International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676

Estimating the Effect of Smoking and Alcohol Consumption on Health Expenditures by Spectral Causality Approach: Evidence from The Turkish Case

Kerem ÖZEN [1]
M. Akif ARVAS [2]
Meltem INCE YENILMEZ [3]

Received: 06.07.2023, Accepted: 28.12.2023
10.5281/zenodo.10475958

Abstract

The main purpose of this study is to evaluate the effects of smoking and alcohol use on health expenditures in Turkey. For this purpose, the spectral Granger causality approach was used, and the data set was collected from the OECD stat website for the period 1990 and 2019. According to the first finding, there is a strong causality between smoking and alcohol use and health expenditure, specifically in the 0, 0.5 domains, and supports the existence of bidirectional causality. Secondly, while there was a unidirectional causality from alcohol to health, this causality was found to be stronger in the following years. The last finding surprisingly revealed that tobacco use was not the Granger cause of health expenditures, whereas reverse causality was only supported in the domains of 0 and 2.5.

Keywords: Smoking, Alcohol Use, Health expenditures, Spectral Granger Causality

JEL Code: I10, I11, C10

1. Introduction

Tobacco and alcohol use contribute fundamentally to diseases and the economic burden of tobacco and alcohol-related diseases. Since these two habits are closely linked behaviors, those people who drink alcohol are more likely to smoke, or who smoke more cigarettes may also drink larger amounts of alcohol. One of the worst sides of this mutual connectivity of habits, people may also tend

[1] PhD, Independent Researcher, Turkey, keremozen5@gmail.com, http://orcid.org/0000-0003-2264-2787
[2] Prof. Dr., Van Yüzüncü Yıl University, Turkey, aarvas@yyu.edu.tr, http://orcid.org/0000-0002-0866-8860
[3] Prof.Dr., Izmir Democracy University, Turkey, melteminceyenilmez@gmail.com http://orcid.org/0000-0002-4689-3196

to use the drugs and be diagnosed with dependence on one of the drugs. Specifically, when alcohol and tobacco are concurrently consumed, they together increase the risk of various forms of cancer, notably lung cancer, as well as cardiovascular diseases. According to the World Health Organization (WHO) reports (World Health Statistics, 2022), almost 8 million people die from tobacco and 3.5 million from alcohol-related diseases each year in the world.

All these difficulties undermine global sweat toward mortal development, particularly in low and middle-income nations (LMICs). Tobacco items are utilized by an estimated 1.3 billion individuals around the world, with 80% living in LMICs (WHO, 2020a). As indicated by late information, tobacco care is imprudently managing its items to women and kids in peaceful areas to extend demand share (Centers for Disease Control and Prevention, 2020). The acting trouble in upholding compelling tobacco control measures is expected partially due to an absence of logical approval of tobacco's beneficial products. For many in society, alcoholic drinks are seen as a routine part of daily life and, therefore, in social environments donated with high visibility, social media popularity, or influence of popular culture worldwide, alcohol is widely accepted as the means of socializing, alongside the tobacco, in the youth. It is marked in the WHO reports, that extensive use of alcohol is responsible for 7.2% global burden of disease for men and 2.3% of women, respectively. As for disability and premature mortality among individuals aged 15 to 49 years, alcohol consumption is responsible for 10 % of all deaths in this age group. Higher rates of alcohol-related death and hospitalization are more common in disadvantaged and especially vulnerable individuals (https://www.who.int/health-topics/alcohol#tab=tab_1).

The economic impact of smoking and drinking does not focus on whether both are harmful on medical grounds, rather it focuses on financial dimensions and the economic burden of these habits in the health care system for many countries. For example, alcohol consumption above 1.5 drinks per day cap increases health costs on average by $61 per capita annually in extra health care expenditure across OECD countries (https://www.oecd-ilibrary.org/), extensively in Australia. The adverse effects of alcohol-related diseases are prevalent as a decrease in life expectancy, employment, and productivity, which can lead to a reduction of 1.6% each year on average in the Gross domestic product (GDP) in the OECD area. This causal link, respectively, makes it necessary to increase tax rates, an equivalent of USD PPP 232 per year. For instance, in France, healthcare costs for alcohol-related diseases made up almost 10% of total healthcare expenditure, which is the highest rate in the OECD, in 2021. In addition to alcohol-related costs, the economic burden of smoking-related diseases and losses in productivity is expected as huge as it was thought, for example, in the USA, it is estimated that smoking costs hit more than $300 billion each year (https://psychiatry.uchicago.edu/news/real-cost-smoking-state).

Since, to the best of our knowledge, there is not any study analyzing the impact of both alcohol use and smoking on health care expenditure in Turkey, this is the first study empirically analyzing the issue for the Turkish case, employing a recently developed approach, known as Granger spectral causality at domain. It has always been evident that spectral analysis is strictly descriptive and cannot be used directly for predicting, but it is nevertheless an effective tool for examining cyclical phenomena and emphasizing lead-lag relationships between series. Additionally, it offers a thorough and flexible technique to describe each series component formally and quantitatively, and by using filtering, it offers a trustworthy estimation method.

