the i-th country and the j-th country. Obviously, $\overline{L}_{ii} = 0$. Table 3 shows the proportion of bilateral

Table 2
Variables and data sources.

Variable Name	Notation	Data Source
GDP	*Gdp*	IMF, World Bank, National Bureau of Statistics of China
Exchange rate	*Er*	IMF, World Bank, WDI Database
Import	*Imp*	IMF, UN Commodity Trading (UNCOMTRADE)
Export	*Exp*	IMF, UN Commodity Trading (UNCOMTRADE)
International tourism revenue	*Itr*	International Balance of Payments Statistical Yearbook (BPM5), IMF, National Bureau of Statistics of China
International oil price	*Poil*	International Bureau of Financial Statistics, IMF, EIU Country Data

Table 3
The proportion of bilateral trade between each country and China and the United States (%).

Country	USA	China	Country	USA	China
US	0.00	0.34	Egypt	0.08	0.11
China	0.15	0.00	Australia	0.16	0.22
Thailand	0.10	0.19	New Zealand	0.13	0.18
Vietnam	0.06	0.35	Russia	0.07	0.19
Singapore	0.16	0.11	Ukraine	0.06	0.18
Cambodia	0.17	0.13	Poland	0.07	0.19
Philippines	0.19	0.13	Czech Republic	0.05	0.15
Malaysia	0.14	0.18	Lithuania	0.03	0.14
Jordan	0.08	0.14	Macedonia	0.07	0.16
Bahrain	0.09	0.17	Hungary	0.05	0.11
Israel	0.13	0.24	Bulgaria	0.04	0.16
Turkey	0.11	0.19	Romania	0.03	0.15
Kuwait	0.12	0.21	Latvia	0.08	0.19
Saudi Arabia	0.14	0.23	Croatia	0.06	0.18
India	0.10	0.21	Armenia	0.09	0.15
Pakistan	0.09	0.22	Georgia	0.04	0.17
Bangladesh	0.04	0.23	Slovenia	0.08	0.14
Sri Lanka	0.03	0.16	Albania	0.04	0.15

trade between each country and China and the United States. The detailed results are provided in Table B1.

As Table 3 suggests, there are 31 countries showing a higher share of foreign trade with China than with the United States. Basically, China exhibits higher influence than the United States in terms of the international trade flows of countries in the Belt and Road Initiative. For example, the proportion of bilateral trade between China and Vietnam, Pakistan, and Bangladesh (35%, 22%, 23%) substantially exceeds their share of the bilateral trade volume with the United States (6%, 9%, 4%).

As far as the United States is concerned, the bilateral trade volume with China has reached more than 30% of its total trade volume. This means that fluctuations in the Chinese economy will not only impact countries in the Belt and Road Initiative, but will also affect the economy of the United States. Therefore, in order to capture the impact of the economic growth of countries in the Belt and Road Initiative on international tourism revenue in a comprehensive manner, further empirical research based on the GVAR approach is beneficial.

4. Empirical analysis

The GVAR model is estimated to analyze the spillover effects in the context of the tourism-economy nexus in the Belt and Road Initiative countries. In order to avoid heteroscedasticity, the original data are transformed by taking logarithms. GVAR Toolbox 2.0 (Smith & Galesi, 2014) is used for the estimation. First, the order of lags is identified and the model is tuned; then, the impulse response and variance decomposition analysis is carried out.

4.1. Model specification

4.1.1. Lag order of variables

The GVAR model requires setting the order of lags for the variables included. The order of lags is identified by applying the Akaike information criterion and Bayesian/Schwarz criterion. The results are shown in Table 4.

In Table 4, p and q represent the lag order of domestic variables and foreign variables, respectively, and r represents the number of cointegration relations. Based on the results in Table 4, the foreign variables in all VARX* models have a lag order of 1. With the exception of seven countries, in the VARX* models of the remaining 29 countries, the lag order of domestic variables is higher than that of foreign variables.

4.1.2. Cointegration test

In order to construct a GVAR model, it is necessary to perform a stationarity test on the variables in each country's VARX* model. The Augmented Dickey-Fuller (ADF) unit root test is applied to this end. Taking China's VARX* model as an example, the null hypothesis of the unit root test cannot be rejected for the level time series of the GDP (*gdp*) and international tourism revenue (*itr*)—i.e. the original series are non-stationary series. Therefore, the original time series needs to be differentiated. According to the results in Table 5, the first-order difference renders stationary time series for all the variables.

On this basis, a test for a cointegration relationship in the VARX* model of each country is carried out. The trace test of the cointegration relationship in the Chinese model is shown in Table 6. According to the trace test, when $r = 4$, the p-value exceeds 0.05, and the null hypothesis that there are at most four cointegration relations between variables is

Table 5
ADF unit root test of variables in Chinese VARX* model.

Variable	ADF Test Statistic	p-value	Variable	ADF Test Statistic	p-value
Gdp	−0.3707	0.8976	Δgdp	−5.0706	0.0036**
Er	−2.2192	0.0286**	Δer	−4.4940	0.0108**
Imp	−3.2245	0.0327**	Δimp	−5.5136	0.0003**
Exp	−3.5235	0.0176**	Δexp	−6.9932	0.0000**
Itr	−0.0538	0.9416	Δitr	−5.9179	0.0001**
poil	−3.4427	0.0217**	$\Delta poil$	−5.0879	0.0007**

Note: ** significance at 5% level.

Table 4
Lag order and cointegration relationships in domestic and foreign variables of the VARX* model.

Region	Country	*p*	Q	*r*	Region	Country	*p*	*q*	*r*
USA (US)	USA	1	1	3	Egypt (EGY)	Egypt	2	1	3
China (CHN)	China	2	1	4	Oceania (OCE)	Australia	2	1	3
Southeast Asia (SEA)	Thailand	2	1	2		New Zealand	2	1	2
	Vietnam	2	1	3	Commonwealth of Independent States (CIS)	Russia	2	1	3
	Singapore	2	1	2		Ukraine	2	1	4
	Cambodia	2	1	3	Central and Eastern Europe (CEE)	Poland	2	1	2
	Philippines	1	1	2		Czech Republic	2	1	4
	Malaysia	1	1	2		Lithuania	2	1	1
West Asia (WA)	Jordan	2	1	3		Macedonia	1	1	2
	Bahrain	2	1	2		Hungary	2	1	3
	Israel	2	1	4		Bulgaria	2	1	2
	Turkey	2	1	3		Romania	2	1	1
	Kuwait	2	1	3		Latvia	2	1	3
	Saudi Arabia	2	1	3		Croatia	2	1	2
South Asia (SA)	India	2	1	2		Armenia	1	1	3
	Pakistan	2	1	2		Georgia	1	1	4
	Bangladesh	1	1	3		Slovenia	2	1	3
	Sri Lanka	2	1	1		Albania	1	1	3

Table 6
Trace test of cointegration relationship in China's VARX* model.

r	$r = 0$	$r = 1$	$r = 2$	$r = 3$	$r = 4$	$r = 5$
Test statistic	146.1143	98.8861	60.0266	31.7281	11.5000	3.5917
p-value	0.0000**	0.0001**	0.0024**	0.0296**	0.1825	0.0581*

Note: ** significance at 5% level; * significance at 10% level.

accepted. That is to say, there are four cointegration relations in China's VARX* model.

A similar approach is followed to perform cointegration tests on the VARX* models of the remaining countries. The number of cointegration relations in the model of each country is presented in Table 4. Detailed results of the trace test for each country's VARX* model can be found in Table B2.

4.1.3. *Weak exogeneity test for foreign variables*

Assuming that cointegration relationships exist in the VARX* models of each country, exogeneity of the foreign variables should be tested. For China's VARX* model, the results in Table 7 show that the F statistics for all foreign variables are lower than the critical value at the 5% significance level. Therefore, the foreign variables are weakly exogenous, and they affect the domestic variables in the long run.

The weak exogeneity test is applied for each country. The results indicate that the foreign variables are weakly exogenous for all countries. Detailed results can be found in Table B3.

4.2. *Generalized impulse response function*

Impulse response analysis is used to observe the dynamic response of a variable being impacted by other variables. Compared with the traditional orthogonal impulse response function, the generalized impulse response function does not need to consider the order of the variables. Therefore, the generalized impulse response function is more suitable for the GVAR model.

In order to analyze the interactive effect of economic growth on international tourism revenue, this paper divides the sample countries into nine regions (see Table 4 for details). Then, the generalized impulse response function is applied to address the two issues—the impact of China's economic growth on international tourism revenue in the remaining regions, and the impact of economic growth in the other regions on China's international tourism revenue.

4.2.1. *The impact of China's economic growth on international tourism revenue in the other regions*

Fig. 1 depicts the impulse response functions which describe the effects of the shocks in China's economic growth on international tourism revenues in the other regions. Specifically, a positive shock of one standard deviation is assumed. The horizontal axis represents the period of the impact, while the vertical axis represents the effect of the shock.

The results suggest that China's economic growth has a positive impact on international tourism revenue in the other regions, with diminishing effects in the long run. The average level effect is 0.09 percent growth in international tourism revenue. Among different regions, China's economic growth has the highest positive spillover effect for Africa, 0.205 percent at the peak; the lowest positive spillover effect is observed for the United States, 0.028 percent at the peak.

Table 7
Weak exogeneity test for foreign variables in China's VARX* model.

Statistics	Critical value ($\alpha = 0.05$)	gdp_s	er_s	imp_s	exp_s	itr_s	$poil$
F(4,133)	2.440	1.545	1.758	1.216	1.159	0.574	1.968

Note: in the Chinese VARX* model, the number of cointegration relationships is four and the number of observations is 136, so the degrees of freedom for the F distribution is 133.

Indeed, the impact of China's economic growth does not induce the same pattern of change in the international tourism revenue in each region. The impulse response trajectory in the USA, SEA, and OCE are uniform and the spillover effect is positive. However, in the early stage, the positive spillover effect shows a decreasing trend. The responsiveness of international tourism revenue in the USA peaks in the twelfth period at 0.026 percent. Correspondingly, SA and OCE reach their maximum responsiveness in the sixth period, at 0.07 percent and 0.069 percent, respectively. Fig. 1a, b, and 1f depict these trends. Obviously, the tourism sector in the US is the largest among the countries discussed, and the effect of China's economic growth is less pronounced. Note that a decline in revenue is observed in the short run in some cases, possibly due to the trade flows and exchange rate effects (Kulendran & Wilson, 2000; Santana et al., 2011; Su, 2013).

