運用鄰近預測檢視會議展覽與台灣民間消費之相關

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摘要

本文透過鄰近預測（nowcasting）方法，檢視會議展覽（MICE）對台灣民間消費（service consumption）的影響。運用搜尋趨勢資料庫（Google trends）的大量即時資料，以高頻率的會議展覽資訊鄰近預測出低頻率的台灣民間消費。目的在以豐富的即期資訊提高預測正確性，也欲了解會議展覽對台灣民間消費之影響。本文將搜尋趨勢資料庫的會議展覽關鍵字，架構出會議展覽檢索指標，並強調檢索指標與台灣民間消費之相互影響，欲瞭解何種會議展覽關鍵字與台灣民間消費有最密切相關。實證結果發現 14 大分類中較常被搜尋的 4 個關鍵字，分別為 incentive（獎勵旅遊）、exhibition hall（展覽館）、conference center（會議中心）、city marketing（城市行銷）。22 小分類中較常被搜尋的 4 個關鍵字，分別為 auto show（汽車展）、Taipei exhibition （台北展覽館）、KEC（高雄展覽館）、lantern festival（燈會）。本文結果穩健地指出台灣民間消費顯著受到會議展覽關鍵字的影響，其也顯示台灣會議展覽主要是靠縣市政府推動及民間企業規劃進行之事實。本文價值在於以數量方法成功證明了”會議展覽可帶動民間消費”的直覺想法，我們運用鄰近預測法不僅得到符合直覺想法之結果，而且本文實證結果亦符合既存理論。本文有二大貢獻，第一，目前未有運用會議展覽資訊進行鄰近預測台灣民間消費的相關文獻，本文彌補此類文獻之匱乏。第二，近 20 年來，台灣政策當局力推會議展覽產業的發展，本文結果歸結出會議展覽產業確實與民間消費具顯著密切相關，也呼應貿易衍生的會展產業確實帶動擴張台灣民間消費與提升台灣經濟之既存事實。

關鍵詞：鄰近預測、台灣民間消費、會議展覽

Application of Nowcasting in Examining the Relationship Between MICE and Service Consumption in Taiwan

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Abstract

This paper examines service consumption in Taiwan using MICE (Meeting, Incentive, Convention, and Exhibition) data via nowcasting. The aim is to improve the accuracy of service consumption forecasts in Taiwan by utilizing real-time information and to identify the impact of MICE on service consumption. We constructed diffusion indices using MICE keywords obtained from a Google Trends database. High-frequency real-time MICE data was used to nowcast the low-frequency service consumption data. This paper focuses on the interrelations between components to determine which has a greater impact on service consumption. The results show that the keywords "Incentive, Exhibition Hall, Conference Center, and City Marketing" groups, and the keywords "Auto Show, Taipei Exhibition, KEC, and Lantern Festival" classifications, all have a significant impact on service

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consumption. Our contributions are twofold. First, our empirical results correspond with the fact that "The derivatives of international trade, MICE industries, have expanded service consumption and boosted Taiwan's economy in recent years." Second, this paper fills a gap in the literature on the relationship between MICE and Service Consumption.

Keywords: Nowcasting, Service Consumption, MICE

I. Introduction

Recently, the big data issues are crucial and have been spotlighted by several literatures and high-frequency internet-searching keywords have been applied to nowcast low-frequency dependent variables for the purpose of accurate forecasting of the economy and to provide multiple decision-making suggestions. This big data is constructed from structured and non-structured data, and people can use the text mining technique to gain thorough information extraction[1′2]. In this paper, we extract the important information from keywords by means of applying the text mining technique with the aim of exploring the impact of MICE (Meeting, Incentive, Convention, and Exhibition) on service consumption in Taiwan.

The Taiwan economy is built on international trade, and the derivatives of international trade, MICE, which have also been developed over a long period of time. MICE has spawned a huge, competitive exhibition and convention industry bristling with equipment and know-how. International cooperation and exchanges have further boosted economic development, thus the extensive economic spillover outcome from MICE should be taken seriously. The prosperity of MICE can enhance a country's economic development, demonstrate city competitiveness, link up industrial chains, accelerate manufacturing activities, and increase employment, which will all strengthen city infrastructure development. With varied themes, exhibitions could attract foreign visitors to promote the expansion of the local economy. For example, CNN reported that the "Taipei 2017 Universiade" had created 7.44 billion NTD output value and 4.46 billion NTD added value, amounting to 11.9 billion NTD. Another example, the "2019 Taiwan Lantern Festival" incorporated the international lantern area, which was attended along with five local governments in Japan and Vancouver, Canada and attracted lots of visitors from more than twenty countries.

Since 1950s, the MICE industry started with the promotion for exploring business opportunities by the central government through international trade shows of the traders (Lin, 1985). In 1974, the first organizes trade show and exhibition had been held on the Grand Hotel Taipei, which brought Taiwan to enter a new phase in the organizing exhibitions progress. The exhibitions had been held on the Army Command Barracks in Taipei city (also known as the CKS Memorial Hall) and Taipei Songshan Airport, separately in 1975 and 1977. Then, the Taipei World Trade Center Co., Ltd. began operations in 1986, and Hall 2 and Hall 3 opened separately in 1999 and 2003. As aforementioned, the MICE industry began in time to grow up in Taiwan, boosting import and export volume from 300 million dollars to 262.3 billion dollars separately on 1950s and 1998, and making Taiwan the world's 14th largest trader of goods. In 1991, the cumulative foreign exchange reserve in Taiwan had exceeded 100 billion dollars, making Taiwan the world's first holder of the largest foreign exchange reserves. That's to say,

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1 "The process of transforming unstructured text into a structured format to identify meaningful patterns and new insights" is called text mining.

2 Data mining and text mining techniques are often applied to analyze big data. Big data contains lots of structured and unstructured information, and if people want to detect the deep information from text data, text mining technique could be used. The difference between data mining and text mining lies in the former having prominent regular structured data, while the latter has unstructured data with no rules. For example, data mining could be applied to databases with structured tables with text mining applied to our daily texts or sentences which are original data without exact definitions.

holding international exhibitions and trade fairs had promoted the economic progress (Li et al., 1999).

The MICE industry in Taiwan had received increasing attention, the Executive Yuan regarded the development of the MICE industry as a priority work plan in “Challenge 2008 National Development Plan” on 2002, and further treated the MICE industry as the emerging industries in “MICE Industry Development Plan” on 2004, and the Executive Yuan held “Tourism Development and Promotion Committee, Executive Yuan MICE Task Force” to coordinate and integrate resources in November 2004. In 2009, the MICE industry had been treated as a leading and important role in economic progress in “Project Vanguard for Excellence in Tourism Promotion Manual”. In the same year, the Bureau of Foreign Trade, MOEA began operations of 4-year ”Taiwan MICE Development Plan” to integrate and drive the MICE industry, making an effort to negotiate for hosting the international events in Taiwan, and increasing the international competitiveness of the MICE industries in Taiwan. With the actively promotion by the governments, the local city government were given incentives for grants to support the MICE industry, which were encouraged to develop the tourism industry through city marketing, for example, Chiayi City International Band Festival, the Dajia Mazu Cultural Festival, and 2010 Taipei International Flora Expo.

Since 2020, the novel coronavirus outbreak had forced the worldwide trade shows and exhibitions being canceled, or changed from physical to online. To minimize the impact of the novel coronavirus, the worldwide international trade was transformed to be digital, and the MICE industry was gradually transforming. The Taiwan government began to provide grant resources for online international trade shows, and online international trade conferences to promote the industrial transformation (Kaohsiung MICE Office, 2021).

Recently, the global exhibition industry kept on growing and trade shows had a trend towards a shift to Asia. According to the statistical reports of UIA (Union of International Association), the international exhibitions amounted to 4,100 shows, including 3,000 shows in Europe and 1,100 shows in Asia, contributing to 760 billion dollars values; and the international conferences contributed to 1,500 meetings, including 62% in Europe and 16% in Asia, contributing to 910 billion dollars values. Based on the” The Trade Fair Industry in Asia-3rd Edition” report of UFI (The Global Association of the Exhibition Industry) in June 2007, the increased exhibition space in Asia had grown 20% from 2006 to 2010, and the exhibition revenues more than 2.4 billion dollars in 2006, which was encouraged by the global manufacturing activities moved to Asia.

