International Journal of Hospitality Management 92 (2021) 102719

Contents lists available at ScienceDirect

International Journal of Hospitality Management

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

Research Paper

The effect of COVID-19 pandemic on domestic tourism: A DEMATEL method analysis on quarantine decisions

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ARTICLE INFO

Keywords:
COVID-19 pandemic
Quarantine decisions
DEMATEL method
Turkey

ABSTRACT

Countries' most effective methods to reduce the impact of outbreaks are quarantine the regions during the pandemic periods. Quarantine decisions during a pandemic directly affect the hospitality industry. There is no universal guideline regarding the quarantine decision during a pandemic. There is a gap in the literature on making the right quarantine decisions to decrease the negative effect of a pandemic on the hospitality industry. To fill this gap, this study uses a decision-making trial and evaluation laboratory (DEMATEL) method to help countries for quarantine decisions due to the COVID-19 pandemic. One of the critical hospitality industry indicators is the inter-regional travel flow between regions for local tourism. Data from the household domestic tourism survey obtained from the Turkish Statistical Institute (TurkStat) is used to acquire the number of people entering and exiting among regions. This study's findings indicate that Istanbul has an essential impact on Turkey's rest. The results also demonstrate that the DEMATEL method provides convenient solutions for quarantine decisions during a pandemic. The DEMATEL application results concerning the COVID-19 pandemic effect might shed light on the hospitality industry's prospects and challenges. This study's findings might be adopted to prepare the hospitality industry for the COVID-19 pandemic and similar pandemic.

1. Introduction

Pneumonia cases with unknown etiology from Wuhan City, Hubei Province was reported to China's World Health Organization's [WHO] Country Office on the last day of 2019 (Tufan and Kayaaslan, 2020). These cases reported about people infected by a new type of coronavirus (COVID-19) that has never been seen before. The current outbreak of COVID-19 disease has developed into a global health threat with continuously rising numbers of confirmed cases (Lau et al., 2020). COVID-19 disease has spread worldwide in a short period (Şencan and Kuzi, 2020). COVID-19 disease among individuals and related deaths continues to rise rapidly (Soof et al., 2020). Therefore, the WHO announced the COVID-19 outbreak a pandemic on 11 March (Zhang et al., 2020). Pandemic diseases may cause acute, short-term fiscal shocks, and long-term damage to economic growth (Çetin and Kara, 2020).

Furthermore, pandemics cause an excessive number of sicknesses and deaths globally and disrupt the countries affected by the social and economic situation (Akın and Gozel, 2020). COVID-19 pandemic has a strong negative effect on public health. It has severe adverse effects on the employees, customers, supply chains, and financial markets (Açıkgoz and Günay, 2020). There is currently no effective specific drug developed and used for COVID-19 (Yavuz and Ünal, 2020) and no vaccine or treatment (Hall et al., 2020). Therefore, many countries are taking several measures stopping productive activities from slowing down the spread of COVID-19 (Piguillem and Shı, 2020).

Modern humanity has not experienced an event that affects everyone in the world equally, except for COVID-19 (Galvani et al., 2020). It is currently impossible to avoid pandemics and limit the spread due to the increasing frequency of traveling (Çetin and Kara, 2020). This pandemic causes profound changes in governments, the global economy, and health systems (Delgado et al., 2020). It is associated with high mortality and morbidity (Arokiaraj, 2020). The most important difference of COVID-19 disease from other diseases is that it spreads very quickly. It spreads easily between people in close contact or through coughs and sneezes (Nussbaumer-Streit et al., 2020). Countries take many measures due to the high rate of virus spread among people. The well-known measures are flight restrictions to certain countries, gradually expanded to suspending all flights and prohibiting foreign national's entry, 14-day isolation, and symptom monitoring for those that came

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https://doi.org/10.1016/j.ijhm.2020.102719
Received 26 May 2020; Received in revised form 27 September 2020; Accepted 6 October 2020
Available online 2 November 2020

from countries under risk. These are some of the precautionary measures of countries (Demirbilek et al., 2020). In addition to these measures, quarantine the region might be considered one of the most significant actions. Therefore, cross-province and cross-city mobility were confined in China's emergence phases (Hao et al., 2020).

"*Quarantine is a marking of the creation of a boundary to ward off a feared biological contaminant lest it penetrate a healthy population*" (Musto, 1986). Quarantine is often proposed to control the spread of infectious diseases through a human population (Sattenspıel and Herrıng, 2003). Liu et al. (2020) highlighted that "*people in-home quarantine must stay at home (or at another designated location) and not go out, and they must maintain a distance of at least one meter from their family, record body temperature and health status every day, and cooperate with tracking measures implemented by their local borough chief*". Home quarantine is generally implemented in conjunction with district quarantines. It usually apply before regional quarantine decisions. However, if the pandemic mainly concentrates in some regions of the country, policymakers decide to apply regional quarantine immediately. Quarantine might be voluntary or mandatory (Cetron and Landwirth, 2005) due to the spread of pandemic. In the case of regional quarantine, policymakers make mandatory quarantine decisions. Regional quarantine aims to prevent movement from one region to another.