The rest of this report is structured as follows: Section 2 gives some graphical information on tobacco and alcohol consumption between men and women in some selected countries and Turkey. This section also contains some summary statistics on overall tobacco and alcohol use patterns, but it also highlights some of the findings to give a fresh environment to the recommended need for better data gathering to inform further rigorous programs. Section 3 includes a brief literature review on the topic. Section 4 will examine the approach, the data set and issues of estimating the causality relationship between tobacco and alcohol use and health expenditure. Section 5 concludes with a summary and conclusion.

2. Tobacco and Alcohol Use

Many countries have launched various attempts to reduce the detrimental effects of alcohol and tobacco use. Alcohol and cigarette tariffs aim to reduce risky substance use while also raising funds for the state. Overconsumption rules have been imposed because cigarette and alcohol usage cause widespread diseases globally and hence have a large influence on healthcare costs. Those who use alcohol or smoke risk not just themselves but also the environment. Such harm not only prevents society's well-being from reaching its apex but also disrupts the market system. It appears that good resource utilization is challenging since it disrupts the market system (Dinler, 2008).

People who are exposed to cigarette smoke are more likely to have the same health problems as smokers. Alcohol varies from cigarettes in this regard. Cigarettes do significantly more environmental harm than alcohol, and they also cause natural pollution in the butts that are tossed into the environment (Uğur et al., 2010).

Cigarette use has a negative externality in some cases. It also has a cost. Governments use a set proportion of alcohol and tobacco consumption taxes from resource allocation to retain efficiency and prevent negative externalities from alcohol and tobacco use. As a result, governments must allocate funds for healthcare spending. In the case of a market failure, the government employs both monetary and fiscal policies to reduce macroeconomic insecurity (Dinler, 2008).

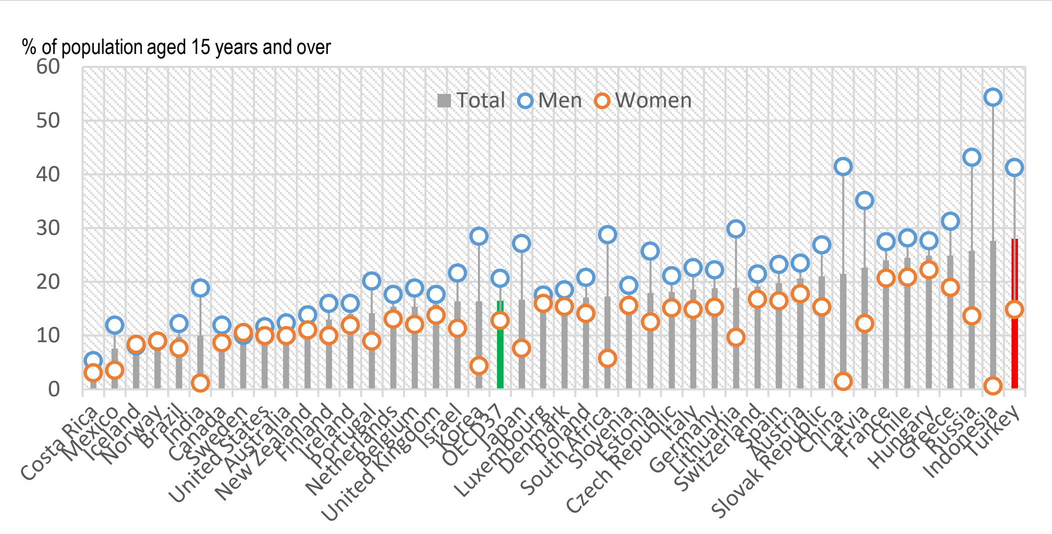
Tobacco smoking is known to cause lung disease, decreased blood circulation, skin aging, heart attacks, and premature death (Ergüder, 2008). Smoking is also known to cause illnesses such as asthma and COPD in pregnant women (Karlıkaya et al., 2006). Because of the decline in air quality in smoking

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676

situations, nonsmokers inside may be harmed by these airless circumstances. Furthermore, the treatment of disorders caused by alcohol and cigarette use is an exceedingly costly and time-consuming process.

It is stated that, in addition to the harm caused by cigarettes and alcohol, the money spent to provide them will be far more beneficial to human health if spent on other products rather than alcohol and cigarettes. Simultaneously, the proportion spent on diseases caused by these things will no longer be an economic burden on a country (Uğur et al., 2010). To alleviate some of the burdens, governments impose a certain amount of tax on the sale of alcohol and cigarettes (Apar, 2015). The transfer of such negative externalities to all taxpayers via increased health insurance and higher taxes has massive financial ramifications (Sissosko, 2009).