As for the global conferences industry, the ICCA (International Congress & Conference Association) report had figured out the international meetings had steadily grown from 1997 to 2007, and the number of international conferences increased exponentially in Asia. Taiwan had 60 exhibitions in 2006 and ranked itself as Asia ranking seventh, however, in the coming year, Taiwan had 46 exhibitions and rank itself as Asia ranking eighth in 2007, representing the exhibition industry in Taiwan had underperformed even though the number of global exhibitions annually steadily grew 8%. And the “2008 Asia Exhibition Industry Report” which was announced by UFI in July 2009 had described that Taiwan had 62 exhibitions in 2008 and ranked itself as Asia ranking seventh, showing the inefficient growth and the inherent problems.

As aforementioned, the exhibition industry was obviously underperforming even though the Taipei Nangang Exhibition Center began operations in 2008. For the Taipei Nangang Exhibition Center starting up in 2008, the government treated 2008 as “MICE Action Year”, and for a substantial increase in the depth and breadth of development of MICE industry with the gathering all the resources from MICE industries efficiently in the future, the government also treated 2009 as “MICE Expansion Year”. However, the amount of trade shows in Taiwan had declined in 2008 and the first half of 2009, and only 9 trade shows were held in the Taipei Nangang Exhibition Center even though it had been operating for 1 year. Hence, it’s necessary to think through the problems of MICE industry development (Wang, 2008).

In 2016 to 2018, the number of international conferences had increased from 217 to 277, and the number of the incentives had increased from 126 to 127, which spurred the revenues of MICE industry from 42.6 billion dollars to 46.2 billion dollars (Bureau of Foreign Trade, MOEA, 2019). According to the ICCA (2017), Taiwan had ranked itself as Asia ranking seventh and global ranking 33rd in global international conferences of countries in 2007, and Taipei had ranked itself as Asia ranking seventh and global ranking 26th in global international conferences of cities in 2007.

Compared the Asia ranking of Taiwan in 2018 with which in 2008, it was not significantly improved. Hence, Bureau of Foreign Trade, MOEA had proposed several approaches to improve the number of international conferences as follows, (1) Screening out suitable international conferences abroad from the ICCA database, and aggressively seeking opportunities for cooperation with which to be held in Taiwan. (2) Cooperated with the local city governments in pushing for the Association Meetings to be staged in local place. (3) To encourage more incentives to be staged in Taiwan.

Based on the statistical report of UFI, the worldwide exhibition agencies pointed out that the Covid-19 outbreak had significant impacts on the MICE industry operations, and 27 percent of respondents agreed with these negative effects. Besides, a country's economic development situation played an important role in the MICE industry conditions, and 21 percent of respondents agreed with the economic depression sourced from the Covid-19 outbreak, which made the MICE industry stagnant. In addition, the importance of exhibition digitization had risen to fourth place for exhibition agencies, representing digital transformation as the very essence of pursuing sustainable operation for MICE industry. Searching for new marketing strategy and operation process to hedge business risk is one of the important issues for development of MICE industry (UFI, 2020a, 2020b).

Since 1970, the Taiwan government has attached importance to MICE and has brought the concept to one of the development projects in the "Program for Promoting 10 Core Service Industries." The MICE industry has great implications for boosting economic development, and the extent of prosperity of a country could be told from its organized events. As stated above, the spillover outcome of events will have a strong impact on service consumption in Taiwan.

The individual's consuming capacity can be viewed from the perspective of service consumption. According to BEA (Bureau of Economic Analysis in U.S. Department of Commerce) and Vosen, and Schmidt (2011), "Private Final Consumption Expenditure" includes "Durable consumption," "non-durable consumption," and "Service consumption." We emphasize on "Service consumption" in this paper. Due to literature shortage of focusing on the impact of MICE on service consumption, we verify their relationship. Formerly much research was concentrated on forecasting economic growth; however, they always had unsatisfactory results because the delay of official data announcements. Thus, the nowcasting method was adopted to improve this situation. Since that real-time data has abundant information, we apply those internet-searching keywords to do nowcasting and examine the influence of real-time MICE data on service consumption via the nowcasting method.

Lately, the authorities have pressed forward with the MICE industry, and the flourishing MICE industries can remind us to detect whether its prosperity has further pushed up service consumption in Taiwan. We classified the internet-searching MICE keywords and applied the Principal Components Analysis (PCA) to extract those MICE diffusion indices, reflecting the real-time information requirements for events. The purpose of this paper lies in examining whether the forecasting performance of service consumption is improved with those MICE diffusion indices or not.

We paid attention to the explanatory of service consumption on MICE industry in Taiwan, mainly from the contribution of MICE industry on one country, that's so called "economic multiplier effect" which had been mentioned in existing literatures. Based on the statistical results in Oppermann (1999), the average consumption

of tourists from exhibitions and conventions are two times larger than sightseeing tourists, and the amount of tourism consumption from MICE industry accounted for 30% of total tourism consumption. UFI announced that the "economic multiplier effect" from the peripheral industries of the MICE industries were up to 8 to 10 times larger than the revenues from exhibitions and conventions, representing that the MICE industries had great impacts on accelerating the development of the MICE-related industries. Several worldwide big cities and countries strived to host international conventions and exhibitions to strengthen further the public image of countries and to build the cities up the international tourism and exhibitions cities, which further in a bid to help boost the country economy and to maintain a significant competitive advantage in the countries (Huang and Chen, 2009).

Accelerating the development of the MICE industries had a significant synergistic effect on the city's economic benefits, which facilitated trade expansion and also generated direct benefits in local economy through holding conventions, exhibitions and incentives, and drove the peripheral industries development, such as hotel, transportation, restaurants, and travel agencies, forming the huge spillover effects of industrial association. Exhibition industries could be treated as a window displaying goods from various countries, which aided a lot in expanding international sales. According to the report of Taiwan Institute of Economic Research, the MICE multiplier effect would be 12 times greater than original trading volume if those facilitating exhibition transactions also being included consideration of calculation with trading volume, representing the huge importance of the MICE industries on the peripheral industries.

Based on the estimation of MOEA, R.O.C., holding a World's Fair could attract 5.5 million number of visitors, create 5 billion dollars operating incomes and provide employment opportunities of 13000 people, which drove the related industry development. Those related industries covered hotels, airline companies, restaurants, advertising agencies, transportation consulting corporations, and travel agencies. Comparing the industrial output values from the MICE peripheral industries with the direct revenues from those exhibitions and conventions, it was concluded that the ratio was about 9:1, and the economic multiplier effects were approaching 54.6 billion dollars (Arnold, 2002).

Inspired by the existing literatures and enormous economic data, which had figured out the MICE industries would expand the service consumption, that's why we paid attention to the impacts of those MICE keywords on service consumption in Taiwan.

The MICE keywords are summarized to have prominent effects on service consumption via nowcasting, which works in concert with the conditions of being pushed forward by the local governments and private enterprises. This paper makes up for a deficiency of literature on the relationship between MICE and service consumption. And our empirical results correspond to the facts that "MICE industries have expanded service consumption and pushed up the Taiwan's economy in recent years."

II. Literature

Lately, internet-searching data has been applied to the relevant literature since its real-time high-frequency nature has abundant information advantages. Because of the delay of official data announcements, the features of internet-searching data can remedy this defect, which reflects the real economy status in this country. Lots of issues are discussed with internet-searching data, which are as follows.

Some nowcasting literatures have focused on GDP. Since Klein and Park (1994), lots of research have applied the nowcasting method to forecast GDP. Klein and Park (1994) built the Current Quarter Model (CQM) to forecast U.S. GDP. Following Giannone, Reichlin and Small (2008), much research has used the Dynamic Factor Model

(DFM) and other techniques to nowcast GDP in different countries. Compared several models, Bragoli and Fosten (2016) concluded that the nowcasting model had better forecasting outcomes. Chernis and Sekkel (2017) used DFM to transform the monthly data into quarterly data to forecast Canada's GDP, and they concluded that DFM had more precise empirical results than the Autoregressive model. Due to the two-year delay of the official data announcement of Japan's GDP, Chikamatsu et al. (2018) used mixed frequency data (MIDAS) and the bridge equation model to estimate GDP with the PCA applied to extract important factors for better estimation. Kabundi et al. (2016) used twenty-one indices covering economic fundamentals, and compared the nowcasting model with the consensus prediction of Reuters, Bloomberg and seven alternative models. The results showed that the alternative model with transformed quarterly frequency variables had better performance. Luciani et al. (2015) mentioned that Indonesia has several high-frequency types of data, and the nowcasting model was constructed from several high-frequency kinds of data to raise the forecast accuracy of the Indonesian economy. Baffigi et al. (2004) evaluated the short-term predictivity of GDP in the Eurozone and compared the traditional model with the bridge equation model.