In WA, CIS, and CEE (Fig. 1d, e, and h), the trajectory of the response to China's economic growth is also synchronized. The difference is that the positive spillover effect has an inflection point. The effect gradually increases in the early stage, then stabilizes and declines. The WA region reaches its maximum responsiveness in year 7 at 0.082 percent, whereas the CIS and CEE reach their peak values in the second period at 0.24 percent and 0.117 percent, respectively. These countries show rather high responsiveness to the growth of China's economy as their tourism sectors are still developing and additional tourist inflow renders a substantial increase in receipts (Demiroz & Ongan, 2005; Lebedeva, 2019). Indeed, the development of human quality is instrumental in the tourism sector of the CEE (Radjenovic, 2019).

Although the impulse response trajectories of the SA region and the EGY region are also synchronized (Fig. 1c and g), the maximum value of the positive spillover effect caused by the shock in these areas is reached in the first period. The response value of EGY is 0.21 percent, and the response value of SA is 0.044 percent. The spillover effect of shock gradually diminishes over time and even becomes negative. The main reason for this is that after 2010, the economic development of South Asia and Africa gradually slowed down, and the economic downturn has reduced the disposable income of residents. This has led to a reduction in the demand for travel abroad, which has negatively affected China's international tourism income. The results suggest that a similar pattern is likely to prevail in the future if there is no further economic development in SA and EGY (Wu, 2013).

4.2.2. *Impact of other regions' economic growth on China's international tourism revenue*

The positive shock of one standard deviation is applied for economic growth in different regions in the Belt and Road Initiative to check the response of China's international tourism revenue. The results are summarized in Fig. 2. The shock effects are different across the regions, and the average level of the effects is an increase of 0.018 percent at the peak point. Economic growth in CEE has the highest positive spillover effect on China's international tourism revenue (0.043% at the peak); the lowest responsiveness is observed for Egypt's economic growth (0.003% at the peak).

Responses to shock in economic growth in each region on China's international tourism revenue differ across the regions. The responsiveness to shocks in the US, SA, and OCE regions is similar. A positive spillover effect in the early period is observed in these cases. Fig. 2a, c, and f suggest that the spillover effect of economic growth in the US

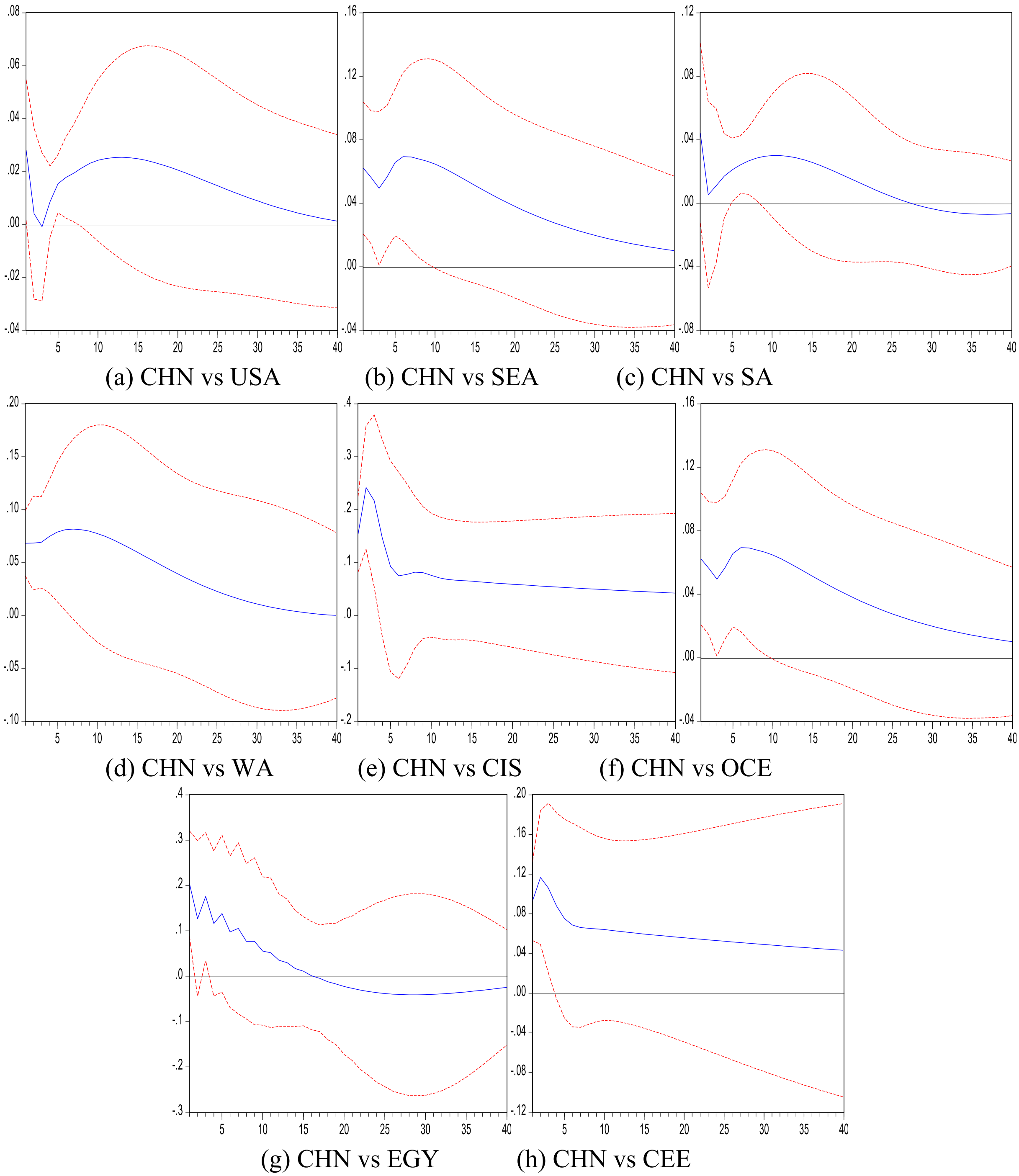

Fig. 1. Impulse response functions for the effect of China's economic growth on international tourism revenue in the other regions.

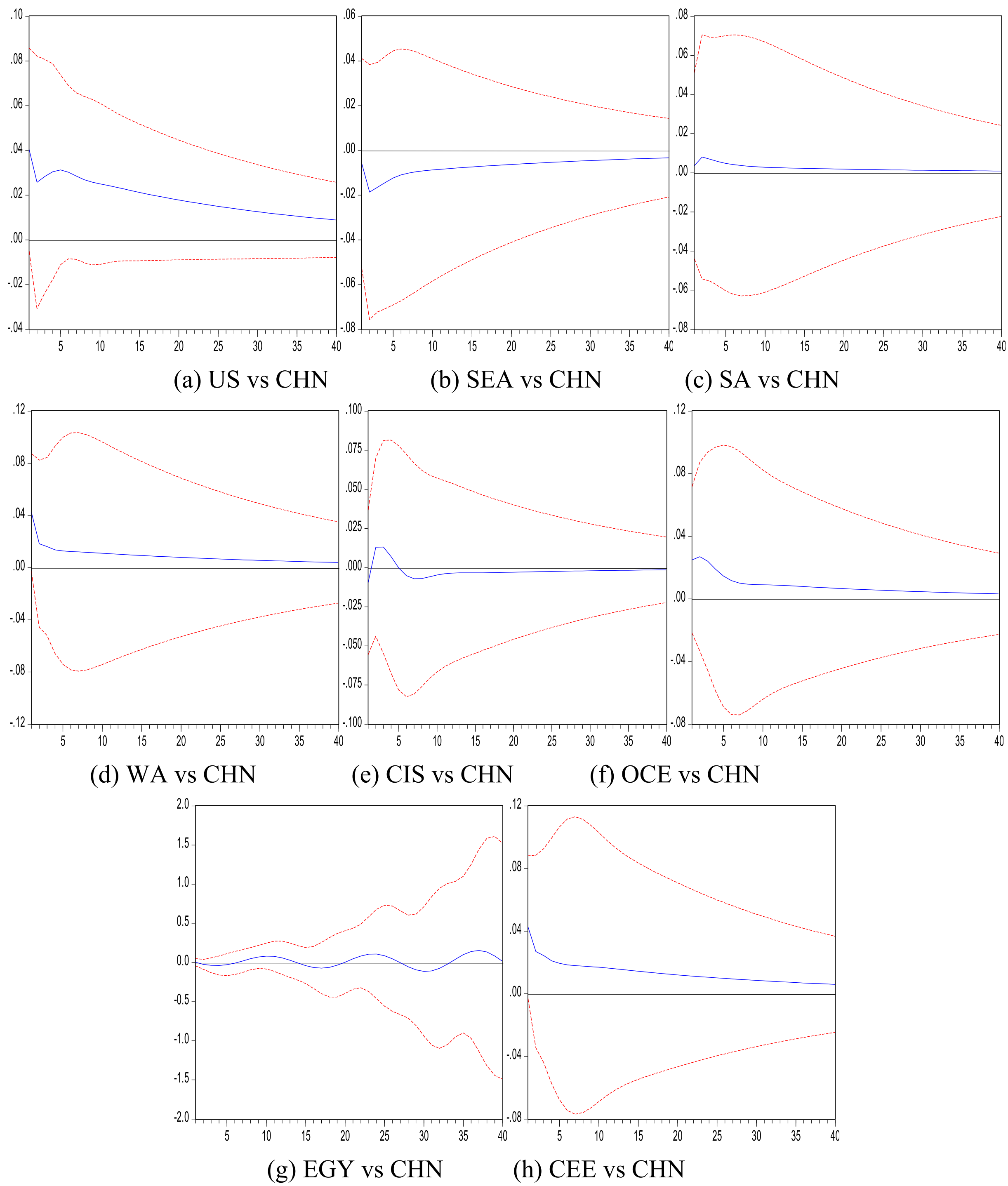

Fig. 2. Effect of the shock of economic growth in other regions on China's international tourism revenue.

reaches its maximum in the first period, with 0.041 percent growth in China's international tourism revenue. Under the shock from SA and OCE, the spillover effect reaches its maximum in the second period at growth rates of 0.008 percent and 0.027 percent, respectively. Therefore, in the short term, economic growth in the US, SA, and OCE will significantly promote the growth of international tourism revenue in China. These markets can be considered priorities for China's inbound policy.

In response to a shock in economic growth in the WA and CEE regions, international tourism revenue in China shows a downward trend of positive spillover effects (Fig. 2d and h). In these instances, the responsiveness reaches the maximum in the first period at rates of 0.027 percent and 0.043 percent, respectively. These countries can serve as potential contributors to the growth of China's tourism industry if they maintain their economic growth.