Figure 1. Population aged 15 and over smoking daily, by sex, 2019 (or nearest year)

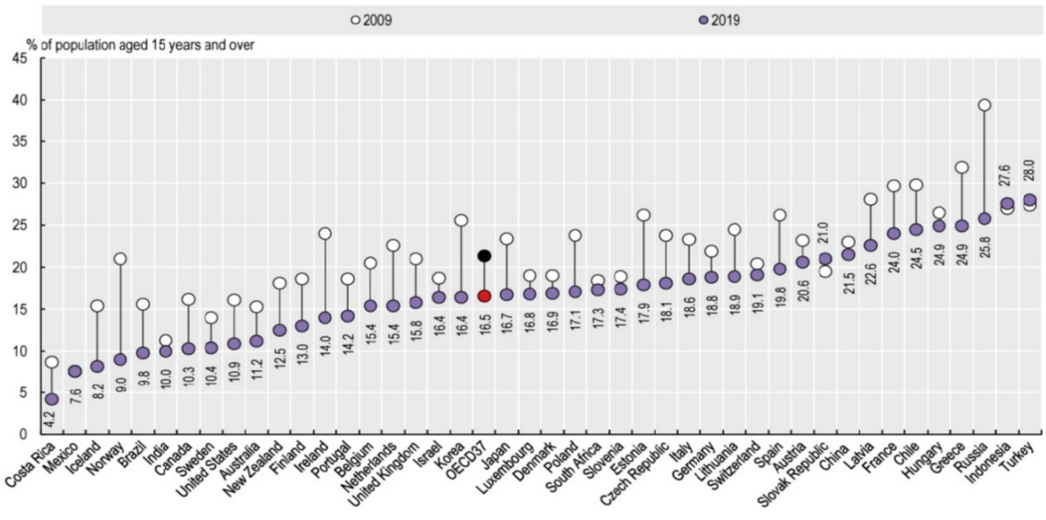


Source: OECD Health Statistics 2021.

In 2019, 16.5 percent of people aged 15 and above in OECD nations smoked daily (Figure 1). Smoking rates range from more than 25% in Turkey to less than 10% in Costa Rica, Mexico, Iceland, and Norway. Indonesia (27.6 percent) and Russia (25.8 percent) have relatively high rates among partner nations, whereas Brazil and India have rates of 10 or below. Men smoke more than women in all nations except Sweden, Norway and Iceland; among OECD countries, 20.6 percent of men and 12.8 percent of women smoke daily. Smoking prevalence differed significantly by gender in Turkey, South Korea, Indonesia, the People's Republic of China (China), and Russia. The largest percentages of males were found in Indonesia (54.4 percent), Russia (43.2 percent), China (41.5 percent), and Turkey (41.3 percent), with the lowest percentages found in Costa Rica, Iceland, and Norway. Women outpaced males in Hungary, Chile, and France (over 20 percent).

Less than 5% of women in Indonesia, India, China, Costa Rica, Mexico, and South Korea smoke.

Figure 2. Population aged 15 and over smoking daily, 2009 and 2019 (or the nearest years)



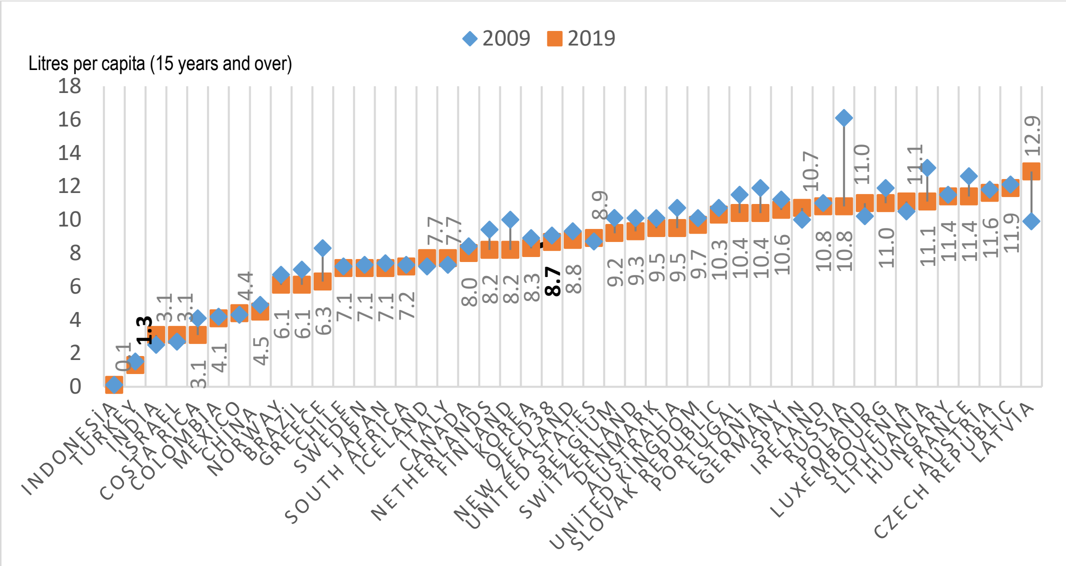
Source: OECD Health Statistics 2021.