Some nowcasting literatures have focused on the employment rate, and their results showed that the keywords model performed better than others (Askitas and Zimmermann,2009; D'Amuri and Marcucci,2010). Other nowcasting literatures have focused on the stock issue, showing the significant relationship of internet click frequencies to market trading volume (Takeda and Wakao, 2014). Some other nowcasting literatures have concentrated on tourism issues, such as Matsumoto et al. (2013) and Choi and Varian (2012). The former explored the impacts of internet-searching data on Japan's service consumption around "Japan's 311 Earthquake," and the latter applied the keywords to summarize which model was better.

Finally, other nowcasting literatures put stress on applying the keywords to nowcast the service consumption, concluding which model performed better (Vosen and Schmidt,2011,2012; Kholodilin et al.,2010).

Previously, many important issues of MICE have been discussed by researchers, such as "the contributions of MICE to the economy, the factors of success of exhibitions, and the importance of cultivating professional talents and making up MICE network environments."

Based on reviewing relevant literatures of exhibitions, mostly focused on the factors influencing the success of the exhibition. Part of literatures paid attention to the company scale and booth size, which were important factors having direct effects on the performance of a company exhibition (Blythe, 2000; Bonoma, 1983; Kerin and Cron,1987). Part of literatures paid attention to the functions of trade shows and the improvement of exhibition event management (Hanlon, 1977; Konikow, 1984; Konopacki, 1978). Part of literatures paid attention to the analysis of the various choices for different industries to participate exhibitions (Wu et al., 2008). Part of literatures paid attention to the derivative problems for intellectual property rights in exhibitions (Schaper,2010). Part of literatures paid attention to the choices of exhibition venues (Lee and Back, 2007).

Based on reviewing relevant literatures of conventions, part of literatures paid attention to the Asia conference market (Muqbil,1997). Part of literatures mentioned that incentives were reward methods of enterprises to motivate employees (McKercher, 2000). McCleary (1978) had concluded several items which were the ultimate concern of the exhibition staff, and Renaghan and Kay (1987) surveyed the conference facilities to sum up important items.

Based on reviewing relevant literatures of MICE industries, most literatures paid attention to explore the development trends and operating types in MICE industries (Chang, 2002; Chang and Lin, 1995; Kim and Chou,2009). Related issues of conventions and exhibitions mostly concentrated on the functions and benefits of MICE industries (Arnold, 2002; Carlsen,1999; Liu, 2005). Part of literatures paid attention to the development trends and strategies of MICE industries (Huang, 2007; Huang and Chen, 2009; Oppermann, 1996).

Part of literatures applied the PCA to discuss some issues, which were more relevant to our paper. Since 1980s, part of literatures started to watch the MICE industries with deepening concern, Fortin et al. (1976) had discussed the location problems of conferences and extracted the 10 prominent influencing factors. Go and Zhang (1997) had applied the PCA to conclude the important factors of choosing the city for holding conferences. Oppermann (1996) surveyed the 30 conference cities in the North America and applied the PCA to conclude 15 prominent elements for choosing conference locations.

Differed with those aforementioned literatures, the main contributions of our paper lied on applying the PCA to extract the main influencing factors and nowcast the low-frequency data with high-frequency data, that's applying the quarterly MICE keywords data to nowcast annual Taiwan service consumption data, and our empirical results corresponded to the suggestions provided by the central government to promote the development of the MICE industry in Taiwan.

Based on those issues, we conclude several important internet-searching MICE keywords, and those keywords are divided into fourteen groups and twenty-two classifications[3]. They are listed as follows.

(1) **MICE**. The definitions of MICE are varied in different countries[4]. In Taiwan, MICE represent Meeting, Incentive, Convention and Event. We follow the definition in Taiwan, and this group is further divided into those four classifications.

(2) **Meeting**. Based on the definition of Department of Commerce, MOEA (Ministry of Economic Affairs) in Taiwan, Meeting is the indoor activity for groups of people getting together at a specific time to share information to satisfy each other's requirements. The definition and classification are varied between different countries. We adopt the popular ones as the classifications in Meeting, which are "Seminar, Conference, Congress, and Summit."

(3) **Incentive**. The incentive belongs to a specific type of MICE. It aims at inspiring and rewarding the employees, which is always held as a tour with high-level consumption activities by the enterprises. Including both meeting and banquet, incentives are always treated as having high economic benefits and spillover effects.

(4) **Convention**. In Taiwan, the top 10 international professional exhibitions include COMPUTEX, Auto Show, and TIMTOS, which attract highly searched for intent on the internet. Hence, we classified the Convention into these three classifications.

(5) **Event.** In MICE industries, events are held for sharing information, building relationships, showing technology, and city marketing. Owing to the fact that popular events in Taiwan are mostly outdoor ones, we choose two of them as the classifications, which are Spring Scream and Fulong.

(6) **Exhibition**. The difference between exhibition and activity lies in the former displaying the objects, which must be held at specific time and locations. The TRADE Show is the representative exhibition in Taiwan, and we choose it as the classification.

(7) **Exposition**. Expositions have extensive scale and contents, and the themes of expositions are subject to the local economy development, society, and culture. In this paper, the exposition is divided into two classifications, which are Fairs and World Games.

(8) **EXPO**. EXPO is the international large-scale exposition, and this activity shows the country's economic strength and promotes industrial experience exchange.

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[3] Based on the definitions in existing literatures and summary in ICCA (2007), we selected the most representative 14 groups of MICE keywords, which were always mentioned for figuring out the overview of MICE in several countries (Huang, 2007). And in each group of those MICE keywords, there were further several classifications owing to the more common in literatures, that's those classifications. However, limited to the data shortage, lots of MICE keywords which were classified into those "classifications" had no searching records in the Google Trends, that's to say, there was no data of some classifications. Hence, it's a pity to cover less classifications in some groups, for there were no data in the Google Trends database.

[4] In Europe and US, MICE cover Meeting Industry, Exhibition and Event Industry.

(9) **Exhibition Hall**. The operation of an Exhibition Hall has close connections with putting on exhibitions. The Exhibition Halls are built for facilitating business activities and delivering knowledge to the visitors. In Taiwan, the main Exhibition Halls are the Taipei Exhibition, Taipei World Trade Center, and KEC; then we further divided this group into these three classifications.

(10) **Festival**. Getz (1991) mentioned that the 7 basic conditions of a Festival include" public, celebrations with specific themes, being held once year or several years, booking an event time in advance, not being held in the fixed building structure, not being held in the same location, and activity contents include various items." Lantern Festival is one of the important festivals in Taiwan, and we treat it as a classification of this group.

(11) **Conference Center**. The building of Conference Centers could bring along related-industry advancement, promote the local economy, and offer lots of employment opportunities. TICC and ICCK are the principal conference centers in Taiwan, which are treated as two classifications.

(12) **Organization**. In MICE industries, PCO (Professional Conference Organizer) and PEO (Professional Exhibition Organizer) are both important organizations, which are set up for holding exhibitions. Also, TAITRA (Taiwan External Trade Development Council) plays an important role in MICE industries in Taiwan. Thus, this group is divided into these three classifications.

(13) **City Marketing**. Kotler (1993) defined city marketing as "displaying the vision and future development of the city through marketing, and transforming a new image of this city, which catch the attention of target consumers." Lots of cities aim at City Marketing for promoting itself through actively striving for funding to hold large-scale exhibitions. Recently, in Asia-Pacific countries, the mutual economic and trade cooperation between cities have boosted economic development. As stated above, Urban Renewal is important for MICE industries, which is treated as a classification.

(14) **Sub-prime**. In August 2007, the US sub-prime mortgage crisis erupted, which had a tremendous impact on the economy worldwide. Taiwan was highly reliant on mutual international trade, and the US sub-prime mortgage crisis had a big hit on MICE industries in Taiwan.

III. Empirical model

The annual service consumption was nowcasted by quarterly internet-searching MICE keywords data, and the empirical tests were proceeding as follows.