Quarantine is an essential public health measure to control outbreaks in practice (Kılıç et al., 2020). Quarantine has been used for centuries to prevent the introduction, transmission, and spread of communicable diseases (Barbisch et al., 2015). In COVID-19, it is imperative to prevent society's spread (Güner et al., 2020). Therefore, it is quite significant to determine the quarantine region(s). Sohrabi et al. (2020) highlighted that one of the key learning points from the response to COVID-19 is to identify high-risk quarantine areas as soon as possible. According to quarantine's social, psychological, and financial costs, deciding which cities should be on the list might be a critical challenge for policymakers (Sorooshian, 2020). Therefore, quarantine decisions during a pandemic should be taken by using the systematic method. There is no universal guideline regarding the quarantine decision during a pandemic. Each country makes its own quarantine decisions by taking into account its conditions and dynamics. There is a gap in the literature on making the right quarantine decisions to decrease the negative effect of a pandemic on the hospitality industry.

Decision-making trial and evaluation laboratory (DEMATEL) method provides the appropriate solutions to the policymakers for quarantine decisions due to the COVID-19 pandemic. Sorooshian (2020) proposed using the DEMATEL method to help decision-makers based on the cause and effect sources of COVID-19 infection in practice. The author also highlighted that the DEMATEL method is one of the most accepted methodologies in operational research, dealing with direct and indirect interrelationships and cross infection among cities. One of the main advantages of using the DEMATEL method in this study is that it provides a digraph showing causal relations among regions. DEMATEL is one of the multi-criteria decision-making methods. Mourıts and Oude Lansınk (2006) highlighted that multi-criteria decision-making methods are hardly applied in the management of quarantine disease control even though it generally improves the quality and transparency of the decision-making process. The DEMATEL method extends the use of multi-criteria decision-making in quarantine disease control and enriches the literature on multi-criteria decision-making.

Since the service sector is delicate during a pandemic, the quarantine decision worst affects the hospitality industry. Feyisa (2020) indicates that employment in leisure and hospitality fell by 459,000, mainly in food services and drinking places due to the COVID-19 pandemic. Additionally, in the world, the tourism industry is experiencing a reset due to the COVID-pandemic just as it did after the previous terrorist attack of 11 September 2001 and the global financial crisis in 2008 (Brouder, 2020). The pandemic's negative effect on the hospitality industry, one of the most critical sectors in the service, can be reduced by the right regional quarantine decisions.

COVID-19 pandemic is affecting the DNA of hospitality at its core (Rivera, 2020). In the last two decades, diseases with their origins in Central Asia, Central America, and Central Africa have significantly damaged several countries' image as a safe tourist destination (Günay et al., 2020). Tourism is one of the largest and fastest-growing industries globally (Ranasinghe et al., 2020).

However, regional quarantine decisions cause travel restrictions in contrast to the nature of tourism. Appropriate quarantine decisions can be made based on the DEMATEL method. Accordingly, the spread of the COVID-19 pandemic might reduce within the country by correct choices. The negative effects of unnecessary quarantines on the hospitality industry can be eliminated by using the DEMATEL method. Conversely, the low demand in the hospitality industry due to wrong quarantine decisions might significantly reduce the number of clients in practice.

The negative impact of the COVID-19 pandemic on the hospitality industry can be reduced by determining the regions with a high travel relationship due to the tourism. Quarantine of regions with no interaction between them will reduce the outbreak's harmful effects and create an unnecessary restriction for the hospitality industry. Thus, a causal and effect model, which is the DEMATEL method, is proposed to make quarantine decisions based on the household domestic tourism survey.

In this study, a real-life case study is conducted to find direct and indirect interrelationships among Turkey's regions using the DEMATEL method. The traveling information among the regions is used to construct the initial direct-relation matrix in the DEMATEL method. Data from the household domestic tourism survey obtained from the Turkish Statistical Institute (TurkStat) is used to acquire the number of people entering and exiting among regions. Turkey's 12 regions are evaluated by the DEMATEL method. The hospitality industry is one of the vital industries contributing to economic growth, especially in developing countries such as Turkey. The study findings also provide insightful hospitality approaches to the other developing countries by considering Turkey's experience.