Over the past decade, daily smoking rates have declined in most OECD countries, from 21.3% in 2009 to 16.5% in 2019 (See Figure 2.) Norway had the largest decline in smoking prevalence (12 %), followed by Ireland (10 %), South Korea (9.2 percentage points) and Estonia (8.3 random points). In Russia, smoking rates have fallen sharply (13.6 percentage points), but the situation remains dire. Smoking rates decreased the least (12 probability points) in Hungary, Slovenia, Switzerland, China, India, and South Africa, while smoking rates remained stable in Mexico. Between 2009 and 2019, smoking rates in the Slovak Republic, Turkey and Indonesia rose by 12 percentage points. Seven OECD countries reported adult smoking rates for 2020. Interest rates fell further in six countries. Although the proportion of adult smokers in Estonia fell from 21.3% in 2016 to 17.2% in 2018, a slight increase is expected in 2020.

IJCEAS

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676

Figure 3. Recorded alcohol consumption among the population aged 15 and over, 2009 and 2019 (or the nearest year)



Source: OECD Health Statistics, 2021

Overall, spirits consumption in the OECD region was 8.7 liters per person in 2019, up from 9.1 liters in 2009 (See Figure 3.) In 2019, Latvia had the highest per capita consumption (12.9 liters), followed by Austria, Hungary, the Czech Republic, Lithuania, France, and Slovenia, all of which had more than 11 liters. In Turkey, Israel, Costa Rica, Colombia and Mexico, usage was low (less than 5 liters per person). Of all countries, Russia had the highest activity (10.8 liters), while Indonesia, India and China had the least activity (less than 5 liters). Between 2009 and 2019, regular usage fell in 29 OECD countries, led by Lithuania and Greece (down 2 liters). Consumption in Russia also fell significantly (by 5 liters). Interestingly, Latvia increased alcohol consumption by a few liters per capita, while India, Poland, Slovenia, and Spain each increased by more than 0.5 liters. At the time of writing, 5 OECD countries have released their alcohol consumption scenarios for 2022. Four nations' positions have not changed significantly during the last three years, while Norway has risen by 18 points (from 6.1 liters in 2019 to 7 liters in 2020).

3. Literature Review

Uğur et al. (2010) attempted to assess the effect of indirect taxes on cigarettes and alcohol on consumption and consequently on health expenses. Regression analysis was performed to estimate the influence of cigarette usage on health expenses for this objective. Consequently, it has been discovered that there is a one-sided link between health expenditures and per capita tobacco usage in Turkey. At the same time, the effect of previous tobacco use on per capita health spending is bigger than the effect of current tobacco uses on per capita health expenditure. This is explained by the fact that the harmful effects of tobacco show after a particular amount of time. Emeç and Gülay (2003) sought to ascertain the impact of socio-demographic factors on alcohol intake. The essential statistics were gathered for this purpose from the State Institute of Statistics' 2003 household survey data. The data acquired was based on the head of the household, and it was seen if socio-demographic characteristics were beneficial in alcohol intake. Household alcohol use was treated as a categorical dependent variable, and the effects of other factors on these variables were assessed using econometric models. According to the regression results, the following factors influence alcohol consumption: household educational status, age, monthly income of the head, whether he smokes or not, the type of residence he lives in, the job status of the place where he works, whether he has health insurance and his occupation. Mercan et al. (2013) also attempt to ascertain the perspectives of persons who have never used alcoholic drinks in 2017, those who have used them in the past, and those who presently use them on alcohol consumption culture, alcohol research, and alcohol control legislation.

The qualitative approach was chosen for this aim; data were acquired through semi-structured interviews and analyzed using theme framework analysis. According to the findings, alcohol is used by users as a tool for relaxation and socializing; those who do not use it describe it as misery, restlessness, breakdown, and sin. Unlike previous investigations, Mercan et al. (2013) evaluated if alcohol usage increased in different skin conditions and whether it reached the level of addiction in their 2013 study. 100 individuals with mental comorbidities and psycho-dermatological illnesses were approached for this purpose. The study included 60 patients and 74 healthy individuals with chronic dermatosis other than psycho-dermatological disease who did not have psychiatric comorbidity, and all participants completed a questionnaire about their sociodemographic characteristics, disease history, duration of alcohol use, and the relationship between users. According to the data, patients with dermatological illness coupled with psychosocial morbidity did not use alcohol more than patients with other chronic dermatoses or healthy persons. Furthermore, it has been argued that extensive research is required for more conclusive results due to varied socio-cultural impacts.

Hayrullahoğlu (2014) investigated whether the special consumption tax on tobacco goods and alcoholic drinks is efficient in lowering consumption by employing tax rates, sales amounts, and smuggling amounts when cigarette consumption and the taxes received because of that consumption. According to the findings, he indicated that the rise in tax rates did not have the predicted impact of lowering demand since it drove people to consume illegally. Beşer and Aşkan (2019) emphasize the necessity of battling cigarette addiction and investigate the role of raising tax rates in reducing tobacco usage. The qualitative technique was utilized in the study, and the findings indicate that strengthening practical punishments to raise social awareness can be successful.