1. Transforming data

Referring to Klein and Park (1994) and following the procedure in Giannone et al. (2008), the quarterly internet-searching MICE keywords data was transformed into the annual data. The estimated service consumption forecast is the nowcasting estimation, y_{4k}, evaluated based on quarterly data information.

$$y_{4k|v_j} = E\left[y_{4k}|\Omega_{v_j}\right],\ v = 4k - l;\ l = 0,..,3, \quad (1)$$

Assume $y = \text{the last quarter of each year}$, representing as $y = 4k, k = 1,2,....$, and k is the observed year. The quarterly data (j) is announced four times each year, and the four data collections, sequentially the 1st to the 4th quarter, represented as $\Omega_{v_j},\ v = 4k - l,\ l = 0,..,3.\ \Omega_{v_j} = \left\{X_{it|v_j}; t = 1,....T_{iv_j}; i = 1,...,n\right\}$ is the information set. $X_{it|v_j}$ is the individual time series data. i represents n variables. t represents the data frequency, which is quarterly from the first observation to the last one (T_{iv_j}).

Equation (1) is the bridge equation. There're four quarterly data to nowcast four current year data, treated as four methods, separately Q1 to Q4, sequentially the 1st quarter to the 4th quarter of each year chosen as the quarterly data.

2. Construct diffusion index

The linear relationship between X and F, as the basis of forecasting single series with diffusion indices in the future, that's Equation (2) as follows.

$$X = F\beta + \varepsilon \quad (2)$$

X is the $T \times N$ matrix composed of N time series variables, T is the number of samples, and F is a $T \times k$ matrix, representing k diffusion indices estimated by X. β represents the $k \times N$ coefficients matrix, called the factor loading matrix, resulting from regressing X by the estimated F. ε is the vector of residuals with white noise.

We have to use the two-step method to estimate F and β in Equation (2). The estimation in the first step, F could be treated as a set of k diffusion factor series having the strongest correlation with the X vector.

$$\min_F \sum_{i=1}^{N} (X_i - F\beta_i)'(X_i - F\beta_i) \quad (3)$$

X_i and β_i are separately the ith element in X and the ith element in the β vector. We assumed temporarily that F is known in equation (2), and then the least square estimator β could be represented as $\widehat{\beta_i} = (F'F)^{-1}(F'X_i)$. Treating $\widehat{\beta_i}$ as β_i of equation (3), the objective function could be rewritten as

$$\min_F \{trace[X'X - X'F(F'F)^{-1}F'X]\} \quad (4)$$

Trace (・) represents the function of the dimensional elements summation in a square matrix. Because X'X comes from the sample series, the solution to equation (3) would be the same as in equation (5).

$$\max_F \{trace[X'F(F'F)^{-1}F'X]\} \quad (5)$$

Adopting the proof in Connor and Korajczyk (1986, 1993), Stock and Watson (1998a, 1998b) concluded that the solution to F in equation (5) was the eigenvector corresponded by the maximizing k eigenvectors, the matrix $\hat{F}$, composed of k eigenvectors in $T \times 1$, which was the estimated diffusion indices. Taking $\hat{F}$ into equation (2), the least square estimator of factor loading matrix β was equation (6).

$$\hat{\beta}_{OLS} = (F'F)^{-1}(F'X) \quad (6)$$

All the time series data were examined with Augmented Dickey-Fuller unit root tests, and the maximized k eigenvalues of XX' and its corresponding eigenvector, which were the estimated diffusion indices. We applied the MICE-related variables to construct the MICE diffusion indices, which is the "internet-searching MICE data indices." The n diffusion indices, named separately DF1 to DFn, that's the possible common factors for service consumption in Taiwan, which were extracted based on Stock and Watson (1998a,1998b, 2002a, 2002b). Through decomposing the weights of the diffusion indices, it could be concluded which variable has much more impact on service consumption and which MICE common factor has effects on service consumption.

3. The bridge equation

The PCA was applied to estimate the common factors for solving the problems of the curse of dimensionality and imprecise estimates from the information sets having many variables.

$$x_{i,t|v_j} = \mu_i + \lambda_{i1}f_{1,t} + .. + \lambda_{i,r}f_{r,t} + \xi_{i,t|v_j}, i = 1, \dots, n$$

μ_i is the intercept, and $\chi_{it} \equiv \lambda_{i1}f_{1k} + \cdots + \lambda_{ir}f_{rk}$ are the common factors. Represented by matrix forms, $x_{t|v_j} = \mu + \Lambda F_t + \xi_{t|v_j}$. And, $x_t = (x_{1t|v_j}, \dots, x_{nt|v_j})'$, $\xi_{t|v_j} = (\xi_{1t|v_j}, \dots, \xi_{nt|v_j})'$, $F_t = (f_{1t}, \dots, f_{rt})'$, Λ is a $n \times r$ factor loading matrix.

$$\hat{y}_{4k|v_j} = \alpha + \beta' \hat{F}_{4K|v_j} \text{ , } \hat{F}_{4K|v_j} = \mathrm{E}[\mathrm{F}_{4k}|\Omega_{v_j}] \text{ for } v = 4k - l; l = 0,..,3 \quad (7)$$

$$\mathrm{F}_t = \mathrm{A}F_{t-1} + \mathrm{Bu}_t,\ u_t \sim WN(0, I_q) \quad (8)$$

B is the $\mathrm{r} \times \mathrm{q}$ matrix of full rank; A is the $\mathrm{r} \times \mathrm{r}$ matrix with eigenvalues larger than 1; u_t is the white noise of common factors.

Equation (7) is the bridge equation, the linear relationship between service consumption nowcasting estimates with the common factors, $\hat{y}_{4k|v_j}$ is the estimated service consumption in Taiwan. In our paper, the service consumption in Taiwan was nowcasted through the bridge equation and the dynamic factor model based on Giannone et al. (2008) and Giannone et al. (2010). Giannone et al. (2008) assumed that the common factor dynamics satisfies the VAR form, that's equation (8). The Kalman filter was applied to estimate the common factors in two steps and brought them into equation (7) to get the nowcasting estimates.

Existing literatures figured out the diffusion indices which were estimated from observable variables, and they were consistent with the unobservable common factors estimated from the aforementioned two-step procedures (Bai, 2003; Bai and Ng, 2002; Forni et al.,2005; Stock and Watson ,2002a). That's why we followed existing literatures to estimate the diffusion indices, which was proxied as the common factor for nowcasting service consumption.

4. VAR model

The k sequences having the strongest correlation with the original series components of X are represented by the estimated diffusion indices. We estimate the diffusion indices for four individual quarters. We could further explore the relationship between service consumption patterns with different diffusion indices and understand the implications of nowcasting annual service consumption in Taiwan via diffusion indices, even though the diffusion indices estimation is a purely statistical approach without economical granger causality background.

Using diffusion indices to construct the VAR model, it is concluded that X_{it} is the observation of the ith economic variable in t period, N is the number of economic variables, and γ is the estimating parameter originated from maximizing the DF_t variations. Satisfying with $\sum_{i=1}^{N} \gamma^2 = 1$, $DF_t = \gamma_1 x_{1t} + \gamma_2 x_{2t} + \cdots + \gamma_N x_{Nt}$ is the first Principal Component, that's DF_t.

The VAR (p) model as AR (1) form,

$$Z_t = AZ_{t-1} + \varepsilon_t \quad (9)$$

Let $\begin{pmatrix} x_t \\ y_t \end{pmatrix} \in R^2$, and assume $(x_t y_t)'$ to be the VAR (p) form.

$E_t(Z_{t+j}) = A^j Z_t$ and $E_t(y_{t+j}) = [010 \ldots .0]A^j Z_t$, among them, $e_2 = \underbrace{\begin{bmatrix} 0 \\ 1 \\ 0 \\ \vdots \\ 0 \end{bmatrix}}_{2p \times 1}$

In addition, $x_t = [010 \cdots 0]Z_t = e_2' Z_t$. Combining the terms, that's,

$$e_2' Z_t = x_t = \sum_{j=1}^{\infty} \beta^j E_t(y_{t+j}) = \sum_{j=1}^{\infty} \beta^j e_2' A^j Z_t \quad (10)$$

Arranging them, we get $e_2' Z_t = e_2' \left(\sum_{j=1}^{\infty} \beta^j A^j\right) Z_t$.