2. Literature review

2.1. Hospitality industry and COVID-19 pandemic

Hospitality is related to "host and guest", "coming together", "tangible and intangible", and "providing security, psychological, and physiological comfort" (King, 1995). COVID-19 pandemic has done unprecedented damage to the hospitality industry (Gursoy and Chi, 2020). Possible negative effects of the COVID-19 pandemic on the hospitality industry might be minimized with the effective management. Although there are limited studies in the literature, they are guiding for managing pandemic. Among these studies, Hoefer et al. (2020) reported eight cases associated with managing a COVID-19 outbreak in a hotel in Tenerife, Spain. They highlighted that the collaboration and communication between the Public Health authorities and the hotel management were vital for controlling the COVID-19 pandemic. Hao et al. (2020) proposed COVID-19 management to address the anti-pandemic phases, principles, and strategies. Duarte Alonso et al. (2020) conducted an empirical research-using sample of 45 hospitality firms, and *60 percent recognized making changes to the business's day-to-day running to respond to initial impacts or biding time in anticipation of a changing business and legal environment*. In another study, Filimonau et al. (2020) conducted an online survey of a sample of senior managers in Spanish hotels. They used structural equation modeling to assess the relationships among organizational resilience, organizational response to COVID-19, perceived job security, and organizational commitment. Huang et al. (2020) used regression models to analyze the effects of intervention policies necessitated by COVID-19 on the hospitality labor market in small businesses of the U.S. economy.

Additionally, Hu et al. (2020) focused on how organizations can achieve deep compliance with COVID-19 safety measures in the

hospitality industry. They highlighted a four-stage psychological process, including 1) heightened risk and health awareness, 2) perceived utility value, 3) behavioral adaptation, and 4) integration towards COVID-19. Farmaki et al. (2020) utilized interviews with P2P accommodation hosts to examine the impacts of COVID-19 on peer-to-peer accommodation platforms. Shin and Kang (2020) conducted three experimental studies using online survey samples to examine the impact of expected interaction and expected cleanliness on perceived health risk and hotel booking intention. Furthermore, purchasing online food deliveries (Cai and Leung, 2020) and factors determining customers' experience using food delivery apps during the COVID-19 pandemic period (Zhao and Bacao, 2020) has also been analyzed.

The tourism industry will be the most affected by the COVID-19 pandemic, as there are travel bans (both external and internal) and border closures (Karabuluta et al., 2020; Sönmez et al., 2020). Kourgiantakis et al. (2020) conducted an online questionnaire to research tourists' travel intentions and traveling behavior during the pandemic in Greece. In another study, Yang et al. (2020) used dynamic stochastic general equilibrium modeling to evaluate the impact of the COVID-19 pandemic on tourism industry. Besides, Li et al. (2020) constructed a structure model to assess the COVID-19 impact on intra-pandemic perceptions and post-pandemic travel planned behaviors. Furthermore, Sharma and Nicolau (2020) evaluated the effects of COVID-19 on the travel and tourism industry considering major subsectors within the travel industry – airlines, hotels, cruise lines, and rental cars. The effect of COVID-19 on different aspects of the tourism industry was highlighted in the literature. Among them are the social costs of tourism during the COVID-19 pandemic (Qiu et al., 2020), the effects of the COVID-19 pandemic on the tourist's psyche (Kock et al., 2020), hotel marketing and management (Jiang and Wen, 2020), hospitality workforce (Baum et al., 2020), sustainability in the hospitality industry (Jones and Comfort, 2020), and global tourism industry (Uğur and Akbıyık, 2020). Additionally, the effects of the COVID-19 pandemic on Chinese citizens' lifestyle and travel (Wen et al., 2020), Indian food and hospitality sector with specific reference to potato crop (Masih et al., 2020), and tourism sector and hotel businesses in Marmaris (Bayat, 2020) has been researched in the literature.

In the literature, the researchers discussed the effects of the COVID-19 pandemic on various countries' tourism and hospitality industry. Among them, the effects of the COVID-19 pandemic on the tourism and hospitality industry in Bangladesh (Hafsa, 2020), the tourism industry in Malaysia (Foo et al., 2020), and the tourism and hospitality industry in India (Kumar, 2020a, b) has been examined in the literature as well. Karim et al. (2020) researched the impact of the Movement Control Order, which the government imposed in Malaysia to prevent the spread of COVID-19, on the tourism and hospitality industry in Malaysia. Rutynskyi and Kushniruk (2020) analyzed the tourism industry's sectoral losses during quarantine due to the COVID-19 pandemic in Lviv.

Chen et al. (2020) used an automated content analysis approach based on the data of Chinese newspaper articles related to the COVID-19 and tourism. Although social distancing, self-isolation, and travel restrictions are keywords to reduce the impact of the COVID-19 pandemic on the hospitality industry, these measures have lead to a reduced workforce across all economical sectors and caused many jobs to be lost (Nicola et al., 2020). It is also known that the COVID-19 crisis has led to international distortions for the hospitality industry (Nicola et al., 2020). Initially, travel restrictions between certain countries and advisory measures like work from home to promote social distancing are applied. However, they realized that the virus had already spread, and many governments switched to mandatory restrictions like lockdowns and travel bans (Tuzovic and Kabadayi, 2020). In another study, Tsionas (2020) discussed the problem of post-COVID-19 gradual adjustment in the tourism and hospitality industry. Mariolis et al. (2020) estimated the COVID-19 multiplier effects of tourism on gross domestic product (GDP), total employment, and trade balance of the Greek economy.