The spillover effects induced by economic growth in the EGY and CIS regions are similar (Fig. 2e and g). The spillover effect fluctuates between positive and negative values, with convergence to zero. In this case, the impact of economic growth is not significant. Therefore, China's tourism industry should not have much expectation of inbound tourism flows from these countries unless structural changes are achieved.

Effect of the shock of economic growth in SEA on China's tourism revenue is different from that of the other regions in that it has a negative spillover effect. The intensity of the spillover effect gradually decreases with time (Fig. 2b). This shows that economic growth in the SEA region, in the short term, has a certain negative effect on China's international tourism revenue. The substitution effect may play an important role here, as SEA tourists may stick to alternative destinations to China. However, in the long run, the impact is relatively stable. This indicates that there is a need to improve the attractiveness of the Chinese tourism industry in the SEA region (Qin & Liu, 2010).

The impulse response functions allow analysis of the nexus of economic growth and international tourism revenue in China and the Belt and Road Initiative countries. Figs. 1 and 2 show that economic growth in different regions will have slightly different spillover effects on international tourism revenue in the short term, with certain differences in the extent, direction, and trend of spillovers. The positive impact of China's economic growth on the international tourism revenue of countries of the Belt and Road Initiative is higher than the reverse effect on China's tourism sector. This shows that China's economic growth continues to drive economic growth along the Belt and Road Initiative countries, as evidenced by increasing international tourism revenues in that area. In general, China and the whole Belt and Road Initiative may achieve mutual growth in respect of the tourism sector.

4.3. Generalized variance decomposition

The impulse response analysis is based on the perspective of the absolute effect (i.e. response is evaluated in an isolated manner for each pair of countries). In order to gain more insights into the contribution of economic growth in China and other regions to international tourism revenue, it is necessary to use the variance decomposition method. This allows measurement of the contribution to variance in relative terms.

Similar to the idea of impulse response analysis, with either China or the other regions treated as the sources of shock, the contribution of economic growth to international tourism revenues is further analyzed. Given the regional heterogeneity, this paper uses 40 periods for the forecast with a step size of five periods to measure the contribution of economic growth to international tourism revenue and define the spillover effects.

4.3.1. China's economic growth contribution to international tourism income in other regions

Table 8 summarizes the results for the effects of China's economic growth on variance in international tourism revenues in the other regions during different forecast periods. In the initial period, China's economic growth explains 4.31 percent on average of the variance of international tourism revenue in each region. China's economic growth makes a high contribution to the variance of international tourism income variables in WA, CEE, and CIS (6.84%, 6.32%, 6.12%, respectively). In contrast, the proportion of variance explained in SA region is the lowest (1.11%).

The results of the model suggest that the share of variance of international tourism revenue in South Asia explained by economic growth in China reaches a maximum value of 2.44 percent in the ten-year forecast horizon. For the WA region, the proportion of the explained variance shows an inverse U-shaped function which reaches its maximum in the fifth period. In contrast, in the four regions of CIS, OCE, EGY, and CEE, the proportion of explained variance increases with the forecast horizon. For the SEA region, the proportion of explained variance grows faster in the early period and stabilizes later on, with a maximum value of 7.22 percent in the 30th period.

4.3.2. Contribution of economic growth in other regions to international tourism revenue in China

The share of variance of China's foreign tourism revenue explained by economic growth in the other regions is presented in Table 9. In the initial period, the economic growth of the CEE, WA, and US regions exhibits high explanatory power for China's international tourism revenue, with explained variance of 15.53 percent, 15.43 percent, and 14.07 percent, respectively. The economic growth in the SA region can

Table 8
The explained proportion of international tourism revenue variance in other regions (%).

Affected area	Forecast period (years)								
	1	5	10	15	20	25	30	35	40
USA	1.93	1.78	2.44	2.27	2.12	2.03	1.99	1.97	1.90
SEA	3.51	6.19	7.09	7.20	7.21	7.21	7.22	7.22	7.22
SA	1.11	1.23	1.98	1.84	1.61	1.50	1.48	1.49	1.50
WA	6.32	7.58	7.34	7.17	7.08	7.04	7.03	7.02	7.02
CIS	6.12	8.74	8.91	9.01	9.07	9.12	9.16	9.19	9.21
OCE	4.06	3.58	4.18	4.48	4.67	4.80	4.90	4.97	5.02
EGY	4.58	5.80	6.04	6.03	6.04	6.10	6.18	6.23	6.26
CEE	6.84	8.34	8.75	8.94	9.06	9.14	9.20	9.24	9.27

Note: a shock of economic growth in China is assumed.

Table 9
The explained proportion of international tourism revenue variance in China (%).

Impact source	Forecast period (years)								
	1	5	10	15	20	25	30	35	40
USA	14.07	15.85	17.53	18.10	18.37	18.52	18.62	18.68	18.71
SEA	0.29	2.78	2.53	2.40	2.34	2.31	2.28	2.27	2.26
SA	0.11	0.46	0.36	0.32	0.29	0.28	0.27	0.27	0.27
WA	15.43	7.13	5.38	4.81	4.54	4.39	4.30	4.24	4.20
CIS	0.79	1.31	1.05	0.89	0.82	0.78	0.76	0.74	0.74
OCE	5.32	6.32	4.54	3.99	3.73	3.58	3.49	3.44	3.40
EGY	0.08	1.51	2.98	3.07	3.87	4.87	5.31	5.85	6.29
CEE	15.53	10.18	8.57	8.15	7.95	7.83	7.76	7.72	7.69

Note: a shock of economic growth in other regions is assumed.

Table 10
Importance of the international tourism sector in Belt and Road Initiative countries (average values for 1995–2017).

Country	International tourism revenue (% of total exports)	International tourism expenditure (% of total imports)	Trend (revenue)	Trend (expenditure)
USA	**10.1**	**5.5**	**−0.1**	**−0.1**
China	**4.7**	**6.6**	**−0.4**	**0.1**
Southeast Asia (SEA)				
Singapore	3.0	4.2	0.0	0.1
Thailand	12.8	4.3	0.1	−0.1
Vietnam	5.4	1.9	−0.2	0.0
Cambodia	21.9	3.0	0.8	0.1
Malaysia	7.4	4.4	0.2	0.2
Philippines	7.6	7.1	0.1	0.4
West Asia (WA)				
Jordan	30.6	7.8	0.5	−0.3
Bahrain	11.8	7.8	−0.1	0.1
Israel	7.8	7.4	−0.2	0.0
Turkey	15.9	2.6	0.1	0.0
Kuwait	1.4	22.5	−0.1	0.1
Saudi Arabia	3.4	10.1	0.2	−0.2
South Asia (SA)				
India	5.2	3.5	−0.1	0.0
Pakistan	4.4	4.9	−0.1	0.0
Bangladesh	0.6	3.0	0.0	−0.1
Sri Lanka	11.5	6.1	0.8	0.2
Egypt	**22.7**	**5.7**	**−0.5**	**−0.1**
Oceania (OCE)				
Australia	13.7	10.9	−0.1	0.1
New Zealand	16.4	7.6	0.2	0.0
Commonwealth of Independent States (CIS)				
Russia	4.0	11.5	−0.1	−0.1
Ukraine	5.2	5.7	0.1	0.4
Central and Eastern Europe (CEE)				
Poland	9.6	6.3	−0.8	−0.4
Czech Republic	8.0	4.4	−0.5	−0.2
Lithuania	6.5	4.3	−0.3	−0.1
Macedonia	5.6	2.8	0.0	0.0
Hungary	9.0	4.1	−0.5	−0.2
Bulgaria	15.2	7.2	−0.2	−0.3
Romania	3.9	3.4	−0.1	−0.1
Latvia	6.1	6.6	−0.1	−0.3
Croatia	38.7	4.7	0.5	−0.1
Armenia	20.5	11.7	1.3	1.0
Georgia	21.1	8.2	0.8	−0.4
Slovenia	9.2	5.0	−0.2	−0.1
Albania	52.9	19.3	0.4	1.1
Average	*12.2*	*6.7*	*0.0*	*0.0*

Note: Stochastic trends are given (in percentage points per year); boldfaced labels indicate the regions considered in Table 4.

only explain 1.11 percent of the variance of China's international tourism revenue.

Compared with the short term, the long-term contribution of economic growth in the WA, CIS, OCE, and CEE regions to China's international tourism revenue declined, while the rest of the region showed an increase, including a significant rise in the long-term contributions of Southeast Asia and Africa. The results in Table 9 suggest that the contribution of economic growth in the US to China's international tourism revenue stands at a relatively high level and follows an upward trend. Economic growth in the EGY plays a long-term role in promoting growth in China's international tourism revenue, and stabilizes upon reaching a higher level. Different from the trends in the aforementioned regions, the contribution of economic growth in SEA, SA, the CIS, and OCE follows an inverse U-shaped function, with the maximum point in the fifth period. The contribution of economic growth in West Asia, Central Europe, and Eastern Europe declines with time, yet stabilizes at a moderately high level in the long run. Economic growth in the SA and CIS regions contributes little to China's international tourism revenue.

Combining the results in Tables 8 and 9 indicates that, in the long run, the region where international tourism revenues benefit to the highest extent from economic growth in China is the CEE. The US is the region that contributes the most to China's international tourism revenue. These findings can substantiate China's tourism development policy. Similarly, the Belt and Road Initiative countries can follow the findings of this study to realize the impacts of economic growth in China and other regions on their tourism revenue.

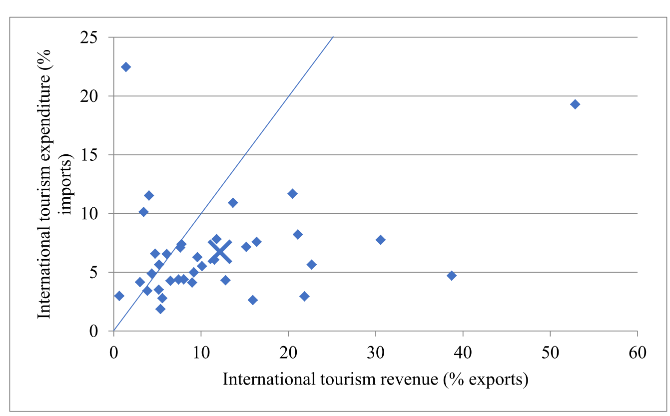

Fig. 3. Tourism revenue and expenditure across the Belt and Road Initiative countries (average values for 1995–2017).
Note: X indicates the sample mean; the diagonal line shows equal importance of revenues and expenditures.