And $e_1' = e_2' \beta A (I - \beta A)^{-1}$, that is $e_1'(I - \beta A) = e_2' \beta A$. The hypothesis testing for coefficient matrix A

in VAR (p) could use the Wald test,

$$x_t = \Phi_{11}x_{t-1} + \Phi_{12}y_{t-1} + \varepsilon_{xt}$$
$$y_t = \Phi_{21}x_{t-1} + \Phi_{22}y_{t-1} + \varepsilon_{yt} \quad (11)$$

Or,

$$\underbrace{\begin{bmatrix} x_t \\ y_t \end{bmatrix}}_{Z_t} = \underbrace{\begin{bmatrix} \Phi_{11} & \Phi_{12} \\ \Phi_{21} & \Phi_{22} \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} x_{t-1} \\ y_{t-1} \end{bmatrix}}_{Z_{t-1}} + \underbrace{\begin{bmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{bmatrix}}_{\varepsilon_t}$$

$$\underbrace{e_1'(I - \beta A)}_{1\times 2} = [1 \quad 0](I - \beta A) = [I - \beta\Phi_{11} \quad -\beta\Phi_{12}]$$

Therefore,

$$\underbrace{e_2'\beta A}_{1\times 2} = [0 \quad 1]\beta A = [\beta\Phi_{21} \quad \beta\Phi_{22}]$$

And the null hypothesis is,

$$\begin{cases} 1 - \beta\Phi_{11} = \beta\Phi_{21} \\ -\beta\Phi_{12} = \beta\Phi_{22} \end{cases}, \text{ or } \begin{cases} \Phi_{11} + \Phi_{21} = \frac{1}{\beta} \\ \Phi_{12} + \Phi_{22} = 0 \end{cases}$$

If the null hypothesis is not accepted, then the model has failed.

For exploring the relationship between the diffusion indices of the four individual quarterly data and annual service consumption data in Taiwan. We used the VAR model to examine the individual diffusion index of four individual quarters to verify their lead, lag, or feedback relationship.[5]

$$\text{Model1: } y_t = \alpha_1 + \beta_1 y_{t-1} + \beta_2 DF1_{t-1} + \beta_3 DF2_{t-1} + \beta_4 DF3_{t-1} + \varepsilon_{yt}$$
$$\text{Model2: } DF1_t = \alpha_2 + \beta_5 y_{t-1} + \beta_6 DF1_{t-1} + \beta_7 DF2_{t-1} + \beta_8 DF3_{t-1} + \varepsilon_{DF1t}$$
$$\text{Model3: } DF2_t = \alpha_3 + \beta_9 y_{t-1} + \beta_{10} DF1_{t-1} + \beta_{11} DF2_{t-1} + \beta_{12} DF3_{t-1} + \varepsilon_{DF2t}$$
$$\text{Model4: } DF3_t = \alpha_4 + \beta_{13} y_{t-1} + \beta_{14} DF1_{t-1} + \beta_{15} DF2_{t-1} + \beta_{16} DF3_{t-1} + \varepsilon_{DF3t} \quad (12)$$

y_t is the annulled data of service consumption in Taiwan, $DF1_t$,$DF2_t$,$DF3_t$are the individual diffusion indices for the four quarters.

IV. Empirical results

1.Data

Our data comes from the Google Trends database, of which recorded data begins from January 2004, and that's why our data covers the period from 2004 to 2020, shown in Table 1.[6] Two different service consumption are compared with each other, that's separately original one and travel class from the "Directorate General of

[5] The model can also be represented as a matrix form. That's $\begin{bmatrix} y_t \\ DF1_t \\ DF2_t \\ DF3_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \begin{bmatrix} \beta_1 & \beta_2 & \beta_3 & \beta_4 \\ \beta_5 & \beta_6 & \beta_7 & \beta_8 \\ \beta_9 & \beta_{10} & \beta_{11} & \beta_{12} \\ \beta_{13} & \beta_{14} & \beta_{15} & \beta_{16} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ DF1_{t-1} \\ DF2_{t-1} \\ DF3_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{DF1_t} \\ \varepsilon_{DF2_t} \\ \varepsilon_{DF3_t} \end{bmatrix}$.

[6] In this paper, the annual data of service consumption and service consumption-travel class are nowcasted with the quarterly data. Due to the official data would be released later, only the 2020 data of annual service consumption data and service consumption-travel class were available, when we run this study. Therefore, we adopted the keywords indicators during the same period to do nowcasting, that's why our sample covered 2004 to 2020.

Budget, Accounting and Statistics, Executive Yuan, Taiwan."[7,8]

2.Empirical results

（1）The factor loading of components

First of all, we focused on the constituents in those significant diffusion indices, which carry a higher weighting, and the outcomes were shown in Tables 2 to 3[9]. Table 2 showed the results with "internet-searching MICE keywords in group." In Table 4-Part A, the higher-weight components are separately "Incentive, Event, Expositions, Exhibition Hall, Conference Center, and City Marketing." In Table 4-Part B, the higher-weight components are separately "Incentive, Exhibition Hall, Conference Center, and City Marketing." Those important internet-searching MICE data represent that the keywords in "Incentive, Exhibition Hall, Conference Center, and City Marketing" groups impact service consumption a lot.

Table 3 demonstrates those outcomes of "internet-searching MICE keywords in classification." In Table 5-Part A, there are no statistically significant diffusion indices, and we choose no constituents to explain. In Table 5-Part B, those constituents carry a greater weighting, that's "Auto Show, Taipei Exhibition, KEC, and Lantern Festival," representing that the keywords in "Auto Show, Taipei Exhibition, KEC, and Lantern Festival" classifications impact service consumption-travel class a lot, also showing that the keywords in "Convention, Exhibition Hall, and Festival" groups have great effects on service consumption.[10]

（2）VAR model

a. The results of groups

The outcomes of "internet-searching MICE keywords in group" are shown in Table 4. Three diffusion indices are derived and adopted to proceed with the VAR test.[11] In Table 4-Part A, the lagged DF1, DF2 and DF3 composed of the 1st quarter data (Q1), the lagged DF1 and DF2 composed of the 2nd quarter data (Q2), and the lagged DF2 composed of the 4th quarter data (Q4) can predict service consumption significantly. In addition, the lagged service consumption can significantly predict DF3 composed of the Q1, for DF1 composed of the Q2, and for DF1 composed of the Q4. As already stated, the granger causality reciprocal reactions exist between the DF3 composed of the Q1 and the DF2 composed of the Q4 with service consumption. In addition, the lagged diffusion indices have significant effects on service consumption in the next period, implying that the concerns with MICE help to expand the service consumption. Those constituents carry a higher weighting, that's "Incentive, Event, Expositions, Exhibition Hall, Conference Center, and City Marketing," showing that the "Incentive, Event, Expositions, Exhibition Hall, Conference Center, and City Marketing" groups have significant effects.

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[7] Based on the BEA, "Service consumption" includes six categories, that's "Housing, Water, Electricity, Gas and Other Fuels," "Transport," "Communication," "Recreation and Culture," "Restaurants and Hotels," and "Miscellaneous Goods and Services" in our paper.

[8] "Service consumption-travel class" is also used for robustly check. "Service consumption-travel class" covers three categories, that's" Recreation and Culture," "Restaurants and Hotels," and "Miscellaneous Goods and Services."

[9] The number in parentheses after those constituents shows the frequencies that the keyword has ever been the top 3 ingredients in each diffusion index. Hence, a larger number represents that this keyword is more important.

[10] For estimating the MICE diffusion indices, the log difference is adopted for all original data, and all data were examined with Augmented Dickey-Fuller unit root tests. It is concluded that all data are stationary without unit root.

[11] We chose VAR model to lag 1 period as VAR (1), based on the AIC and SC criteria.