As can be seen from the above literature, there is a gap in the literature about making the right quarantine decisions to reduce the negative impact of a pandemic on the hospitality industry. This study uses a decision-making trial and evaluation laboratory (DEMATEL) to assist countries in quarantine decisions due to the COVID-19 pandemic to fill this gap. To the best of our knowledge, this is the first study that applies the DEMATEL method for quarantine decisions due to the COVID-19 pandemic.

2.2. The DEMATEL method

The DEMATEL can be used to find interdependence among factors and investigate and solve complicated and intertwined problems (Si et al., 2018). Researchers perform the application of the DEMATEL method to the hospitality industry. For example, Horng et al. (2013) used the DEMATEL method to find relationships among creativity dimensions for future restaurant space design. Chen et al. (2011) utilized the DEMATEL method to establish a performance evaluation and relationship model for hot spring hotels. In another study, Cheng et al. (2012) performed the DEMATEL method to explore the service quality improvement priority of fine-dining restaurants and the causal relationship between service quality attributes in practice. Additionally, Lin et al. (2020) used the DEMATEL method to find the interdependence of the critical motives behind hotel giving in Taiwan.

Application of the DEMATEL method to problems related to the COVID-19 pandemic has been conducted in the literature. For example, Dizbay and Öztürkoğlu (2020) highlighted the importance of demand forecasting for the COVID-19 vaccine. They conducted the DEMATEL method to find the cause and effect relationships among the factors and provide insights to managers for better vaccine demand forecast. Their study showed that immunization related beliefs is the most critical factor for vaccine demand forecast. Maqbool and Khan (2020) identify then ten barriers to implementing public health and social measures to prevent transmission of COVID-19 and used the DEMATEL method to find the casual relationships among these barriers. Maqbool and Khan (2020)' study concluded that lack of resources for implementing public health and social measures is the most influential barrier. In another study, Kashyap and Raghuvanshi (2020) identified the critical success factors for developing COVID-19 preventive strategies to control the pandemic using the fuzzy logic based DEMATEL method.

A systematic methodology to solve quarantine decisions during a pandemic is very important to decrease the spread of infectious diseases. There is no systematic methodology to solve the quarantine decision-making problem in the literature. The solution to the problem highly depends on human flow among the regions. The best indicator showing human flow among the regions is the number of people entering and exiting among regions. The DEMATEL method is an excellent systematic methodology for making correct quarantine decisions due to the COVID-19 pandemic (Sorooshian, 2020). A better understanding of the structural relationship and an ideal way to solve complicated system problems are handled by the DEMATEL method (Li et al., 2014).

Correct quarantine decision mainly aims to decrease the maximum rate of spread with minimal restrictions. In this sense, the number of cases in a region might significantly decrease, considering generated alternative quarantine decisions based on the DEMATEL method's results. The DEMATEL method considers interdependence among variables and aid in the development of a chart to reflect interrelationships between variables. It might also provide practical solutions for researching and solving complicated and intertwined problem groups concepts (Li and Tzeng, 2009). Here, variables refer to regions. The DEMATEL method divides regions into two groups, cause and effect groups in a digraph (Wu, 2008). The main steps of the DEMATEL method are given as follows in a stepwise manner based on Wu (2008) and Hsu et al. (2013).

Step 1: Calculate the average initial direct-relation matrix (**A**):

Matrix **A** (average initial direct-relation matrix) = $[a_{ij}]$

$$a_{ij} = \frac{1}{H} \sum_{k=1}^{H} X_{ij}^{k} \quad (1)$$

where,

H = number of experts

n = number of factors (total number of regions equals "n" in this study)

k = number of respondents surveyed

X_{ij}^{k} = degree of influence for factor i to factor j concerning k^{th} respond (factor refers to the region in this study)

Step 2: Calculate the direct influence matrix (**D**): The direct influence matrix **D** is computed using Eq. (2) and Eq. (3).

$$S = \max\left(\max_{1<i<n} \sum_{j=1}^{n} a_{ij}\ ,\ \max_{1<j<n} \sum_{i=1}^{n} a_{ij}\right), \quad (2)$$

$$\mathbf{D}\ (\text{the direct influence matrix}) = \frac{\mathbf{A}}{S} \quad (3)$$

Step 3: Calculate the total relation matrix (**T**): The total relation matrix implies total-influence matrix, and it is calculated using Eq. (4).

$$\mathbf{T} = \mathbf{D}\ (I - \mathbf{D})^{-1} \quad (4)$$

where, I = identity matrix.

Step 4: Set up a threshold value to draw a digraph showing causal relations among regions and calculate C, R, ri + cj, and ri - cj values. The threshold value can be calculated based on computing the average elements in matrix T or the opinion of decision-maker(s).

- C = sum of a column of the matrix T.
- cj represents direct and indirect effects on factor j by the other factors.
- R = sum of a row of the matrix T.
- ri represents direct and indirect effects given by factor i to the other factor.
- ri + cj = the importance of factor i.
- ri- cj = the net effect of factor i.