4.4. Tourism sector within economies of Belt and Road Initiative countries

Use of the GVAR model allowed identification of spillover effects in the tourism industry in Belt and Road Initiative countries. However, it is important to ascertain the role of this sector within the economy. A particularly serious issue is the resilience of the economy. Thus, even though certain important spillover channels leading to economic growth within certain countries and country groups are identified, one may be concerned about the overall specialization of the economy. Indeed, economically underdeveloped countries may rely highly on tourism development, which may, in turn, undermine their sustainability. For instance, the eruption of a contagious disease may render a steep decline in international tourism flows and revenues (Gössling et al., 2020). In order to address this issue, this sub-section further combines the results of the GVAR modeling with the statistical data.

The importance of the tourism sector within the overall economy is represented by the two indicators provided by the World Bank (2020), namely tourism receipts in percent of the exports and tourism expenditure in percent of the total imports (the data for 1995–2017 are used). This shows the relative importance of the industry as well as the direction of the sector's development. Due to availability of data, this research focuses on the international tourism sector as a whole. The average values for the period covered are presented in Table 10.

The importance of the inbound tourism sector in China is declining, whereas that of outbound tourism is increasing, as shown by the trend coefficients associated with both tourism revenue and expenditure. In China, the relative importance of outbound tourism is higher (tourism expenditure comprises 6.6 percent of imports on average) compared to the inbound tourism (4.7 percent of exports on average). For the sake of comparison, one may consider the US, where inbound tourism is relatively more important in the sense of the trade structure and accounts for 10.1 percent of exports (with negative trend coefficients indicating the declining importance of inbound and outbound tourism there). The sample averages for tourism revenue and expenditure are 12.2 percent of total exports and 6.7 percent of total imports. This suggests that the Belt and Road Initiative countries rely on inbound tourism rather than outbound tourism. Indeed, this can be attributed to the fact that most of the countries considered are developing economies. The distributions of the average relative tourism revenue and expenditure indicators are given by relating them in the two-dimensional space (Fig. 3).

The sample points mostly fall below the diagonal line, as suggested by the average values in Table 10. The three points in the upper left region of Fig. 3 represent oil-rich countries (Kuwait, Saudi Arabia, and Russia). International tourism revenue there comprises just a meagre share of exports, yet tourism expenditures constitute an important share of total imports (above 10 percent). Such countries may be resistant to turmoil in the international tourism markets. In contrast, the lower right region of Fig. 3 contains observations with relatively high inbound tourism importance and low outbound tourism flows. These include Jordan, Croatia, and Albania, where tourism revenue exceeds 30 percent of the total exports (along with positive trend coefficients). Therefore, spillovers of tourism revenue may further push certain countries in the Belt and Road Initiative toward loss of resilience if other sectors of the economy are not further developed.

The results of the GVAR modeling and the share of the tourism in the overall economy are related in Fig. 4. The impacts of economic growth in China (as estimated by the GVAR model) are related to the share of tourism revenue in total exports (Fig. 4a). Therefore, Egypt shows the highest relative importance of tourism (compared to the group average) and a medium-level contribution of China's economic growth. The OCE region also shows a relatively high share of tourism revenue in total exports and a medium-level impact of China's economic growth on the tourism revenue there. Therefore, the latter two destinations can be seen as prospective options for China's tourists. The development of travel packages and promotion of these destinations in general would be beneficial in increasing the tourist flow from China.

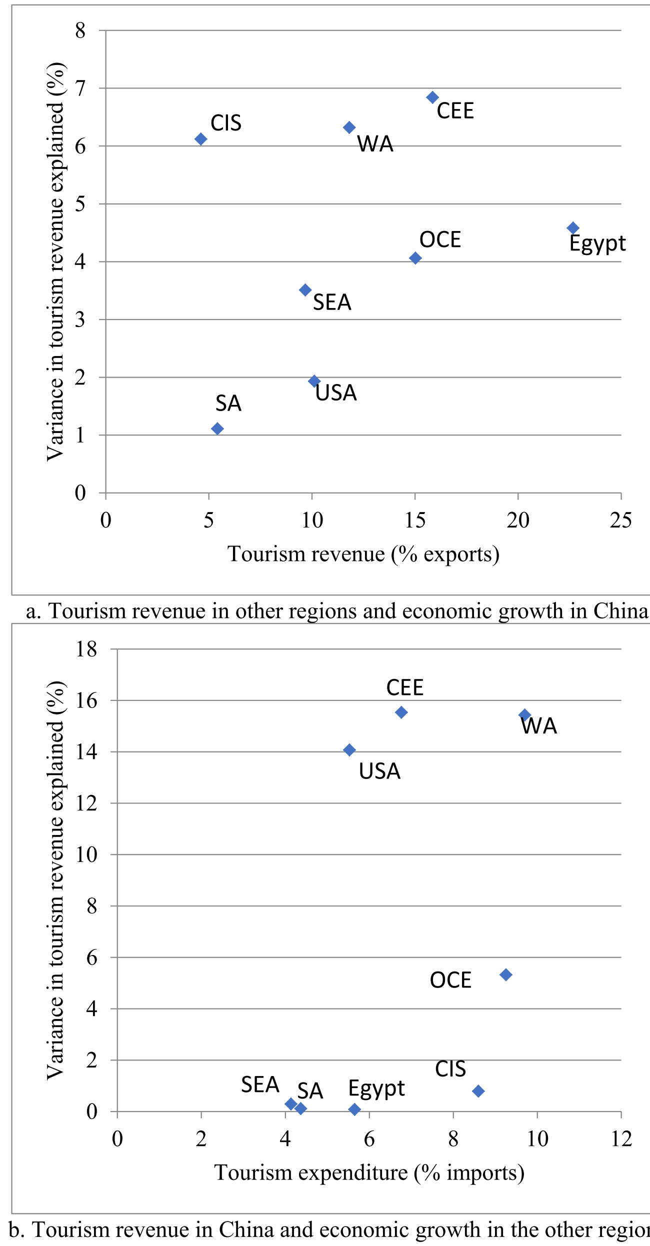

Fig. 4. Importance of the tourism sector and tourism revenue spillover in the regions under analysis.
Note: Variance explained is based on the one-year forecasting period (see Tables 8 and 9).

The economic growth of the other regions is related to China's tourism revenue in Fig. 4b. Obviously, the two clusters of the regions emerge based on the two criteria. Firstly, CEE, the USA, and WA are relatively important in shaping China's tourism revenue (as suggested by relatively high shares of variance explained). CEE, the USA, and WA also show average tourism expenditure exceeding 5 percent of the total imports. The government of China should consider the economic situation in these countries when assessing perspectives for the development of China's tourism sector. Secondly, there is a cluster of regions with low impact on China's tourism revenue and shares of tourism expenditure ranging from 4–10 percent of the total imports. China could seek to attract more tourists from these regions (SEA, SA, Egypt, CIS) by improving the institutional environment (e.g. visas) and encouraging tourism companies to offer more attractive tour packages.

5. Conclusions and recommendations

5.1. Conclusions

Applying the GVAR model, this paper focused on the 36 countries in the Belt and Road Initiative (along with the United States) to analyze the spillover effects of economic growth on international tourism revenue. Both China and the other regions were treated as experiencing economic growth to check its impact on the international tourism revenue there. The results suggest that there are differences in the effects of economic growth on international tourism revenue among countries in the Belt and Road Initiative. However, these variables are positively correlated in the Belt and Road Initiative countries. The cases of Egypt and South Asia are different from the other regions considered, as, possibly due to the low economic development level, their contribution to the tourism receipts in China remains negligible.

China's economic growth contributes to the international tourism revenue of countries in the Belt and Road Initiative in the short run. The impulse response and variance decomposition analysis confirmed that China's economic growth has a positive spillover effect on international tourism revenues in other regions. West Asia, Central and Eastern Europe, Russia, and Ukraine are particularly affected in this regard.

Economic growth in the US, Central and Eastern Europe, West Asia, and Oceania shows a positive spillover effect on China's international tourism revenue. This confirms the positive effects of the economic growth of Belt and Road Initiative countries on the development of China's tourism industry. However, regions with relatively low levels of economic development do not show an increase in tourism expenditure due to economic growth comparable to that observed for the case of economic growth in China.

The present paper considers international tourism revenue. Therefore, the whole tourism sector is analyzed at the aggregate level. Such an approach may mask any intra-sectoral differences existing among, for example, different quality segments. Further research should attempt to identify the spillover effects at the sub-sector level.

5.2. Recommendations

Continuing economic development across the world has increased the demand for tourism services. In addition, countries' interdependence has increased in terms of international tourism flows. There is a dynamic complementary relationship between economic growth and the development of the international tourism industry for China and countries in the Belt and Road Initiative.

The results indicate that China should deepen its policy of opening up to the rest of the world. In particular, strengthening cooperation in the tourism industry with countries in the Belt and Road Initiative would be beneficial for all the parties. The Chinese government needs to promote the international tourism service trade further. This can be facilitated by simplifying the approval process for inbound tourism and the use of information technologies to improve the managerial processes. As regards China, local governments should cooperate with the central government when promoting the cultural history of the Silk Road as a major attraction. The results of the research confirmed that tourism receipts can be improved both in China and in the other countries in the Belt and Road Initiative due to the economic growth there, yet different patterns of interrelationships need to be taken into account. Therefore, China's tourism enterprises should create a personalized 'national brand' for each country in the Belt and Road Initiative, and continuously enhance the attractiveness and international competitiveness of the tourism industry. Reciprocal measures should be taken by the other countries in order to reap the benefits of cooperation in the framework of the initiative.

The countries in the Belt and Road Initiative need to adjust their international tourism development strategies dynamically to reduce the impact of adverse shocks caused by economic fluctuations in the other countries. Economic restructuring due to policy changes and situations in international markets that China is currently undergoing will lead to a slowdown in economic growth for a certain period of time. Without additional measures, this may reduce tourism revenue in the Belt and Road Initiative countries. Also, the spillover effect may render a decline in the growth of China's international tourism sector. Thus, the Belt and Road Initiative may contribute to the development of the tourism sector directly and indirectly. The study showed that certain countries (e.g. Jordan, Croatia, and Albania) are engaged in the tourism industry to the extent where the share of revenue generated in the sector becomes excessive in comparison to other countries. In such countries, the development of the tourism industry needs to be cautious and take economic interdependencies into account when shifting labor force to the tourism sector. As regards China's tourism sector, Asian countries, Russia and Ukraine, and Egypt should receive more attention and support to increase the international tourism revenue originating from these countries. Development of mutual tourism policies that would ease the traveling would directly contribute to growth in tourism flows and revenue across the Belt and Road Initiative countries.