Table1

Data description and classifications

Data				Source	Period	Frequency
Dependent variables	Service Consumption			Directorate General of Budget, Accounting and Statistics, Executive Yuan, Taiwan	2004 ~ 2020	Annual
	Service Consumption-Travel Class					
Real-time MICE-related variables	Group		Classification	Google trends database	2004Q1 ~ 2020Q4	Quarterly
	1	MICE				
	2	Meeting	1 Seminar			
			2 Conference			
			3 Congress			
			4 Summit			
	3	Incentive				
	4	Convention	5 COMPUTEX			
			6 Auto Show			
			7 TIMTOS			
	5	Event	8 Spring Scream			
			9 Fulong			
	6	Exhibition	10 TRADE SHOW			
	7	Exposition	11 Fair			
			12 World Game			
	8	EXPO				
	9	Exhibition Hall	13 Taipei Exhibition			
			14 Taipei World Trade Center			
			15 KEC			
	10	Festival	16 Lantern Festival			
	11	Conference Center	17 TICC			
			18 ICCK			
	12	Organization	19 TAITRA			
			20 PCO			
			21 PEO			
	13	City Marketing	22 Urban Renewal			
	14	Subprime				

Table 2

The factor loadings of diffusion indices in group - Service Consumption

Dependent variables	Part A						Dependent variables	Part B				
	Service consumption							Service consumption-travel class				
Independent variables	Q1	Q1	Q1	Q2	Q2	Q4	Independent variables	Q1		Q2	Q3	Q4
Variables	DF1	DF2	DF3	DF1	DF3	DF2	Variables	DF1	DF2	DF3	DF2	DF2
MICE(1)	*2*						MICE(1)	*2*				
Meeting(0)							Meeting(0)					
Incentive(3)			*2*		*2*	*1*	***Incentive (2)***			*2*		*1*
Convention(1)				*1*			Convention (0)					
Event(2)	*1*			*1*			Even(1)	*1*				
Exhibition(0)							Exhibition (0)					
Expositions(2)		*1*	*3*				Expositions (1)		*1*			
EXPO(0)							EXPO(1)				*2*	
Exhibition Hall(2)		*3*			*1*		***Exhibition Hall(3)***		*3*	*1*	*2*	
Festival(1)				*1*			Festival (0)					
Conference Center(2)	*2*					*2*	***Conference Center(2)***	*2*				*2*
Organization(1)	*1*						Organization(1)	*1*				
City Marketing(4)		*2*	*1*		*3*	*3*	***City Marketing(4)***		*2*	*3*	*1*	*3*
Subprime(0)							Subprime(0)					
First r eigenvalues of the correlation matrix	0.82	1.62	1.15	9.09	1.51	2.83	First r eigenvalues of the correlation matrix	8.76	1.62	1.51	1.67	2.83
Variability explained	0.82	0.82	0.82	0.87	0.87	0.86	Variability explained	0.82	0.82	0.87	0.87	0.86

Source: The authors. The numbers in cells of table are the ranking of components in diffusion index. (1). In the first column, the number in the parentheses after those components of diffusion index represents the frequencies that the keyword has ever been the top 3 ingredients in each diffusion index. Hence, larger number represents that this keyword is more important. (2). In Table 2-Part A, we choose those diffusion indices having significant effects on dependent variables in Table 4-Part A. And there's only those diffusion indices composed of the 1st, 2nd, and 4th quarter data (Q1, Q2, Q4) have significant effects on Service Consumption. Based on the ranking of constituents, we conclude those constituents carry a higher weighting in bold italics, which are "Incentive, Event, Expositions, Exhibition Hall, Conference Center, and City Marketing." (3) In Table 2-Part B, we choose those diffusion indices having significant effects on dependent variables in Table 4-Part B. And there's only those diffusion indices constructed by the 1st, 2nd, 3 rd. and 4th quarter data (Q1, Q2, Q3, Q4) have significant effects on Service consumption-travel class. (3). According to the ranking of constituents, it could be summarized that those constituents carry a higher weighting in bold italics, that's "Incentive, Exhibition Hall, Conference Center, and City Marketing."

Table 3

The factor loadings of diffusion indices in classification - Service consumption-travel class

Dependent variables	Part B Service consumption-travel class
Independent variables	Q1
Variables	DF3
Seminar(0)	
Conference(0)	
Congress(0)	
Summit(0)	
COMPUTEX(0)	
Auto Show(1)	*2*
TIMTOS(0)	
Spring Scream(0)	
Fulong(0)	
TRADE SHOW(0)	
Fair(0)	
World Games(0)	
Taipei Exhibition(1)	*1*
Taipei World Trade Center(0)	
KEC(1)	*3*
Lantern Festival(1)	*3*
TICC(0)	
ICCK(0)	
TAITRA(0)	
PCO(0)	
PEO(0)	
Urban renewal	
First r eigenvalues of the correlation matrix	3.10
Variability explained	0.69

Source: The authors. The numbers in cells of table are the ranking of components in diffusion index. (1). In the first column, the number in the parentheses after those constituents shows the frequencies that the keyword has ever been the top 3 ingredients in each diffusion index. Hence, larger number represents that this keyword is more important. (2). At first, we choose those diffusion indices having significant effects on dependent variables in Table 5-Part A. However, there's no significant effects, we ignore the higher-weight constituents of diffusion indices in this section. (3). In Table 3-Part B, we choose those diffusion indices having significant effects on dependent variables in Table 5-Part B. And there's only those diffusion indices composed of the 1st quarter data(Q1) have significant effects on Service consumption-travel class. According to the ranking of constituents, it could be summarized that those higher-weight constituents in bold italics, that's "Auto Show, Taipei Exhibition, KEC, and Lantern Festival."

In Table 4-Part B, the lagged DF1 and DF2 composed of the Q1, the lagged DF3 composed of the Q2, the lagged DF2 composed of the 3rd quarter data (Q3), and the lagged DF2 composed of the Q4 can predict service consumption-travel class significantly. Besides, the lagged service consumption-travel class can significantly predict DF3 composed of the Q1, and for DF1 and DF2 composed of the Q2, and for DF1 composed of the Q4. As stated above, the DF2 composed of the Q1 has granger causality reciprocal reactions with service consumption-travel class. Those lagged diffusion indices have significant impacts on service consumption-travel class in the next period, implying that the concerns with MICE help to motivate people to consume and expand the service consumption-travel class. Those constituents carry a greater weighting, that's "Incentive, Exhibition Hall, Conference Center, and City Marketing," showing that the "Incentive, Exhibition Hall, Conference Center, and City Marketing" groups have significant effects.

We can conclude that the results in Table 4-Part A to Part B, implying that the internet-searching MICE keywords in "Incentive, Exhibition Hall, Conference Center, and City Marketing" groups robustly have impacts on various concepts of service consumption.

b. The results of classifications

The outcomes of "internet-searching MICE keywords in classification" are shown in Table 5. Three diffusion indices are derived and adopted to proceed with the VAR test.[12] In Table 5-Part A, the lagged diffusion indices have no effects on service consumption, but the lagged service consumption could significantly predict DF2 and DF3 composed of the Q1, and for DF2 composed of the Q2. However, because of the non-significant results of lagged diffusion indices, we ignore the higher-weight components of diffusion indices in this section.

In Table 5-Part B, the lagged DF3 composed of the Q1 can predict service consumption-travel class significantly, also the lagged service consumption-travel class could significantly predict DF3 composed of the Q1. As mentioned above, the granger causality reciprocal reactions exist between service consumption-travel class with the DF3 composed of the Q1. Those lagged diffusion indices have significant effects on the service consumption-travel class in the next period, implying that the concern with MICE helps to increase the service consumption-travel class. Those constituents carry a greater weighting, that's "Auto show, Taipei Exhibition, and Lantern Festival," showing that the keywords in "Convention, Exhibition Hall, and Festival" groups have significant effects. We could conclude that the results in Table 5-Part A to Part B, service consumption-travel class is robustly impacted by the keywords in "Convention, Exhibition Hall, and Festival" groups, and its constituents carry a greater weighting, that's "Auto show, Taipei Exhibition, KEC and Lantern Festival."

To sum up the results in Table 2 and Table 3, as for the results of "internet-searching MICE keywords in group," the "Incentive, Exhibition Hall, Conference Center, and City Marketing" are crucial MICE data, and they impact two different service consumption significantly. As regards the outcomes of "internet-searching MICE keywords in classification," the "Convention, Exhibition Hall, and Festival" are crucial MICE data, also impact service consumption-travel class significantly.

[12] We chose the VAR model to lag 1 period to be VAR (1), based on the AIC and SC criteria.