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676

Öğel et al. (2014) study the frequency of alcohol usage and associated socio-demographic factors. A survey was done with 707 people living in 24 different neighborhoods of Istanbul via face-to-face interviews at their homes for the study. Alcohol usage rates were like prior home investigations, according to the data. The study did, however, indicate that women consumed alcohol at a higher rate. At the same time, while the rate of regular alcohol usage was the same for men and women, it was much greater for males. When demographic and socioeconomic elements are included (Ergin and Pek, 2020). The researchers used the Double Threshold and Tobit techniques to identify the socioeconomic and demographic characteristics influencing cigarette use in Turkish resident households using the 2014 TUIK Household Budget Survey (HBA). To that purpose, socio-demographic factors employed in the study included educational level, marital status, gender and age, and household size among the demographic characteristics of the household head, which are known to impact cigarette usage. The total disposable income level of the family in a year was utilized as the economic variable.

Considering research on the influence of cigarette usage on health expenses (Başol and Can, 2015). This work item priority to non-physical, to talk about the harm to the environment and gave to the people and the state in terms of cost, Turkey and cigarettes in the world/tobacco initiatives and the struggle to address the policy, to mention a statistical from the survey results and cigarettes/tobacco were intended to address the financial dimension. According to the findings, tobacco usage endangers both individual and societal health and promotes inefficient use of both public resources and individual wealth. Since 2008, Turkey has gained momentum in tobacco control (Uğur and Kömürcüler, 2015). They attempted to examine the efficiency of cigarette taxes in Turkey by studying cigarette taxes in the EU in this study. Because of the data comparison, Turkey's tobacco product taxes should be aligned with those of the EU. Specific taxes should be reviewed over 1000 pieces, as in the EU example, and computed by taking 2% of the set price for bundles of 20.

For people to support tax hikes as well as the public focus on health, risks should be put in public attention. When we look at the research on this issue, one study from 2008 may be addressed in detail by demonstrating the links between numerous factors. This recognized study attempted to examine the link between the explanatory factors, and the regression model dependent variables. To that objective, sequential logit model estimates were performed to identify the determinants influencing alcohol and cigarette consumption expenditures across Turkey and in seven areas. At the same time, data from the Turkish Statistical Institute's 2003 household budget survey were utilized. According to the findings, in Turkey, monthly income, age, education level, marital status, gender, workplace status, job status, private insurance status, and type of dwelling all had an impact on alcohol consumption expense. Furthermore, the characteristics influencing cigarette consumption expenditure were identified as monthly income, gender, age, health insurance, education level, marital status, employment, and property.

Furthermore, the impacts of the factors described above depending on the region on alcohol and cigarette consumption expenditures were investigated.

Vals et al. (2013) want to look at the impact of drinking and smoking on overweight adults. Approximately 6500 persons between the ages of 25 and 64 were polled for this purpose. The research was carried out in Estonia between 2004 and 2008. The study's analyses were separated into primary care, usage of specialized care services, hospitalizations, and ambulance calls. According to the findings of the study, overweight and/or obesity are closely linked to the utilization of primary care and outpatient care. Smoking was also linked to hospitalizations and ambulance calls in both men and women. At the same time, no link was seen between hospitalizations, ambulance calls, and beer consumption.

Wine consumption and hospitalizations have been linked to a variety of health services and comparable associations. Strong alcohol use is positively connected with hospitalizations since it raises the risk. It has been established that there is a favorable association between the intake of light alcoholic drinks and the provision of various health services. Daskalopoulou et al. (2017) attempt to investigate the association between smoking and alcohol use and healthy aging in a systematic manner. To that purpose, major electronic data were examined, and data from March 2017 onwards were rigorously evaluated. Two random meta-analyses were pooled because of this. According to the findings, a total of 28 studies were discovered. In 23 investigations, positive outcomes were obtained. Alcohol intake and HA were shown to have a favorable association in 12 research, no link in 9 studies, and a negative relationship. In addition, Pryce (2019) sought to investigate the impact of the UK smoking ban on alcohol expenditure. The influence of smoking prohibitions on alcohol use is uncertain, notably the disparity between smokers and nonsmokers. These impacts were investigated using survey data. According to the analytical data, smoking households are expected to cut their weekly indoor alcohol spending by £1.70 (roughly 15-20 percent), whereas non-smoking households are expected to exhibit no significant change. As a result, the smoking prohibition may have impacted in-house stores via a discount. Simultaneously, this study adds to the evidence that tobacco regulations impact smoking behavior (Marcon et al., 2018; Breton et al., 2021).