3. Analysis and results

COVID-19 is now a pandemic spreading in most countries, including Turkey (Petersen and Gökengin, 2020). Turkey's first COVID-19 case was a 44-year-old male referred to the hospital on 9 March 2020 (Demirbilek et al., 2020). "*Control of infectious diseases is a major public health concern*" (Farewell et al., 2005). Quarantine decision during a pandemic is critical to control the disease. Turkey established a Science Committee and "COVID-19 Risk Assessment", "COVID-19 Guideline" and "Case Report Form" regulations of personal protective equipment along with need-based guidelines, treatment algorithms, brochures, and related documents (Demirbilek et al., 2020).

In this section, travel information among regions in Turkey is obtained from Turkey Statistical Institute (TurkStat), and the application of the DEMATEL method is described in detail. The number of people entering and exiting among regions is needed to apply the DEMATEL method for quarantine decisions due to COVID-19 Pandemic in Turkey. Therefore, Household Domestic Tourism Survey data obtained from TurkStat is used in this study. The data gives the travel information between entering and exiting among the 12 regions of Turkey. Data were collected from household members residing domestically by computer-aided face-to-face interview method. All households living in settlements located within the borders of Turkey participated in the survey study. The data are arranged in the form of a matrix by the DEMATEL method. Then the implementation steps of the DEMATEL method are conducted in this section. It should be noted that the diagonal of the input matrix should be "zero" for applying the DEMATEL method. Although there are travel information within the regions, we assigned "zero" at the diagonal of the matrix due to the DEMATEL method's properties. The average initial direct-relation matrix (A) is presented in Table 1. As shown in Table 1, the row shows the region of residence and the column shows the region visited.

The direct influence matrix (D), which shows the normalized initial direct-relation matrix, is calculated based on Eq. (3) and given in Table 2.

The total relation matrix (T) showing total-influence based on the direct influence matrix is given in Table 3. As indicated in Step 4 of the DEMATEL method, it is necessary to set up a threshold value to filter out some negligible effects in practice. The average of the elements in matrix T is computed to determine the threshold value in this study. The average of the elements in matrix T is 0.0339. The summary table obtained from the total relation matrix (T) is given in Table 4. Table 4 shows the total relations among regions, ignoring negligible effects. In other words, Table 4 shows only affects greater than the threshold value. The sum of influences given and received among the regions is given in Table 5.

Fig. 1 illustrates the digraph showing causal relations among regions. Fig. 1 shows that the regions are visually divided into two groups: the cause group (net causes) and the effect group (net receivers). Istanbul (TR1), East Marmara (TR4), and West Anatolia (TR5) are net causes. In contrast, West Marmara (TR2), Aegean (TR3), Mediterranean (TR6), Central Anatolia (TR7), West Black Sea (TR8), East Black Sea (TR9), North East Anatolia (TR10), Central East Anatolia (TR11), and South East Anatolia (TR12) are net receivers based on R-C values.

TR1 is affected by TR2, TR3, TR4, TR5, TR6, TR7, TR8, and itself but affects all regions. Thus, Istanbul is a critical region concerning quarantine decisions due to COVID-19 Pandemic in Turkey. Istanbul is Turkey's most populous region. Therefore, a quarantine decision regarding Istanbul will affect all regions in Turkey. Decision-makers should pay attention to three regions, namely TR1, TR4, and TR5 rather than receivers (TR2, TR3, TR6, TR7, TR8, TR9, TR10, TR11, and TR12). Consequently, there is a quarantine decision regarding TR1, TR4, and TR5 that would have a high effect on TR3 and TR6 in practice.

4. The effect of COVID-19 pandemic on the hospitality industry

The hospitality industry is one of the most affected industries in a pandemic. Planning the impact of a global health epidemic on the hospitality and tourism industry is essential (Baum and Hai, 2020). The clients' expectations might be directly affected by the states' measures and regulations concerning hospitality restrictions in the pandemic. Regional quarantine decisions are one of the most critical measures taken by states in this period.

The number of COVID-19 patients in Istanbul is significantly higher than in Turkey's other regions (see Fig. 2). The DEMATEL method shows that Istanbul is a prominent first-degree region affecting other parts of Turkey. Istanbul is the center of the trade, production of goods and services, especially for tourism. Thus, we argued that it would be beneficial for the decision-makers to review the situation of Istanbul regarding COVID-19 and quarantine practices based on the DEMATEL method's results.

TR1, TR4, and TR5 regions with the highest domestic tourism activity. Moreover, these regions are in the cause group (see Fig. 1). This result implies that TR1, TR4, and TR5 regions might adversely affect other regions of the hospitality industry in Turkey due to the COVID-19 pandemic.

The number of beds of the regions are given in Table 6. It has only 20.8 percent of the total number of beds in the TR1, TR4, and TR5 regions. Besides, it is remarkable that TR3, TR6, and TR8 regions, which have the second-highest domestic tourism mobility, have 64.7 percent of the total bed capacity.

As it can be seen from Table 5, the importance of the region can be prioritized as TR1 > TR5> TR6 > TR3 > TR4 >

Table 1
Average initial direct-relation matrix (A).