Funding

This work was funded by the projects of the National Social Science Fund of China (No. 16ZDA053, No. 16BTJ026).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Annex A. Preliminaries for the GVAR model

The construction of the GVAR model consists of two steps. The first step is to construct the exogenous vector autoregressive model (VAR*) for each country or region. The second step is to combine the VAR* into a global vector autoregressive model (GVAR) through a capital flow matrix or a trade weight matrix. When constructing the GVAR model, it is necessary to consider the three types of relationship among the objects analyzed. Firstly, the domestic variables of each country or region will be affected by the contemporaneous and lagged foreign variables. Secondly, the domestic variables of each country or region will be affected by global variables. Thirdly, a country or region will be affected by the contemporaneous impact of other countries or regions.

To illustrate the GVAR model, one can assume that it consists of $n+1$ countries, and both domestic and foreign variables are included into the model with a lag of order 1. For easier exposition, one can also assume the lag of order 1 is applied. However, one can generalize the model by introducing lags of order K and further extending the associated vectors of variables and coefficients accordingly. Therefore, the VARX*(1,1) model for each country is presented as:

$$\mathbf{X}_{it} = \boldsymbol{\beta}_{i0} + \boldsymbol{\beta}_{i1}t + \boldsymbol{\Lambda}_i\mathbf{X}_{i,t-1} + \boldsymbol{\Psi}_{i0}\mathbf{X}^*_{it} + \boldsymbol{\Psi}_{i1}\mathbf{X}^*_{i,t-1} + \boldsymbol{\theta}_{it}, t = 1, 2, \cdots, T, i = 0, 1, \cdots, n, \tag{1}$$

where i keeps track of countries (or regions) and t indicates the time period; $\boldsymbol{\beta}_{i0}$ represents the intercepts for country i, while $\boldsymbol{\beta}_{i1}$ is the vector of the linear trend coefficients for country i. Without loss of generality, the reference country is denoted by $i = 0$. $\mathbf{X}_{it}$ represents the vector of domestic variables with weak exogeneity of the i-th country during the t-th period; $\mathbf{X}^*_{it}$ is the vector of foreign variables. The orders of vectors $\mathbf{X}_{it}$ and $\mathbf{X}^*_{it}$ are k and k^*_i, respectively. $\boldsymbol{\Lambda}_i$ represents the k_i-th order square matrix of lag coefficients. Both $\boldsymbol{\Psi}_{i0}$ and $\boldsymbol{\Psi}_{i1}$ are the $k_i \times k^*_i$ coefficient matrices, with $\boldsymbol{\Psi}_{i0}$ representing the influence of the foreign variables of the i-th country during the period t, and $\boldsymbol{\Psi}_{i1}$ represents the influence of the foreign variables of the i-th country during period $t-1$. $\boldsymbol{\theta}_{it}$ is a $k_i \times 1$ vector of country-specific error which is assumed to be serially uncorrelated. For any country i, $\boldsymbol{\theta}_{it}\tilde{\ }IID(\mathbf{0}, \boldsymbol{\Sigma}_{ii})$, the mean of variable $\boldsymbol{\theta}_{it}$ is $\mathbf{0}$ (i is fixed) and the variance is$\boldsymbol{\Sigma}_{ii}$, which does not change with time.

After the reference country is identified, all the domestic and foreign variables in the model for country i can be arranged into a$(k_i + k^*_i) \times 1$ vector $\mathbf{Q}_i$. Correspondingly, for time period t,$\mathbf{Q}_{it} = \begin{bmatrix}\mathbf{X}_{it} \\ \mathbf{X}^*_{it}\end{bmatrix}$. Then, Equation (1) becomes:

$$\mathbf{A}_i\mathbf{Q}_{it} = \boldsymbol{\beta}_{i0} + \boldsymbol{\beta}_{i1}t + \mathbf{B}_i\mathbf{Q}_{i,t-1} + \boldsymbol{\theta}_{it}, \tag{2}$$

where $\mathbf{A}_i = (\mathbf{I}_{k_i}, -\boldsymbol{\Psi}_{i0})$ and $\mathbf{B}_i = (\boldsymbol{\Lambda}_i, \boldsymbol{\Psi}_{i1})$. Both $\mathbf{A}_i$ and $\mathbf{B}_i$ are $k_i \times (k_i + k^*_i)$ coefficient matrices, and $\mathbf{A}_i$ is a non-singular matrix with $k_i = rank(\mathbf{A}_i)$. $\mathbf{I}_{k_i}$ is the identity matrix of order k_i.

If the VARX* models of each country are synthesized into a GVAR model, a $k \times 1$ endogenous variable vector $\mathbf{X}_t$ should be constructed. Note that $k = \sum_{i=0}^{n} k_i$ represents the number of all endogenous variables in the GVAR model. Assuming that there is a known weight matrix$\mathbf{W}_i$, the variable vector$\mathbf{Q}_{it}$of the i-th country can be expressed in terms of $\mathbf{X}_t$. Then, the following relationship exists:

$$\mathbf{Q}_{it} = \mathbf{W}_i\mathbf{X}_t. \tag{3}$$

Indeed, $\mathbf{W}_i$is considered to be a matrix connecting the GVAR model with the VARX* model of the i-th country—i.e. a weight matrix. Substituting Equation (3) into Equation (2), one can get:

$$\mathbf{A}_i\mathbf{W}_i\mathbf{X}_t = \boldsymbol{\beta}_{i0} + \boldsymbol{\beta}_{i1}t + \mathbf{B}_i\mathbf{W}_i\mathbf{X}_{t-1} + \boldsymbol{\theta}_{it}. \tag{4}$$

Since $\mathbf{A}_i\mathbf{W}_i$and a$\mathbf{B}_i\mathbf{W}_i$re both matrices of order, $(k_i \times k)$let us denote an$\mathbf{C}_i = \mathbf{A}_i\mathbf{W}_i$d. I$\mathbf{D}_i = \mathbf{B}_i\mathbf{W}_i$n this case, Equation (4) can be written in the form of

$$\mathbf{C}\mathbf{X}_t = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 t + \mathbf{D}\mathbf{X}_{t-1} + \boldsymbol{\theta}_t, \tag{5}$$

where the following vectors are used:

$$\boldsymbol{\beta}_0 = \begin{bmatrix}\boldsymbol{\beta}_{00} \\ \boldsymbol{\beta}_{10} \\ \vdots \\ \boldsymbol{\beta}_{n0}\end{bmatrix}, \boldsymbol{\beta}_1 = \begin{bmatrix}\boldsymbol{\beta}_{01} \\ \boldsymbol{\beta}_{11} \\ \vdots \\ \boldsymbol{\beta}_{n1}\end{bmatrix}, \boldsymbol{\theta}_t = \begin{bmatrix}\boldsymbol{\theta}_{0t} \\ \boldsymbol{\theta}_{1t} \\ \vdots \\ \boldsymbol{\theta}_{nt}\end{bmatrix}, \mathbf{C} = \begin{bmatrix}\mathbf{A}_0\mathbf{W}_0 \\ \mathbf{A}_1\mathbf{W}_1 \\ \vdots \\ \mathbf{A}_n\mathbf{W}_n\end{bmatrix}, \mathbf{D} = \begin{bmatrix}\mathbf{B}_0\mathbf{W}_0 \\ \mathbf{B}_1\mathbf{W}_1 \\ \vdots \\ \mathbf{B}_n\mathbf{W}_n\end{bmatrix}.$$

As $\mathbf{C}$ is a non-singular matrix of order$k \times k$, Equation (5) can be further simplified. Thus, the GVAR model can be expressed as follows:

$$\mathbf{X}_t = \mathbf{C}^{-1}\boldsymbol{\beta}_0 + \mathbf{C}^{-1}\boldsymbol{\beta}_1 t + \mathbf{C}^{-1}\mathbf{D}\mathbf{X}_{t-1} + \mathbf{C}^{-1}\boldsymbol{\theta}_t. \tag{6}$$

Considering that country-specific VARX* models are also affected by global common variables such as oil prices, the global variables should be introduced in the GVAR model as a $s \times 1$ vector $\boldsymbol{\lambda}_t$. In this case, the extended VARX* model is obtained based on Equation (1):

$$\mathbf{X}_{it} = \boldsymbol{\beta}_{i0} + \boldsymbol{\beta}_{i1}t + \boldsymbol{\Lambda}_i\mathbf{X}_{i,t-1} + \boldsymbol{\Psi}_{i0}\mathbf{X}^*_{it} + \boldsymbol{\Psi}_{i1}\mathbf{X}^*_{i,t-1} + \mathbf{Z}_{i0}\boldsymbol{\lambda}_t + \mathbf{Z}_{i1}\boldsymbol{\lambda}_{t-1} + \boldsymbol{\theta}_{it}. \tag{7}$$

Then, the corresponding extended GVAR model can be expressed as:

$$\mathbf{C}\mathbf{X}_t = \boldsymbol{\beta}_0 + \boldsymbol{\beta}_1 t + \mathbf{D}\mathbf{X}_{t-1} + \mathbf{Z}_0\boldsymbol{\lambda}_t + \mathbf{Z}_1\boldsymbol{\lambda}_{t-1} + \boldsymbol{\theta}_t, \tag{8}$$

where $\mathbf{Z}_0 = (\mathbf{Z}_{00}, \mathbf{Z}_{10}, \cdots, \mathbf{Z}_{n0})'$ and $\mathbf{Z}_1 = (\mathbf{Z}_{01}, \mathbf{Z}_{11}, \cdots, \mathbf{Z}_{n1})'$ represent the coefficient matrices associated with the current and preceding time periods, respectively. Equation (8) can be further simplified as follows:

$$\mathbf{X}_t = \mathbf{C}^{-1}\boldsymbol{\beta}_0 + \mathbf{C}^{-1}\boldsymbol{\beta}_1 t + \mathbf{C}^{-1}\mathbf{D}\mathbf{X}_{t-1} + \mathbf{C}^{-1}\mathbf{Z}_0\boldsymbol{\lambda}_t + \mathbf{C}^{-1}\mathbf{Z}_1\boldsymbol{\lambda}_{t-1} + \mathbf{C}^{-1}\boldsymbol{\theta}_t. \tag{9}$$

Estimation of the parameters of the GVAR model relies on the idea of sub-system estimation. The VARX* models of each country are estimated independently. The weight matrix in GVAR models is often calculated directly from trade data or capital flow data. Garratt et al. (2006) have demonstrated the feasibility of this method.