4. Methodology, Data, and Results

4.1. Method

In general, causality may be defined as the relationship between a first event, which represents the cause, and a second event, which represents the effect, where the second occurrence is viewed because of the first event. In common use, the cause and effect can be of numerous types: they can be individual events or even objects, processes, attributes, variables, facts, or world states. Furthermore, the cause and effect might be either univariate or multivariate. In general, we mean causation in the sense of Granger (1969). Granger causality is defined by Granger (1969) as whether time series X adds to the prediction of time series Y. In other words, a variable X is the Granger cause of another variable Y if using X and Y together in the prediction of Y improves the prediction of Y. The most frequent

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676

Granger causality tests are the Wald-Granger causality test and the Haugh–Pierce causality test (Gourévitch et al. 2006). These tests are commonly used to examine the long-term predictive connection between two variables. Granger (1988) also proposed the frequency domain (spectral) causality decomposition, in which variables are cointegrated at zero frequency.

Geweke (1982) and Hosoya (1991) contributed to this method by evaluating the causality decomposition connection using spectral density. In this regard, the spectral Granger causality differs from the standard Granger causality (1969). Breitung and Candelon (2006) established a practical approach to assess Granger causality in the frequency domain using the theoretical underpinnings supplied by Granger (1969), Geweke (1982), and Hosoya (1991). (2006). As a result, this study adopts the technique proposed by Breitung and Candelon (2006), which was based on preliminary research by Geweke (1982) and Hosaka (1991). Following Breitung and Candelon (2006) approach, let $z_t = [x_t, y_t]^{'}$ be the vector of endogenous variables observed at time t = 1, ….., T and is represented as follows:

$$\Psi(L) = e_t \tag{1}$$

where $\Psi(L) = I - \Psi_1 L - ...... - \Psi_2 L^p$ having L as the lag operator such as $Lz_t = z_{t-1}$. The error vector is assumed to be white noise with mean zero and covariance matrix $E(e_t e_t^{'}) = \Sigma$ defined as positive. If the system is stable, then the VAR will have a VMA (∞) with the following structure.

$$z_t = \Phi(L) e_t \tag{2}$$

Where $\Phi(L) = I + \Phi_1 L + \Phi_1 L^2 + ...$ and $\Phi(L) = \Psi(L)^{-1}$. Let G be the inferior triangular matrix of the Cholesky decomposition such as $GG' = \Sigma$. Therefore, the representation with orthogonal errors can be expressed as:

$$z_t = GG^{-1} e_t + \Phi_1 GG^{-1} e_{t-1} + ... \tag{3}$$

$$z_t = \Psi(L)\eta_t = \begin{bmatrix} \Psi_{11}(L) & \Psi_{12}(L) \\ \Psi_{21}(L) & \Psi_{22}(L) \end{bmatrix} \begin{bmatrix} \eta_{1t} \\ \eta_{2t} \end{bmatrix} \tag{4}$$

Where $\Psi(L) = \Phi(L)G$, $\eta_t = G^{-1} e_t y \Phi_0 = I$. Therefore, $E(\eta_t \eta_t^{'}) = I$. According to equation (4), the spectral density of x_t is given by:

$$f_x(w) = \frac{1}{2\pi} \Sigma_{k=-\infty}^{\infty} \gamma k^{e^{-ikw}} \tag{5}$$

Where w is the angular frequency, e^{-ikw} is the Euler equation and γk is the autocovariance of order k of x_t. Let $\gamma(\mathcal{L}) = \Sigma_{k=-\infty}^{\infty} \gamma_k L^k$ be the autocovariance generating function (A.G.F), then the spectrum of x_t will be:

$$f_x(w) = \frac{1}{2\Pi}\gamma\left(e^{-iw}\right) \tag{6}$$

On the other hand, if x_t is defined in terms of their moving average representation, then:

$$x_t = \Pi(L)u_t \tag{7}$$

Where $\Pi(L) = 1 + \pi_1 L + \cdots$. It can be shown that the A.G.F of x_t will be given by $\gamma(L) = \sigma^2 \Pi(L)\Pi(L^{-1})$, therefore the spectrum of x_t will be equal to:

$$f_x(w) = \frac{\sigma^2}{2\Pi}\left|\Pi\left(e^{-iw}\right)\right| \tag{8}$$

The above expression is known as the rational spectrum or as the spectrum of an *ARMA(p,q)* model. In an *ARMA(p,q)* process the polynomial $\Pi(L)$ is equal to $\frac{B_q(L)}{A_p(L)}$, where $A_p(L)$ and $B_q(L)$ are the lag polynomials corresponding the *AR(p)* and *MA(q)* terms respectively. Therefore, given the $VMA(\infty)$ representation, the spectrum of x_t corresponds to:

$$f_x(w) = \frac{\sigma^2}{2\pi}(\left|\psi_{11}(e^{-iw})\right|^2 + (\left|\psi_{12}(e^{-iw})\right|^2) \tag{9}$$

The hypothesis that y_t does not cause x_t at frequency in the Granger sense, w can be proved with the following formulation.