	Region visited												
		TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TR10	TR11	TR12
Region of residence	**TR1**	0	3062190	2793073	3013203	942429	1869288	833904	2064807	1622686	482116	504607	699985
	TR2	924717	0	595791	331376	141295	163831	107200	216122	96897	38415	50510	62718
	TR3	728065	637533	0	592303	668457	843352	394142	296143	107915	176703	83299	243726
	TR4	1326789	675307	1259126	0	708317	679775	286360	687490	391028	228236	175095	132578
	TR5	881709	314747	1513476	785275	0	1918681	1177652	1518446	311132	240763	176735	203032
	TR6	763297	57969	1100236	210394	866196	0	693499	130927	123094	40193	366167	1430803
	TR7	484058	72592	259618	206708	482447	656532	0	195196	109482	49465	79083	75573
	TR8	868086	112187	210440	297201	845006	174745	137934	0	369354	28560	29734	41340
	TR9	346803	20439	74327	96751	172428	141932	46799	123528	0	69332	10424	15779
	TR10	148626	15009	88967	100431	62435	106303	20475	34378	142001	0	12554	5886
	TR11	306858	23059	108548	97553	169908	228208	43599	30124	34503	35949	0	244615
	TR12	325275	35483	221022	126337	139861	1220786	55723	33067	52855	4992	185820	0

TR1: Istanbul; **TR2**: West Marmara; **TR3**: Aegean; **TR4**: East Marmara; **TR5**: West Anatolia: **TR6**: Mediterranean; **TR7**: Central Anatolia; **TR8**: West Black Sea; **TR9**: East Black Sea; **TR10**: North East Anatolia; **TR11**: Central East Anatolia; **TR12**: South East Anatolia.

Table 2
The direct influence matrix (D).

	Region visited												
		TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TR10	TR11	TR12
Region of residence	**TR1**	0.0000	0.1712	0.1561	0.1684	0.0527	0.1045	0.0466	0.1154	0.0907	0.0270	0.0282	0.0391
	TR2	0.0517	0.0000	0.0333	0.0185	0.0079	0.0092	0.0060	0.0121	0.0054	0.0021	0.0028	0.0035
	TR3	0.0407	0.0356	0.0000	0.0331	0.0374	0.0471	0.0220	0.0166	0.0060	0.0099	0.0047	0.0136
	TR4	0.0742	0.0378	0.0704	0.0000	0.0396	0.0380	0.0160	0.0384	0.0219	0.0128	0.0098	0.0074
	TR5	0.0493	0.0176	0.0846	0.0439	0.0000	0.1073	0.0658	0.0849	0.0174	0.0135	0.0099	0.0113
	TR6	0.0427	0.0032	0.0615	0.0118	0.0484	0.0000	0.0388	0.0073	0.0069	0.0022	0.0205	0.0800
	TR7	0.0271	0.0041	0.0145	0.0116	0.0270	0.0367	0.0000	0.0109	0.0061	0.0028	0.0044	0.0042
	TR8	0.0485	0.0063	0.0118	0.0166	0.0472	0.0098	0.0077	0.0000	0.0206	0.0016	0.0017	0.0023
	TR9	0.0194	0.0011	0.0042	0.0054	0.0096	0.0079	0.0026	0.0069	0.0000	0.0039	0.0006	0.0009
	TR10	0.0083	0.0008	0.0050	0.0056	0.0035	0.0059	0.0011	0.0019	0.0079	0.0000	0.0007	0.0003
	TR11	0.0172	0.0013	0.0061	0.0055	0.0095	0.0128	0.0024	0.0017	0.0019	0.0020	0.0000	0.0137
	TR12	0.0182	0.0020	0.0124	0.0071	0.0078	0.0682	0.0031	0.0018	0.0030	0.0003	0.0104	0.0000

Table 3
The total relation matrix (T).

	Region visited												
		TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TR10	TR11	TR12
Region of residence	**TR1**	0.0576	0.1996	0.2070	0.1991	0.0910	0.1492	0.0718	0.1462	0.1092	0.0360	0.0385	0.0606
	TR2	0.0607	0.0140	0.0490	0.0324	0.0171	0.0225	0.0128	0.0232	0.0131	0.0051	0.0059	0.0090
	TR3	0.0564	0.0494	0.0234	0.0485	0.0495	0.0651	0.0324	0.0311	0.0150	0.0134	0.0092	0.0228
	TR4	0.0938	0.0601	0.0993	0.0253	0.0571	0.0637	0.0302	0.0586	0.0349	0.0180	0.0156	0.0191
	TR5	0.0767	0.0394	0.1160	0.0673	0.0256	0.1329	0.0811	0.1031	0.0310	0.0188	0.0172	0.0283
	TR6	0.0581	0.0190	0.0823	0.0294	0.0607	0.0262	0.0494	0.0230	0.0158	0.0062	0.0251	0.0871
	TR7	0.0360	0.0130	0.0285	0.0215	0.0346	0.0479	0.0071	0.0200	0.0116	0.0050	0.0073	0.0106
	TR8	0.0590	0.0199	0.0309	0.0314	0.0557	0.0264	0.0167	0.0141	0.0286	0.0049	0.0051	0.0083
	TR9	0.0231	0.0063	0.0110	0.0109	0.0132	0.0134	0.0057	0.0116	0.0031	0.0050	0.0019	0.0033
	TR10	0.0106	0.0035	0.0085	0.0083	0.0055	0.0088	0.0028	0.0043	0.0094	0.0006	0.0014	0.0017
	TR11	0.0211	0.0062	0.0130	0.0107	0.0131	0.0189	0.0056	0.0062	0.0048	0.0031	0.0015	0.0165
	TR12	0.0258	0.0084	0.0240	0.0143	0.0152	0.0755	0.0092	0.0079	0.0069	0.0019	0.0132	0.0079