Annex B. Assumptions and results of the GVAR model

Table B1
The trade matrix between the countries in the sample (%).

	USA	CHN	THA	VIE	SIN	CAM	PHI	MAS	JOR	Bah	ISR	TUR	KUW	KSA	IND	PAK	BAN	SRI
USA	0	34.13	3.01	5.04	4.12	2.07	3.01	5.20	2.00	1.03	3.02	2.11	1.03	6.00	3.02	1.10	2.03	3.18
CHN	14.78	0	3.95	2.32	0.89	2.59	3.53	5.20	2.94	3.69	3.02	3.50	01.94	2.75	3.94	1.13	2.00	3.97
THA	9.67	19.02	0	2.84	0.81	3.59	1.63	2.00	2.00	2.84	0.85	3.71	5.94	4.00	5.00	3.66	6.81	2.57
VIE	5.63	34.87	4.00	0	3.51	4.68	4.92	4.00	4.52	6.03	6.67	3.54	2.61	1.60	3.00	3.81	1.73	0.65
SIN	15.73	11.00	5.00	6.90	0	4.00	9.73	3.92	5.50	3.67	10.51	8.93	3.54	5.50	4.51	6.00	3.84	6.73
CAM	16.88	13.02	6.67	6.00	4.39	0	4.81	4.37	4.18	4.02	5.13	7.89	2.71	3.04	4.17	3.51	4.73	5.06
PHI	18.56	13.01	2.87	3.04	4.28	4.00	0	4.38	3.03	2.19	4.43	3.04	2.73	3.76	1.66	0.91	3.00	2.00
MAS	13.89	17.68	4.43	2.78	3.67	2.00	2.04	0	5.06	3.82	9.54	1.00	4.04	4.62	2.22	3.95	2.91	4.11
JOR	7.81	14.01	03.80	2.98	4.38	3.89	2.67	2.34	0	4.72	3.00	5.05	1.80	2.00	1.74	2.51	0.74	3.19
Bah	8.97	16.93	5.74	3.80	2.76	2.46	9.00	4.31	5.28	0	2.61	10.07	4.29	3.10	3.38	5.17	4.93	3.82
ISR	12.74	23.85	10.53	3.62	3.39	6.16	3.75	3.07	4.00	3.95	0	5.28	9.71	3.89	5.28	3.96	10.01	7.73
TUR	10.83	18.92	4.57	5.03	2.91	0.85	3.38	3.62	4.36	6.28	3.81	0	4.29	4.15	5.00	3.07	6.00	5.07
KUW	12.01	20.54	2.78	2.27	3.29	1.01	2.06	2.74	4.96	5.68	5.42	2.19	0	0.88	3.10	3.47	1.78	5.38
KSA	13.87	23.00	1.98	3.69	4.47	4.00	4.82	3.85	2.99	6.73	3.38	2.85	3.45	0	3.62	3.96	4.42	10.06
IND	10.01	20.56	3.89	2.14	2.74	3.83	2.17	3.18	8.63	2.28	2.19	1.00	2.17	1.73	0	1.00	3.72	2.95
PAK	8.96	21.57	6.00	5.58	4.30	5.47	3.29	1.76	1.29	2.03	1.38	2.05	3.17	1.04	2.00	0	4.95	2.75
BAN	3.96	22.65	7.84	4.17	5.00	3.58	5.04	4.09	3.78	5.46	5.38	2.42	2.17	4.09	3.38	4.17	0	4.28
SRI	2.66	15.85	6.63	4.19	5.38	3.29	3.20	3.61	1.19	2.30	2.37	2.45	1.47	2.08	3.39	4.61	5.00	0
EGY	7.86	10.83	4.49	2.17	3.95	2.27	4.35	1.18	4.63	2.99	3.14	2.78	5.00	4.29	3.17	2.89	3.67	2.85
AUS	16.02	21.58	2.96	4.13	6.66	4.00	4.63	5.38	3.85	4.19	6.56	4.13	4.39	2.18	2.39	3.56	7.62	4.00
NZL	12.93	17.69	4.18	4.29	3.73	2.09	2.84	4.35	8.10	9.83	6.29	3.63	5.07	6.00	2.54	11.51	3.65	3.18
RUS	7.00	18.84	6.37	4.78	5.16	4.17	4.38	5.37	3.18	8.32	4.07	3.66	4.38	3.18	3.29	6.72	8.64	4.00
UKR	5.96	18.02	2.47	8.52	5.34	3.29	2.18	3.67	2.29	0.53	4.26	3.85	6.16	3.26	3.18	10.22	7.64	3.19
POL	6.65	18.63	3.56	5.24	3.17	1.69	3.18	3.06	7.64	4.29	.3.28	5.00	3.83	6.19	3.28	4.28	2.65	3.14
CZE	5.00	1.88	2.16	3.00	4.02	1.19	2.26	2.54	3.68	3.32	3.00	2.17	6.38	4.01	4.39	3.12	1.47	3.65
LTU	2.78	14.00	1.98	3.16	3.68	2.19	3.14	1.88	4.00	4.01	5.53	3.20	4.14	6.07	1.26	4.00	5.21	2.01
MKD	6.69	16.00	3.38	4.04	5.13	4.37	3.29	1.64	7.56	6.85	4.37	3.88	5.16	8.18	3.08	4.14	2.97	3.68
HUN	5.01	10.85	3.69	3.27	2.96	2.54	5.00	4.13	4.38	3.17	4.38	2.19	3.26	2.28	1.06	2.17	4.30	5.05
BUL	3.97	15.68	4.16	2.39	3.17	4.16	2.99	3.75	3.15	2.48	2.18	5.03	4.96	3.71	5.10	3.30	4.25	3.64
ROM	3.00	14.69	2.45	1.38	4.12	3.38	5.00	5.18	3.29	7.05	4.10	4.00	4.29	5.38	5.16	4.37	5.25	3.26
LAT	7.96	18.38	5.28	1.64	5.28	3.25	4.46	4.01	4.53	6.69	3.61	5.00	4.55	5.28	3.18	5.09	4.28	4.01
CRO	6.00	17.36	3.06	2.97	6.17	4.69	5.28	3.13	3.05	2.98	5.92	5.20	2.75	4.00	3.29	3.28	4.00	0.52
AME	8.68	14.53	5.01	5.29	4.38	2.26	4.19	2.28	3.16	4.18	7.30	6.04	5.52	4.30	4.41	3.35	2.58	4.63
GEO	4.00	16.50	4.58	3.29	4.46	5.08	8.16	5.20	3.18	2.29	6.01	5.63	3.07	4.03	4.91	5.01	3.39	4.00
SLO	7.75	13.58	5.16	3.57	2.84	3.69	4.26	6.01	5.39	3.88	3.32	2.95	4.03	3.17	4.29	3.33	2.64	5.03
ALB	4.10	14.66	4.07	2,30	3.15	4.00	6.17	3.63	3.26	5.02	4.11	2.67	3.18	3.62	5.29	3.54	7.03	4.86

EGY	AUS	NZL	RUS	UKR	POL	CZE	LTU	MKD	HUN	BUL	ROM	LAT	CRO	AME	GEO	SLO	ALB
4.28	2.04	5.11	5.00	6.21	4.09	6.92	5.83	2.06	2.53	3.67	5.02	8.62	2.64	2.00	0.93	1.32	1.00
2.20	1.95	1.97	3.00	3.95	2.01	2.95	3.00	3.03	2.00	1.99	3.01	1.96	1.58	0.83	1.62	2.60	1.28
2.60	3.00	4.00	4.53	6.61	4.03	3.00	3.90	2.74	4.50	6.00	5.55	3.09	3.05	3.00	1.82	3.77	4.55
2.08	3.72	5.00	5.12	5.51	3.64	3.82	6.61	3.59	5.00	6.00	4.01	4.54	5.72	3.80	4.51	4.00	5.67
8.00	2.91	3.55	1.60	3.79	4.98	10.00	8.63	4.00	5.55	4.81	5.01	5.02	4.12	2.94	3.03	2.78	1.52
5.67	10.53	4.83	4.14	5.50	4.18	11.43	6.03	3.51	4.07	2.29	4.110	2.59	3.37	1.19	4.43	5.18	3.51
3.65	2.84	2.04	1.95	3.36	3.10	5.79	3.50	4.01	6.66	12.63	2.00	3.00	2.05	4.27	8.32	2.93	2.01
2.00	1.73	2.17	3.10	6.04	3.09	4.94	5.03	1.21	2.63	2.84	3.00	1.19	1.38	2.74	1.82	2.00	1.00
5.38	1.04	1.94	3.50	3.71	1.06	2.29	6.27	3.97	4.52	4.00	2.70	5.01	5.56	6.00	3.75	2.81	2.96
2.76	3.00	4.06	4.14	6.50	5.00	2.81	3.86	3.19	6.20	6.05	3.82	2.29	2.11	4.20	6.61	5.00	2.91
3.30	3.72	10.55	8.04	6.00	10.38	2.79	4.56	1.93	3.17	1.01	3.29	3.78	4.52	5.00	5.57	3.71	2.89
2.64	1.92	3.72	5.05	3.00	3.89	9.74	2.98	5.12	2.95	1.01	3.32	2.85	2.10	1.73	4.01	4.89	9.03
2.83	4.00	2.03	3.18	3.54	1.05	10.64	3.78	3.91	3.29	3.74	4.29	3.27	5.00	4.47	0.47	3.20	10.03
0.76	3.85	5.47	3.48	4.43	3.38	1.03	4.14	4.96	3.05	3.79	3.11	3.30	2.95	2.17	3.49	2.95	5.73
6.39	3.74	2.19	1.68	2.30	4.19	2.03	4.00	5.38	4.39	5.51	3.06	2.17	3.07	3.39	6.61	3.29	4.51
10.48	8.77	3.45	5.28	4.29	5.39	4.16	2.85	3.19	4.73	4.02	1.67	1.94	1.03	3.75	3.38	2.07	3.19
5.10	4.82	3.07	4.29	5.00	4.02	2.39	2.30	4.16	1.74	0.95	3.47	2.78	6.36	3.19	0.53	0.04	0.28
7.13	5.39	4.38	2.75	9.06	3.89	4.13	3.78	4.28	2.54	4.01	3.20	4.04	7.63	6.27	5.19	3.07	3.38
0	5.18	4.66	3.79	7.04	9.05	4.49	2.43	2.19	1.95	3.07	4.12	1.96	3.76	5.49	3.28	1.56	9.83
5.13	0	2.84	3.12	3.03	4.19	4.28	6.48	5.31	4.82	5.64	3.75	3.61	2.43	2.19	3.67	134	10.36
2.95	4.73	0	4.66	4.10	5.27	1.94	3.18	1.03	5.02	3.65	3.86	4.32	3.13	2.85	4.09	3.19	2.68
3.07	2.98	2.36	0	9.38	3.41	4.69	2.75	1.11	2.76	3.00	4.00	6.61	5.50	5.13	4.19	4.38	3.75
2.98	4.47	4.13	3.65	0	3.72	2.89	2.84	4.00	6.62	5.19	2.13	2.54	3.69	2.54	1.36	2.39	4.63
4.65	6.61	2.03	2.00	4.08	0	3.19	2.19	2.18	3.01	2.76	3.26	4.18	0.52	3.28	2.75	3.07	4.27
8.86	8.03	5.38	2.18	5.17	4.01	0	6.27	5.15	3.01	4.00	3.28	3.19	4.20	6.11	2.05	3.46	5.81
8.46	3.28	2.89	2.87	5.16	3.88	2.85	0	3.19	2.76	2.16	6.13	4.48	5.01	3.48	3.29	4.16	2.06
2.95	4.00	5.16	1.93	4.28	3.95	2.18	6.39	0	9.03	2.19	1.86	3.18	3.92	3.65	2.29	1.38	2.78
3.87	3.75	0.47	2.16	0.53	0.27	1.63	3.19	2.17	0	1.98	3.26	2.11	4.18	3.15	3.04	4.83	3.66
4.29	1.26	5.53	3.04	4.66	3.38	2.19	5.62	1.86	2.76	0	1.65	3.43	3.19	7.26	2.57	4.82	2.39
2.19	3.00	2.18	4.52	5.11	3.38	2.19	3.00	1.85	2.02	3.53	0	3.59	3.38	2.66	5.14	4.16	3.54
3.75	2.63	3.00	4.37	4.02	3.85	3.68	5.53	3.96	2.73	2.65	3.06	0	4.01	5.29	3.54	2.28	1.85
1.99	5.54	3.95	4.07	5.10	4.00	7.38	4.39	1.25	5.07	1.66	2.05	3.16	0	2.18	1.83	3.00	1.11
2.83	6.00	1.85	4.01	3.96	2.69	4.00	4.36	4.04	10.41	4.29	2.08	2.54	5.00	0	3.95	1.92	2.29
2.16	7.28	2.38	4.09	4.16	1.03	4.27	2.26	3.64	4.58	7.51	2.06	3.15	4.40	2.94	0	3.38	2.11
5.28	1.69	1.32	2.75	5.04	2.17	5.58	1.82	3.09	1.63	3.47	3.63	2.64	3.62	5.05	1.93	0	2.48
4.00	3.69	5.21	3.04	4.52	3.81	4.68	3.79	2.90	1.82	4.06	3.23	4.79	2.53	2.06	3.17	1.96	0