$$M_{y\to x}(w) = \log\left[1 + \frac{\left|\psi_{12}(e^{-iw})\right|^2}{\left|\psi_{11}(e^{-iw})\right|^2}\right] \tag{10}$$

if $\left|\psi_{12}(e^{-iw})\right|^2 = 0$, the measure is zero, which means y_t not cause x_t in the frequency *w*. The same lag polynomial will be equal to equation (11), providing that $\psi(L) = \theta(L)^{-1}G$:

$$\psi(L) = \frac{1}{|\theta(L)|}\begin{bmatrix} \theta_{22}(L) - \theta_{12}(L)g_{21} & -\theta_{12}(L)g_{22} \\ -\theta_{21}(L)g_{11} + \theta_{11}(L)g_{21} & \theta_{11}(L)g_{22} \end{bmatrix} \tag{11}$$

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676

Hence the element $\psi_{12}(L)=\frac{-\theta_{12}(L)g_{22}}{\theta(L)}$. In this way y_t does not cause of x_t in the frequency w if the following condition is fulfilled.

$$\theta_{12}(e^{-iw})=\left|\Sigma_{k=1}^{p}\theta_{12,k}\cos(kw)-i\Sigma_{k=1}^{p}\theta_{12,k}\sin(kw)\right|=0 \tag{12}$$

If the two sums are jointly equal to zero, then the condition is met. The hypothesis that $M_{y\to x}(w)=0$ is equivalent to proving $H_0:R(w)\beta$ where.

$$\beta=\left[\theta_{12,1},\theta_{12,2},\dots,\theta_{12,p}\right] \tag{13}$$

$$R(w)=\begin{bmatrix}\cos(w) & \cos(2w) & \dots & \cos(pw)\\ \sin(w) & \sin(2w) & \dots & \sin(pw)\end{bmatrix} \tag{14}$$

In the add-in the hypothesis is tested using the following conditions:

$$F\left[2,T-k\right]=\frac{(Rb-q)^{'}(R\left[s^2(X^{'}X)^{-1}R^{'}\right](Rb-q)}{2} \tag{15}$$

For each equation in the VAR, $H_0:Rb=q$ is the null hypothesis, where b is the vector of estimated coefficients of the respective equation, R is a matrix of restrictions of size $2xk$, q is a 2x1 zero vector, k is the number of coefficients estimated, X is a matrix of Txk with the observations of the independent variables in the model, and finally, s^2 is the estimation of the variance error of the corresponding equation.

The purpose of this research is to determine if alcohol and cigarette intake are the Granger causes of health spending in a certain time. For example, health expenditure (HE) is said to be Granger-caused by alcohol consumption (AC) if AC aids in the prediction of HE, or if the coefficients of the delayed AC are statistically significant in an AC-HE regression. Empirically, the following vector autoregressive (VAR) model can be used to test for Granger causality:

$$\ln HE_t=\alpha_0+\sum_{i=1}^{k}a_i\ln HE_{t-i}+\sum_{i=1}^{k}a_i\ln AC_{t-i}+e_{1t} \tag{16}$$

$$\ln HE_t=\alpha_0+\sum_{i=1}^{k}a_i\ln HE_{t-i}+\sum_{i=1}^{k}a_i\ln TC_{t-i}+e_{1t} \tag{17}$$

4.2. Data Set

This study uses a yearly data set for Turkey on alcohol use, cigarette usage, and health costs. The OECD database was used to get the data set for the period 1990-2019. The variables in the study are defined as follows: ln (HE) denotes the logarithm of health expenditures measured in Turkish Liras per capita (TL). Ln (AC) represents the logarithm of alcohol consumption per person (ages 15+, in liters), whereas ln (TC) represents the logarithm of tobacco consumption expenditure per person, in TL.

Figure 4 shows trends in lnAC, lnTC and lnHE for Turkey. It can be understood that the changing time-paths of alcohol and tobacco consumption series were basically the same. Specifically, while both series displayed an upward trend until 2010, then they showed a slow downward trend, which means a rise in consumption taxes on tobacco and alcoholic beverages forced consumers to afford less to the bundle of two goods. On the other hand, a slowly declining health expenditure began to rise after the COVID-19 pandemic outbreak, which *spread around the world in 2020.*