Table 4

VAR results in group

	Dependent variables	Part A				Part B			
		Service consumption				Service consumption-travel class			
Model	Coefficients	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	$\widehat{\alpha_1}$	-1.52	-2.69	1.67	11.95	-21.13	4.97	2.09	12.17
	$\widehat{\beta_1}$	0.01(0.01)	0.51**(0.17)	0.73**(0.20)	0.34(0.28)	0.17(0.32)	-0.03(0.40)	0.04(0.32)	0.31(0.29)
	$\widehat{\beta_2}$	19.15†(11.31)	22.51*(11.35)	1.89(17.65)	-30.94(36.31)	102.26**(31.74)	10.83(33.65)	20.02(40.56)	-28.08(45.27)
	$\widehat{\beta_3}$	-4.64**(1.35)	1.04(0.79)	-2.42(1.65)	-7.22**(2.42)	-6.24†(3.76)	2.66(2.48)	-9.41**(3.60)	-8.03**(2.95)
	$\widehat{\beta_4}$	1.70†(0.99)	-3.81**(1.57)	-0.66(1.02)	1.57(2.01)	-4.58(2.81)	-10.04**(4.96)	-1.33(2.26)	2.38(2.52)
2	$\widehat{\alpha_2}$	0.28	0.30	0.30	0.10	0.28	0.27	0.31	0.09
	$\widehat{\beta_5}$	0.01(0.01)	0.01**(0.004)	0.002(0.003)	0.01**(0.01)	0.004(0.01)	0.01**(0.003)	0.003(0.002)	0.01**(0.01)
	$\widehat{\beta_6}$	-0.16(0.51)	-0.30(0.29)	-0.15(0.30)	0.43(0.74)	-0.17(0.50)	-0.17(0.28)	-0.21(0.29)	0.47(0.81)
	$\widehat{\beta_7}$	0.01(0.06)	-0.001(0.02)	-0.02(0.03)	0.14**(0.05)	0.02(0.06)	0.001(0.02)	-0.01(0.03)	0.13**(0.05)
	$\widehat{\beta_8}$	-0.01(0.04)	0.05(0.04)	-0.01(0.02)	0.003(0.04)	-0.01(0.04)	0.05(0.04)	-0.01(0.02)	0.002(0.04)
3	$\widehat{\alpha_3}$	1.88	-1.74	0.85	1.34	1.98	-2.02	0.86	1.28
	$\widehat{\beta_9}$	-0.003(0.05)	0.09(0.06)	0.01(0.03)	0.01(0.04)	0.01(0.04)	0.07†(0.04)	0.01(0.02)	0.004(0.03)
	$\widehat{\beta_{10}}$	-7.08†(3.81)	4.76(4.19)	-3.56(2.66)	-5.15(4.65)	-7.89**(3.70)	5.51(3.27)	-3.58(2.67)	-4.86(4.76)
	$\widehat{\beta_{11}}$	0.48(0.45)	-0.05(0.29)	0.69**(0.25)	0.21(0.31)	0.62(0.44)	-0.06(0.27)	0.68**(0.24)	0.21(0.31)
	$\widehat{\beta_{12}}$	0.14(0.33)	0.82(0.58)	0.24(0.15)	0.05(0.26)	0.09(0.33)	0.95†(0.55)	0.24(0.15)	0.06(0.27)
4	$\widehat{\alpha_4}$	1.80	0.46	2.00	-1.55	1.72	0.38	2.10	-1.50
	$\widehat{\beta_{13}}$	0.12**(0.04)	0.03(0.03)	0.07(0.06)	-0.02(0.03)	0.09**(0.03)	0.02(0.02)	0.06(0.04)	-0.01(0.03)
	$\widehat{\beta_{14}}$	-9.17**(3.00)	-2.48(1.80)	-9.01†(5.29)	5.83(4.16)	-8.83**(2.95)	-2.19(1.66)	-9.59†(5.13)	5.56(4.28)
	$\widehat{\beta_{15}}$	0.26(0.36)	0.002(0.13)	0.23(0.49)	-0.77**(0.28)	0.22(0.35)	0.004(0.12)	0.26(0.46)	-0.76**(0.28)
	$\widehat{\beta_{16}}$	0.02(0.26)	0.89**(0.25)	-0.03(0.31)	-0.24(0.23)	0.04(0.26)	0.91**(0.24)	-0.04(0.29)	-0.25(0.24)
	det(SSE)	0.00000002	0.00000001	0.000000001	0.000001	0.0000002	0.0000001	0.00000001	0.000001
	AIC	-15.48	-15.78	-18.58	-12.18	-13.17	-13.63	-16.33	-11.32
	BIC	-14.75	-15.05	-17.85	-11.45	-12.44	-12.90	-15.60	-10.59
	HQ	-15.55	-15.84	-18.65	-12.25	-13.24	-13.70	-16.40	-11.38

Source: The authors. Robust t statistics in brackets. † significant at 10%; * significant at 5%; ** significant at 1%.

Table 5

VAR results in classification

	Dependent variables	Part A				Part B			
		Service consumption				Service consumption-travel class			
Model	Coefficients	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	$\widehat{\alpha_1}$	2.05	2.19	1.91	1.97	1.60	1.52	1.96	4.48
	$\widehat{\beta_1}$	0.61**(0.22)	0.59**(0.23)	0.73**(0.20)	0.62**(0.21)	0.79**(0.16)	0.86**(0.19)	0.82**(0.16)	0.50**(0.19)
	$\widehat{\beta_2}$	-1.53(2.30)	0.003(3.35)	1.80(3.21)	-0.60(2.01)	-1.40(2.23)	1.64(3.54)	2.62(3.28)	3.49(5.76)
	$\widehat{\beta_3}$	1.81(1.95)	-0.56(1.94)	1.94(2.65)	0.54(1.63)	1.24(1.91)	0.87(2.02)	1.19(2.59)	-3.68(2.30)
	$\widehat{\beta_4}$	1.68(2.05)	-1.16(2.03)	-1.66(2.44)	0.27(1.72)	4.20**(1.94)	2.98(2.23)	-3.51(2.31)	1.29(0.24)
2	$\widehat{\alpha_2}$	0.07	0.0002	0.05	-0.06	0.20	-0.03	-0.02	-0.05
	$\widehat{\beta_5}$	-0.02(0.02)	0.002(0.01)	-0.01(0.01)	0.01(0.02)	-0.03**(0.01)	0.01(0.01)	-0.001(0.01)	0.002(0.01)
	$\widehat{\beta_6}$	0.65**(0.23)	0.96**(0.19)	0.83**(0.20)	0.79**(0.21)	0.53**(0.20)	0.96**(0.19)	0.82**(0.21)	0.80**(0.26)
	$\widehat{\beta_7}$	0.39*(0.20)	0.04(0.11)	0.004(0.16)	0.08(0.17)	0.47**(0.18)	0.06(0.11)	0.07(0.16)	-0.06(0.10)
	$\widehat{\beta_8}$	-0.27(0.21)	-0.02(0.12)	0.15(0.15)	0.02(0.18)	-0.29†(0.18)	-0.004(0.12)	0.07(0.15)	0.08(0.11)
3	$\widehat{\alpha_3}$	-0.30	0.42	0.26	-0.02	-0.28	0.45	0.23	0.43
	$\widehat{\beta_9}$	0.06**(0.02)	-0.08**(0.03)	-0.02(0.02)	0.002(0.03)	0.04**(0.02)	-0.06**(0.03)	-0.01(0.02)	-0.02(0.02)
	$\widehat{\beta_{10}}$	0.33(0.25)	-0.06(0.47)	0.45(0.39)	0.15(0.30)	0.29(0.26)	0.01(0.48)	0.46(0.29)	1.06†(0.55)
	$\widehat{\beta_{11}}$	-0.49**(0.21)	-0.48†(0.28)	-0.32(0.32)	0.02(0.25)	-0.47**(0.22)	-0.44(0.27)	-0.27(0.31)	0.20(0.22)
	$\widehat{\beta_{12}}$	0.22(0.22)	-0.08(0.29)	0.19(0.29)	0.01(0.26)	0.12(0.22)	-0.18(0.30)	0.14(0.28)	-0.30(0.23)
4	$\widehat{\alpha_4}$	0.23	-0.12	-0.02	-0.08	0.24	-0.06	-0.09	0.03
	$\widehat{\beta_{13}}$	-0.04†(0.02)	0.03(0.03)	0.02(0.02)	0.02(0.03)	-0.03*(0.02)	0.01(0.02)	0.02(0.02)	-0.01(0.02)
	$\widehat{\beta_{14}}$	0.26(0.22)	0.13(0.39)	0.41(0.38)	-0.19(0.25)	0.27(0.22)	0.10(0.41)	0.36(0.38)	-0.07(0.58)
	$\widehat{\beta_{15}}$	-0.16(0.19)	0.28(0.23)	-0.05(0.32)	-0.09(0.20)	-0.15(0.18)	0.19(0.23)	-0.03(0.30)	-0.11(0.23)
	$\widehat{\beta_{16}}$	0.08(0.20)	-0.02(0.24)	-0.25(0.29)	-0.39†(0.21)	0.14(0.19)	-0.02(0.26)	-0.26(0.27)	-0.45†(0.24)
	det(SSE)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
	AIC	-8.15	-7.92	-7.91	-7.51	7.82	-7.73	-7.73	-7.35
	BIC	-7.36	-7.12	-7.11	-6.72	-7.03	-6.93	-6.94	-6.55
	HQ	-7.96	-7.74	-7.72	-7.32	-7.63	-7.55	-7.55	-7.16

Source: The authors. Robust t statistics in brackets. † significant at 10%; * significant at 5%; ** significant at 1%.