Table B2
Results of ADF unit root test in the models of each country.

Country	Variable	gdp	er	imp	exp	itr	poil	*Δgdp*	*Δer*	*Δimp*	*Δexp*	*Δitr*	*Δpoil*
USA	Test Stat.	−2.6473	−3.6352	−4.2378	−4.2667	−1.5235	−4.9722	−5.3282	−3.0753	−3.8622	−4.7562	−4.6752	−4.7832
	p-value	0.2965	0.0286**	0.0022***	0.0374**	0.6016	0.0023***	0.0000***	0.0001***	0.0022***	0.0030***	0.0000***	0.0000***
CHN	Test Stat.	−0.3707	−2.2192	−3.2245	−3.5235	−0.0538	−3.9864	−5.0706	−4.4940	−5.5136	−6.9932	−5.9179	−5.0879
	p-value	0.8976	0.0286**	0.0327**	0.0176**	0.9416	0.0044***	0.0036***	0.0108**	0.0003***	0.0000***	0.0001***	0.0007***
VIE	Test Stat.	0.0671	−3.9864	−7.0365	−4.6654	−2.6764	−3.8965	−3.4827	−4.6534	−3.6632	−3.6322	−4.0732	−4.0232
	p-value	0.6753	0.0044***	0.0000***	0.0283**	0.0866	0.0021***	0.0000***	0.0001***	0.0000***	0.0017***	0.0123**	0.0237**
THA	Test Stat.	−0.3267	−3.8965	−3.0765	−4.0645	−0.7624	−5.6235	−3.6328	−5.8732	−3.0752	−5.2782	−6.2765	−5.6235
	p-value	0.6732	0.0021***	0.0000***	0.0001***	0.4864	0.0326**	0.0000***	0.0021***	0.0000***	0.0001***	0.0031***	0.0326
SIN	Test Stat.	−2.7623	−3.0664	−4.7342	−5.0982	0.0833	−4.7643	−4.0252	−5.6457	−4.7925	−3.7236	−5.2322	−7.2352
	p-value	0.0578	0.0000***	0.0000***	0.0000***	0.0684	0.0000***	0.0000***	0.0032***	0.0000***	0.0002***	0.0001***	0.0000***
CAM	Test Stat.	−0.6763	−3.8745	−5.7845	−5.0273	−0.3267	−3.6742	−3.0627	−3.8748	−4.8322	−5.7236	−6.8652	−3.9763
	p-value	0.0579	0.0003***	0.0000***	0.0000***	0.0674	0.0286**	0.0367**	0.0243**	0.0000***	0.0000***	0.0003***	0.0018***
PHI	Test Stat.	−0.0052	−4.8322	−5.7236	−6.8652	−1.7364	−6.7834	−4.7862	−3.7848	−4.7643	−3.9864	−7.0365	−4.6654
	p-value	0.6322	0.0000***	0.0000***	0.0003***	0.0993	0.0002***	0.0041***	0.0000***	0.0038***	0.0044***	0.0000***	0.0283**
MAS	Test Stat.	−2.7832	−4.7643	−3.9864	−7.0365	−2.7822	−3.0646	−5.3453	−5.7822	−4.7862	−3.8965	−3.0765	−4.0645
	p-value	0.6732	0.0038***	0.0044***	0.0000***	0.0963	0.0000***	0.0003***	0.0000***	0.0000***	0.0021***	0.0000***	0.0001***
JOR	Test Stat.	0.6265	−4.7862	−3.8965	−3.0765	−1.9633	−3.7543**	−4.6269	−4.6545	−3.9754	−4.7635	−6.7834	−5.8724
	p-value	0.0763	0.0000**	0.0021**	0.0000***	0.3733	0.0273**	0.0000***	0.0037***	0.0019***	0.0000***	0.0002***	0.0000***
BRN	Test Stat.	−0.2078	−3.7822	−4.1074	−3.7853	−2.0327	−4.6972	−3.6757	−3.0664	−4.7342	−5.0982	−5.8844	−5.6532
	p-value	0.0572	0.0036***	0.0000***	0.0000***	0.3673	0.0000***	0.0035***	0.0000***	0.0000***	0.000***	0.0286***	0.0023***
ISR	Test Stat.	0.0264	−3.0152	−3.0646	−5.5614	−1.7663	−4.6532	−4.6253	−3.8745	−5.7845	−5.0273	−7.2342	−3.6744
	p-value	0.8376	0.0000***	0.0000***	0.0000***	0.4643	0.0377**	0.0375**	0.0003***	0.0000***	0.0000***	0.0032***	0.0000***
TUR	Test Stat.	−1.7823	−5.0982	−6.6582	−7.5753	−2.067	−4.6532	−4.7852	−3.7674	−3.6154	−3.7822	−4.1074	−3.7853
	p-value	0.2746	0.0067***	0.0000***	0.0000***	0.0583	0.0000***	0.0001***	0.0000***	0.0000***	0.0036***	0.0000***	0.0000***
KUW	Test Stat.	−2.6322	−3.6532	−7.2352	−5.8844	−0.7834	−3.3377	−4.3242	−4.7632	−5.0761	−3.0152	−3.0646	−5.5614
	p-value	0.0753	0.0000***	0.0000***	0.0028***	0.0926	0.0392**	0.0032***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
KSA	Test Stat.	−1.9363	−4.8522	−4.5282	−5.8522	−0.0023	−3.7833	−5.2376	−4.9844	−7.4853	−6.4367	−5.5525	−6.5825
	p-value	0.2478	0.0003***	0.0000***	0.0000***	0.2690	0.0034***	0.0017***	0.0035***	0.0355**	0.0289**	0.0002***	0.0000***
IND	Test Stat.	−1.0363	−3.41269	−4.6522	−4.6632	−2.7864	−3.5342	−3.6538	−4.63247	−5.5633	−3.7987	−3.7854	−3.0844
	p-value	0.3963	0.0000***	0.0035***	0.0026***	0.6397	0.0001***	0.0162**	0.0000***	0.0000***	0.0000***	0.0352**	0.0353**
PAK	Test Stat.	0.0237	−3.7838	−3.0653	−4.5825	−1.7358	−4.8743	−5.6583	−4.9476	−5.5842	−5.6783	−4.0653	−3.8793
	p-value	0.5373	0.0006***	0.0002***	0.0030***	0.3746	0.0000***	0.0009***	0.0032***	0.0000***	0.0000***	0.0000***	0.0021***
BAN	Test Stat.	−0.0634	−5.2322	−4.75822	−3.4127	−2.0467	−3.4126	−3.0465	−3.7838	−3.7564	−6.6582	−7.5753	−4.6785
	p-value	0.0783	0.0033***	0.0110**	0.0000***	0.9363	0.0027***	0.0037***	0.0047***	0.0001***	0.0000***	0.0000***	0.0000***
SRI	Test Stat.	−2.7322	−4.7844	−3.0764	−3.6744	−2.6743	−5.2782	−5.0982	−3.7236	−5.2322	−7.2352	−5.8844	−5.6532
	p-value	0.4673	0.0000***	0.0384**	0.0000***	0.4543	0.0000***	0.0067***	0.0030***	0.0000***	0.0000***	0.0028***	0.0111**
EGY	Test Stat.	1.0233	−3.7896	−4.5233	−3.7896	−1.7434	−3.7894	−3.6532	−3.0653	−4.5825	−4.5282	−5.8522	−3.6573
	p-value	0.8936	0.0039***	0.0027***	0.0039***	0.3267	0.0026***	0.0000***	0.0002***	0.0030***	0.0000***	0.0000***	0.0172**
AUS	Test Stat.	0.0023	−3.7944	−3.0752	−3.7944	−1.6434	−4.6734	−4.8522	−4.75822	−3.4127	−3.4126	3.41269	−4.7654
	p-value	0.9643	0.0000***	0.0000***	0.0000***	0.3244	0.0000***	0.0003***	0.0110**	0.0000***	0.0037***	0.0000***	0.0301***
NZL	Test Stat.	0.0326	−4.7544	−4.8743	−3.0646	−0.6353	−3.6433	−4.6542	−3.0764	−3.6744	−3.7236	−5.2322	−7.2352
	p-value	0.0905	0.0183**	0.0000***	0.0029***	0.5343	0.0000***	0.0000***	0.0384**	0.0000***	0.0000***	0.0033***	0.0020***
RUS	Test Stat.	−1.3764	−3.4127	−3.4126	−5.0273	−0.0046	−4.0765	−5.8732	−3.0752	−5.2782	−6.5825	−4.7844	−4.7874
	p-value	0.3754	0.0001***	0.0027***	0.0378**	0.4764	0.0000***	0.0018***	0.0000***	0.0000***	0.0367**	0.0000***	0.0386**
UKR	Test Stat.	−2.7631	−4.6978	−4.5433	−4.1433	−0.4673	−3.4541	−3.7849	−4.8743	−3.7894	−4.4456	−3.7896	−4.2974
	p-value	0.0635	0.0003***	0.0000***	0.0000***	0.3654	0.0302**	0.0204**	0.0000***	0.0026***	0.0000***	0.0039***	0.0000***
POL	Test Stat.	−3.0002	−4.7843	−4.7856	0.0023	−1.3584	−4.6752	−3.4127	−3.4126	3.41269	−5.8543	−3.7944	−3.8965
	p-value	0.0572	0.0028***	0.0000***	0.0437**	0.4554	0.0078***	0.0001***	0.0027***	0.0000***	0.0044***	0.0000***	0.0030***
CZE	Test Stat.	−1.3267	−5.2322	−7.2352	−5.2322	−2.6454	−4.0134	−4.6978	−4.5433	−3.7838	−6.7934	−4.7544	−4.7635
	p-value	0.2964	0.0300**	0.0000***	0.0033***	0.6744	0.0000***	0.0003***	0.0000***	0.0006***	0.0000***	0.0183**	0.0003***
LTU	Test Stat.	−2.9835	−3.7838	−6.7934	−3.6732	−1.7642	−3.9086	−4.7843	−4.7856	−3.7236	−3.0667	−4.0765	−5.0982
	p-value	0.4723	0.0006***	0.0000***	0.0000***	0.4536	0.0000***	0.0028***	0.0000***	0.0000***	0.0000***	0.0002***	0.0045***
MKD	Test Stat.	0.0032	−3.7236	−3.0667	−4.5282	−2.7848	−3.1853	−5.2322	−7.2352	−3.9765	−3.0152	−3.0646	−5.0273
	p-value	0.3964	0.0000***	0.0000***	0.0000***	0.0577	0.0186**	0.030**	0.0000***	0.0000***	0.0000***	0.0029***	0.0378**
HUN	Test Stat.	−3.4127	−3.4126	3.41269	−3.8613	−3.0001	−3.0916	−3.7443	−3.7843	−4.75822	−4.0755	−3.9086	−3.7822
	p-value	0.2853	0.0037***	0.0000***	0.0283**	0.5037	0.0000***	0.0000***	0.0000***	0.0034***	0.0382	0.0002***	0.0000***
BUL	Test Stat.	−2.4743	−3.7838	−6.7934	−5.0753	−1.5443	−4.5632	−4.6743	−4.7852	−3.1074	−3.8613	−5.0974	−3.0152
	p-value	0.5873	0.0006***	0.0000***	0.0103**	0.3864	0.0201**	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0084***
ROM	Test Stat.	−0.7832	−3.7236	−3.0667	−3.9884	0.7622	−4.9263	−4.6785	−3.2234	−3.7833	−4.0373	−7.5643	−3.2671
	p-value	0.8934	0.0000***	0.0029***	0.0238**	0.6725	0.0391**	0.0000***	0.0001***	0.0000***	0.0000***	0.0000***	0.0261**
LAT	Test Stat.	−2.7667	−3.7843***	−3.9086***	−4.0267**	−0.7647	−4.0773***	−3.6731**	−4.6522	−3.6511***	−3.7847***	−3.9884***	−4.7843***
	p-value	0.7537	0.0000	0.0002	0.0173	0.5675	0.0001	0.0462	0.0372	0.0073	0.0000	0.0001	0.0071
CRO	Test Stat.	−3.0027	−3.0484	−3.7443	−4.7843	−0.3465	−3.3442	−4.6784	−4.8434	−4.0265	−5.8643	−5.6782	−3.6757
	p-value	0.3746	0.0046***	0.0032***	0.0000***	0.0663	0.0361**	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
ARM	Test Stat.	−1.4873	−3.6583	−4.8724	−4.0276	−2.8743	−3.0264	−3.7988	−3.0484	−3.7443	−4.7843	−3.7833	−3.7497
	p-value	0.2074	0.0018***	0.0029***	0.0287**	0.0853	0.0387**	0.0000***	0.0046***	0.0032***	0.0000***	0.0000***	0.0000***
GEO	Test Stat.	−2.4378	−3.0484	−4.4351	−4.8743	−1.5637	−6.7773	−4.4427	−3.7654	−4.8724	−4.6753	−4.6582	−3.7622
	p-value	0.0753	0.0046***	0.0285**	0.0000***	0.0673	0.0261**	0.0000***	0.0002***	0.0028***	0.0005***	0.0000***	0.0000***
SLO	Test Stat.	−1.0464	−3.9884	−3.5541	−3.4126	0.0764	−5.2863	−3.6282	−3.6583	−4.7892	−4.0773	−4.7582	−3.7514
	p-value	0.3052	0.0001***	0.0291**	0.0027***	0.3672	0.0274**	0.0000***	0.0018***	0.0036***	0.0001***	0.0001***	0.0000***
ALB	Test Stat.	−2.8744	−3.2183	−4.7853	−4.5433	−0.1046	−5.0281	−3.6235	−4.8654	−4.8523	−5.7862	−3.6721	−3.8524
	p-value	0.5893	0.0499**	0.0401**	0.0000***	0.3644	0.0423**	0.0000***	0.0000***	0.0017***	0.0362**	0.0282***	0.0000***