TR8 > TR2 > TR7 > TR12 > TR9 > TR11 > TR10 based on (R + C) values. TR1 and TR5 regions have the highest domestic tourism mobility, and these regions rank first and second regarding their importance. Therefore, it is essential to make quarantine decisions carefully regarding these regions.

TR9, TR10, and TR11 are regions with the least domestic tourism activity (see Fig. 2). TR9, TR10, and TR11 are the least affected regions in the COVID-19 pandemic based on the result of the DEMATEL application (see Fig. 1). Furthermore, TR9, TR10, and TR11 do not affect other regions in Turkey. TR10 and TR11 regions are only affected by Istanbul. Accordingly, if Istanbul is not quarantined, the hospitality industry in the TR10 and TR11 regions may be negatively affected by the COVID-19 pandemic. TR9 region is affected by both Istanbul and TR4 regions.

A total of 198,284 laboratory-confirmed cases of coronavirus disease in 2019 is reported to the Ministry of Health (COVID-19 Situation Report, 2020). 54.85 percent of the total number of cases are in Istanbul. TR1, TR4, and TR5 regions in the impact class have 73.4 percent of the total number of cases. 73.4 percent of the total number of cases are in the cause group (TR1, TR4, and TR5). Hence, the current number of cases supports the validity and reliability of the DEMATEL method's results.

These results imply that determining the quarantined regions in a correct and timely manner might directly affect the hospitality industry. In other words, stopping the interaction between quarantine regions and safe regions is essential to ensure tourism continuity. This analysis will be crucial for both policymakers and individuals in the sector. The hospitality industry might have a chance to sustain by timely and correctly defining the quarantine-needed regions.

Table 4
Summary table obtained from Table 3.

	Region visited	TR1	TR2	TR3	TR4	TR5	TR6	TR7	TR8	TR9	TR10	TR11	TR12
Region of residence	**TR1**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	TR2	✓		✓									
	TR3	✓	✓		✓	✓	✓						
	TR4	✓	✓	✓		✓	✓		✓	✓			
	TR5	✓	✓	✓	✓		✓	✓	✓				
	TR6	✓		✓		✓		✓					✓
	TR7	✓				✓	✓						
	TR8	✓				✓							
	TR9												
	TR10												
	TR11												
	TR12						✓						

Table 5
The sum of influences given and received among the regions.

Region	R	C	R + C	R-C
TR1	1.3659	0.5789	1.9448	0.7869
TR2	0.2648	0.4387	0.7036	−0.1739
TR3	0.4162	0.6930	1.1092	−0.2768
TR4	0.5757	0.4991	1.0748	0.0766
TR5	0.7376	0.4384	1.1759	0.2992
TR6	0.4823	0.6505	1.1328	−0.1681
TR7	0.2432	0.3248	0.5680	−0.0816
TR8	0.3010	0.4492	0.7502	−0.1482
TR9	0.1083	0.2833	0.3916	−0.1749
TR10	0.0654	0.1182	0.1836	−0.0528
TR11	0.1209	0.1422	0.2631	−0.0213
TR12	0.2104	0.2754	0.4858	−0.0650

5. Conclusion

Quarantine decisions are the most critical decisions affecting the hospitality industry during pandemic periods. The decision of which regions to quarantine directly affects the country's economy. It can affect all areas of trade, especially tourism and supply chain. Determining the quarantined-regions by considering the causative relationships between the regions might decrease the negative consequences of the COVID-19 pandemic on the hospitality industry. For this reason, a systematic approach should be applied to determine the quarantined region during the COVID-19 pandemic. In this study, a systematic approach for determining the quarantine decision is presented using the DEMATEL method. Additional measures related to travel and trade might be avoided for public health through the DEMATEL method.

Travel information among Turkey's regions is based on household domestic tourism survey data obtained from Turkey Statistical Institute (TurkStat). The number of people entering and exiting among regions was used to analyze causative relations among the 12 regions of Turkey.