Table 6

Granger-causality results in group and classification

Keywords	**Groups**				**Classifications**	
Dependent variables / Frequency	Part A		Part B		Part B	
	Service Consumption		Service Consumption-travel class		Service Consumption-travel class	
	Granger-causality	higher-weight internet searching keywords	Granger-causality	higher-weight internet searching keywords	Granger-causality	higher-weight internet searching keywords
Q1	y_t ⇄DF3	Incentive(-0.52), Expositions(-0.48), City Marketing(-0.53)	y_t ⇄DF2	Expositions(-0.56), Exhibition Hall(-0.37), City Marketing(0.50)		
Q4	y_t ⇄DF2	Incentive(-0.55), Conference Center(0.50), City Marketing(-0.45)			y_t ⇄DF3	Auto Show(0.45), KEC(-0.40), Taipei Exhibition(-0.47), Lantern Festival(-0.40)

Source: The authors. "$\chi \rightarrow Z$" means χ cause Z, and Z is the outcome of χ. "$\chi \leftarrow Z$" means Z causeχ, and χ is the outcome of Z. "$\chi \rightleftarrows Z$" means χ granger cause Z, and Z also granger cause χ. The number in the parentheses after those constituents of diffusion index represents its weight.(1) In the second column, "y_t ⇄DF3" means the DF3 composed of the 1st quarter data (Q1) has granger causality reciprocal reactions with service consumption.(2) In the second column, "y_t ⇄DF2" means the DF2 composed of the 4th quarter data (Q4) has granger causality reciprocal reactions with service consumption.(3) In the fourth column, "y_t ⇄DF2" means the DF2 constructed by the 1st quarter data (Q1) has granger causality reciprocal reactions with service consumption-travel class.(4) In the sixth column, "y_t ⇄DF3" means the DF2 composed of the 4th quarter data (Q4) has granger causality reciprocal reactions with service consumption.

Based on the results in Table 4-Part A and Table 4-Part B, it's concluded that the performances of the two different models are almost the same. Likewise, the results in Table 5-Part A and Table 5-Part B are almost the same. However, comparing the results in Table 4 and Table 5, the VAR results in Table 5 have better performance with smaller AIC and BIC. The possible explanations are that the classifications include much more keywords than groups, which induce the constructed diffusion indices in classifications to have higher explanatory ability.

In the second column of Table 6, the DF3 composed of the Q1, and the DF2 composed of the Q4 granger cause to service consumption, and vice versa (y_t ⇄DF3; y_t ⇄DF2). In the fourth column of Table 6, the DF2 composed of the Q1 granger causes to service consumption-travel class, and vice versa (y_t ⇄DF2). In the sixth column of Table 6, the DF2 composed of the Q4 granger causes to service consumption, and vice versa(y_t ⇄DF3). According to those outcomes of Table 6, it could be summarized that the important components in groups, Incentive and City Marketing, have an important role in reinforcing service consumption. In order to boost the economy, the central government and private enterprises should always cooperate to push forward Incentives and further progress City Marketing, which will all bring about the expansion of service consumption. Likewise, higher service consumption and economic prosperity will promote large-scale exhibitions and Incentives, which will further accelerate City Marketing. Those are possible explanations for the granger causality reciprocal reactions.

V. Conclusions

The influences of MICE on service consumption in Taiwan was emphasized in this paper. And those internet-searching MICE keywords are put into several categories.

As for the outcomes of nowcasting annual data of two different service consumption with quarterly data, the keywords in "Incentive, Exhibition Hall, Conference Center, and City Marketing" groups have significant effects. Further, the keywords in classifications, that's "Auto Show, Taipei Exhibition, KEC, and Lantern Festival," which have impacts on two different service consumption significantly.

Among those keywords, "Auto Show, Taipei Exhibition, KEC, and Lantern Festival" carry the highest weight. It could be summarized that the MICE keywords in "Incentive, Exhibition Hall, Conference Center, and City Marketing" groups can predict two different service consumption significantly.

The importance of Incentive lies in improving working efficiency and increasing profit sharing with employees, which is the reason why enterprises adopt Incentive to encourage staff. Incentive is a high-level MICE travel pattern involving both meetings and banquets, which could enhance consumption and elevate economic benefits in some areas. The Taiwan government is eager to promote MICE industries, and Incentive is treated as one of the important elements to push MICE industries forward. The importance of the Exhibition Hall lies in hosting an exhibition needing both a location and visitors, and the local governments should make an effort to strive for exhibition center buildings that promote local economic development. The importance of City Marketing lies in city (urban) planning that contributes a lot to urban progress, which includes architecture, industrial development, and urban land readjustment. The local governments also should be dedicated to developing local culture and characteristics in order to attract tourists to come, and should design several unique limited events to attract the presence of both residents and foreign tourists; for example, "the Burning of the King Boat in Donggang, Pingtung County." These kind of popular Incentive activities will further encourage the local governments to push forward with the City Marketing to attract visitors.

The importance of the Auto Show lies in gathering major brands to attract consumers to view multiple products at once with car dealerships also eager to offer limited discounts and hold new product launches during

the exhibition, which are all designed for attracting visitors' attendance. Hence, the Auto Show attracts the public's attention. The importance of the Taipei Exhibition lies in the status of Taipei City, which is the capital of Taiwan, and international events are often held in Taipei City. Lots of concerts, conventions, and incentives have been held in Taipei Exhibitions, which encourage people to have highly intensive searches on the internet. The KEC is the primary exhibition center in southern Taiwan, which has accelerated the higher internet-searching times of the KEC. Including both indoor and outdoor showgrounds, the KEC has held several exhibitions to attract visitors. As the representative activity in Taiwan, the Lantern Festival has been held for more than 30 years, which also has accelerated the higher internet-searching times. With active promotion by the government, the characteristic Lantern Festival attracts international attention.

Our empirical results thus have figured out the importance of incorporation between the central government and private enterprises, which could boost the economy and drive the development of industry. The higher-weight internet-searching keywords in significant diffusion indices are separately "Incentive, Exhibition Hall, Conference Center, City Marketing, Auto show, KEC, Taipei Exhibition, and Lantern Festival," which are all extensions from MICE industries. Owing to the strong correlation between the execution of activities, the cooperation of government and private enterprises to hold events, and the local government striving for the construction of exhibition facilities, can all bring about the expansion of service consumption and explain the significant effects on service consumption by means of those keywords.

As mentioned above, among the fourteen groups and twenty-two classifications, those eight internet-searching keywords could affect the service consumption, which are separately "Incentive, Exhibition Hall, Conference Center, City Marketing, Auto show, KEC, Taipei Exhibition, and Lantern Festival."

Bureau of Foreign Trade, MOEA (2019) had proposed several ways to improve the number of international conferences as follows, (1) Screening out suitable international conferences abroad from the ICCA database, and aggressively seek opportunities for cooperation with which to be held in Taiwan. (2) Cooperated with the local authorities in pushing for the Association Meetings to be staged in local place. (3) To encourage more incentives to be staged in Taiwan.

According to Bureau of Foreign Trade, MOEA (2019), it had figured out several suggestions for promoting the MICE industry in Taiwan, that's "cooperating with the local government to facilitate the city marketing by the central government" and "encouraging the enterprises to hold the incentives in Taiwan." In our paper, we used the real-time data to nowcast the service consumption in Taiwan, accompanying with more abundant information, it was concluded that the empirical results corresponded to those suggestions for promoting the development and implementation of guidance for the MICE industry in Taiwan by the central government.

All in all, it's concluded that the abundant high-frequency information of MICE can explain the interrelations of MICE to service consumption significantly. Besides, the empirical results robustly point out the significant effects of MICE activities on service consumption. Our contributions are twofold. At first, our empirical results correspond to the facts that "MICE industries have expanded service consumption and pushed up the Taiwan's economy in recent years." Secondly, this paper makes up for a deficiency of literature on the relationship between MICE and service consumption.

The merit of this paper lies in successfully examined the intuitions of the MICE conducing to the private service consumptions expansion via quantitative methods. In the past, people just took their granger causality relationships for granted, however, it appeared to be lacking in proof. Especially, lots of economic theorems couldn't be successfully verified through quantitative methods, but the nowcasting method was applied in this paper and we concluded the expected results corresponding to the existing theorems.

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