Note: 1. the abbreviations refer to country names in accordance with international standards (ISO 3166–1:2006).
2. *** significance at a 1% level; ** significance at a 5% level.

Table B3
Weak exogeneity test for foreign variables in the VARX* model of each country ($\alpha = 0.05$).

Country	F Statistics	Critical Value	Test Statistic						Country	F Statistics	Critical Value	Test Statistic					
			gdps	ers	imps	exps	itrs	poil				gdps	ers	imps	exps	itrs	poil
USA	F(3,134)	2.672	0.653	2.662	1.563	1.364	2.045	1.785	EGY	F(3,134)	2.672	1.632	2.517	2.210	2.334	1.038	1.295
CHN	F(4,133)	2.440	1.545	1.758	1.216	1.159	0.574	1.968	AUS	F(3,134)	2.672	2.543	1.293	0.286	2.054	2.327	1.383
THA	F(2,135)	3.063	2.092	1.073	0.361	0.603	2.538	1.678	NZL	F(2,135)	3.063	0.653	0.953	0.487	1.035	2.056	2.726
VIE	F(3,134)	2.672	1.350	1.673	1.072	0.311	2.087	0.710	RUS	F(3,134)	2.672	1.533	2.068	0.033	2.286	1.937	2.111
SIN	F(2,135)	3.063	0.013	1.063	0.877	1.009	2.543	0.361	UKR	F(4,133)	2.440	2.076	0.156	2.035	2.103	1.624	1.028
CAM	F(3,134)	2.672	0.015	0.035	1.010	1.180	1.654	1.073	POL	F(2,135)	3.063	1.875	0.957	1.835	1.935	2.541	2.193
PHI	F(2,135)	3.063	1.565	0.853	0.961	0.663	2.636	1.216	CZE	F(4,133)	2.440	1.753	1.553	1.339	2.043	1.937	0.285
MAS	F(2,135)	3.063	0.012	1.036	0.036	0.537	0.084	0.957	LTU	F(1,136)	3.063	2.988	2.563	1.034	2.333	1.032	3.062
JOR	F(3,134)	2.672	1.760	1.133	1.533	1.334	0.875	0.412	MKD	F(2,135)	3.063	1.638	3.063	1.745	2.532	1.624	1.103
BRN	F(2,135)	3.063	1.936	0.686	2.063	1.963	1.678	0.077	HUN	F(3,134)	2.672	0.412	2.033	2.475	1.035	1.375	1.001
ISR	F(4,133)	2.440	1.295	1.533	2.053	0.709	0.799	1.382	BUL	F(2,135)	3.063	1.676	1.311	0.051	0.017	0.122	1.120
TUR	F(3,134)	2.672	1.547	0.100	1.375	2.202	2.094	2.073	ROM	F(1,136)	3.063	0.503	2.854	1.836	2.071	0.103	1.215
KUW	F(3,134)	2.672	1.638	2.532	1.038	1.186	1.347	0.285	LAT	F(3,134)	2.672	2.563	2.671	1.553	0.044	0.710	0.081
KSA	F(3,134)	2.672	1.835	1.123	0.853	1.547	1.838	0.700	CRO	F(2,135)	3.063	1.367	2.853	2.083	0.063	0.154	0.095
IND	F(2,135)	3.063	2.963	1.072	0.038	0.412	1.360	0.182	ARM	F(3,134)	2.672	0.958	2.643	1.767	1.564	2.003	2.195
PAK	F(2,135)	3.063	2.065	2.054	0.295	3.028	0.288	0.105	GEO	F(4,133)	2.440	1.053	0.273	0.065	0.942	1.842	1.647
BAN	F(3,134)	2.672	1.533	1.037	1.386	1.865	1.935	0.013	SLO	F(3,134)	2.672	1.938	1.571	0.799	2.735	0.176	2.385
SRI	F(1,136)	3.063	0.933	1.036	1.036	0.236	2.067	0.087	ALB	F(3,134)	2.672	1.285	0.144	1.341	2.210	0.016	2.094

Note: The abbreviations refer to country names in accordance with international standards (ISO 3166–1:2006).

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