These regions are visually divided into two groups. The first group describes the cause group (net causes) consist of Istanbul (TR1), East Marmara (TR4), and West Anatolia (TR5) are in the first group, whereas West Marmara (TR2), Aegean (TR3), Mediterranean (TR6), Central Anatolia (TR7), West Black Sea (TR8), East Black Sea (TR9), North East Anatolia (TR10), Central East Anatolia (TR11), and South East Anatolia (TR12) are net receivers (the second group). The cause group is critical to slow the spread of COVID-19 disease in practice. This study's findings show that Istanbul has a high effect on the spread of the COVID-19 pandemic.

Tourism firms need to become more agile, flexible, and open (Sigala, 2018). However, little is still known how tourism firms (should) response to the disaster like COVID-19. Especially in the crisis, the hospitality industry should become adapted to the new environment. Therefore, understanding the restrictions and consequences of disaster might be insightful for the service sector. Determining the quarantined regions in a correct and timely manner might be essential for the hospitality industry when considering the spreading of the COVID-19. Thence, tourism firms might have options for new investment or joint ventures in non-quarantined regions to decrease the negative economic effect of COVID-19. The DEMATEL method provides correct and consistent solutions to determine the quarantined regions and the causative effects on the rest of the country. The hospitality industry

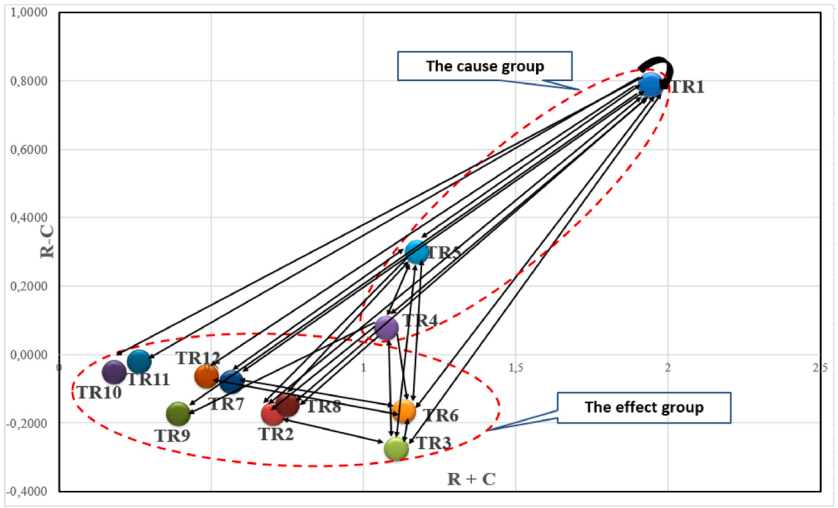

Fig. 1. The digraph showing causal relations among regions.

Fig. 2. COVID-19 cases and region of residence (prepared by the authors based on COVID-19 Situation Report (2020) and TurkStat (2018).

Table 6
Number of beds of the regions (Tourism Statistics 1, 2020).

Region	TR1	TR2	TR3	TR4	TR5	TR6
Number of Beds	202474	77237	306046	76394	46445	664312
Percent (%)	13.0	4.9	19.6	4.9	2.9	42.5
Region	**TR7**	**TR8**	**TR9**	**TR10**	**TR11**	**TR12**
Number of Beds	46827	40652	28234	19856	19448	33690
Percent (%)	3.0	2.6	1.9	1.3	1.2	2.2

might handle disaster effects by conducting alternative investment plans in non-quarantined regions by using this analysis findings.

Moreover, Turkey, as a developing country, especially in hospitality, might be a role model for other hospitality-oriented countries. The methods and practices to be developed for the early and accurate determination of quarantine regions might be useful for other tourism countries. With the quarantine of the risk generating regions, the spread of diseases might be decreased, and the regions suitable for tourism will be identified. Thus, tourism activities might be carried out in mutual interaction, both within the country and between countries, among safe regions. Therefore, the methodology identified in this study might shed light on the hospitality industry to determine the degree of safe regions in disaster periods. At the micro-level, tourism firms might have a chance to decide new investments in safe regions wherein macro-level governments might develop new projects or funds to support the hospitality industry in quarantined or non in case.

The contribution of this paper is twofold. This is the first study that applies a mathematical modeling method for quarantine decisions due to the COVID-19 pandemic to the best of our knowledge. Second, the application of the DEMATEL method for quarantine decision due to the COVID-19 pandemic extends the use of a multi-criteria decision-making method in the field of quarantine disease control and contributes the literature on multi-criteria decision making.

Quarantine regions might be decided using the DEMATEL method based on flight information between countries in future studies. Additionally, the population and the acreage of the regions might be essential inputs. The diffusion speed of COVID-19 disease among regions can be calculated based on the population information per square kilometers for better quarantine decisions due to the COVID-19 pandemic. The short and long-term effects of the COVID-19 pandemic on the hospitality industry should be researched by considering the quarantine times for the quarantined areas in future research.

Acknowledgments

The first author is grateful to the Council of Higher Education in Turkey for supporting her scientific studies.

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