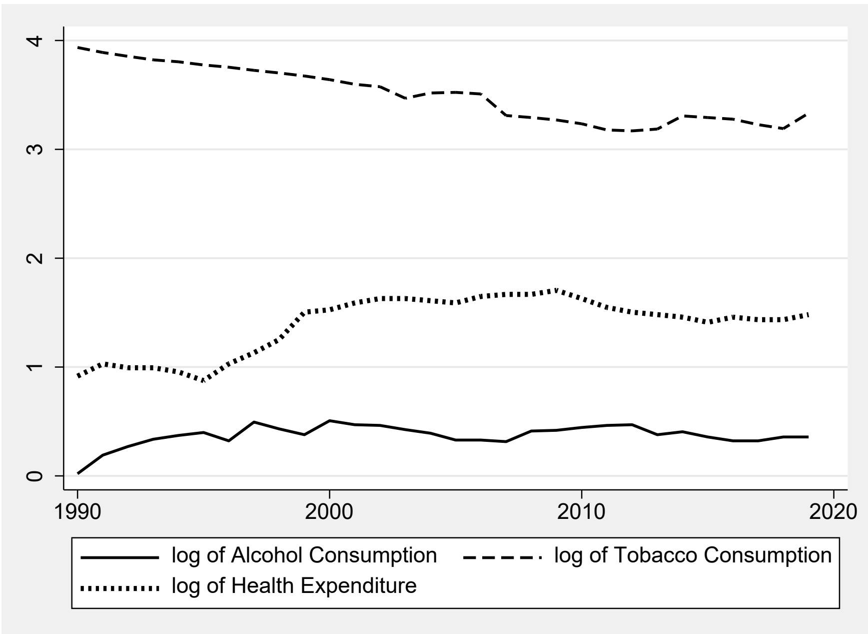


Figure 4. The time path of AC, TC and HE.
(***Source*****:** Authors'own plot)

Table 1 shows basic descriptive statistics of the variables. As is seen in the table, standard deviations, which are related to the distance between each value and the mean of a variable, indicate a considerable dispersion around the mean or median. Besides, all results of the Shapiro- Wilk (w) test strongly reject the hypothesis of normal distribution in each series.

IJCEAS

International Journal of Contemporary Economics and Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676

Tablo 1. Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Min	Max	Shapiro-Wilk w-test
lnAC	0.371	0.380	0.096	0.019	0.506	0.867***
lnHE	1.392	1.480	0.266	0.875	1.704	0.019**
lnTC	3.501	3.510	0.249	3.169	3.935	0.848***

***, ** : statistically significant at 1% and 5% level

Before proceeding with model estimation, it is necessary to check whether variables are stationary or, to put it in another way, variables possess a unit root. Since the causality test requires that the variables are stationary, Philips and Perron (PP) (1988) test, Kwiatkowski et. al. (KPSS) (1992), and Zivot and Andrews (ZA) (1992) test procedures are applied, and the results are reported in Table 2 below.

Table 2. Unit Root Estimation for PP, KPSS and ZA Test

Unit root test: constant and linear trend						
Variables	PP test		KPSS test		ZA test	
	t-stat	Lag	t-stat	Lag	t-stat	Lag
At level						
ln (AC)	-4.605***	2	0.217***	1	-4.353	4
ln (TC)	-4.552***	1	0.221***	1	-3.298	3
ln (HE)	-1.013	1	0.245***	2	-3.658	3
First Difference (Δ)						
Δln (AC)	-6.720***	1	0.157**	2	-7.526***	3
Δln (TC)	-4.493***	2	0.098	2	-5.236**	3
Δln (HE)	-3.937**	3	0.073	3	-5.424***	3

1. ***, **, and * respectively stand for 1%, 5% and 10% level of significance.
2. PP test critical values are -4.343, -3.584 and -3.230 respectively for 1%, 5% and 10% levels of significance.
3. KPSS test critical values are 0.216, 0.146 and 0.119, respectively for 1%, 5% and 10% levels of significance
4. ZA test critical values are 1%: -5.34, 5%: -4.80, and 10%: -4.58 for the model when breaks occur both in intercept and trend.

Table 2 displays the anticipated outcomes of the PP, KPSS, and ZA unit root tests. While virtually three variables are confirmed stationary using PP and KPSS tests, ZA test results suggest the presence of a unit root in the series at levels when a constant and a linear trend are included in the test equations. We selected ZA test scores for stationary processes since this research takes structural breakdowns in the series into account to minimize misleading findings. Taking the initial differences of variables, the stationarity assumption was maintained at I(1), which was validated by PP test findings. After the series has reached order one stationary, we may proceed to determine the lag length for the Vector Autoregressive (VAR) model and estimate three types of causality tests for comparison.

4. 3. Estimation Results

Table 3. Results of Spectral Granger Causality Test

			Spectral Granger causality test statistics						
	W-G F-test	Geweke causality	λ= 0	λ= 0.5	λ= 1	λ= 1.5	λ = 2	λ= 2.5	λ= 3
dlnAC→ dlnTC	7.322**	1.017(15%)	8.06***	9.96***	7.53**	3.05	1.49	4.91*	2.84
dlnTC→ dlnAC	1.075	5.590**(85%)	6.62**	6.62**	5.03*	1.50	4.44*	1.01	0.67
dlnAC dlnTC		0.010 (0.01%)							
Total Corr.		6.518**							
dlnAC→ dlnHE	13.43***	0.446(3%)	3.52	0.92	3.60	4.49*	0.40	3.42	7.12**
dlnHE→ dlnAC	0.448	8.631***(57%	3.20	3.93	1.14	1.97	3.81	1.34	0.94
dlnAC dlnHE		6.152**(40%)							
Total Corr.		15.230***							

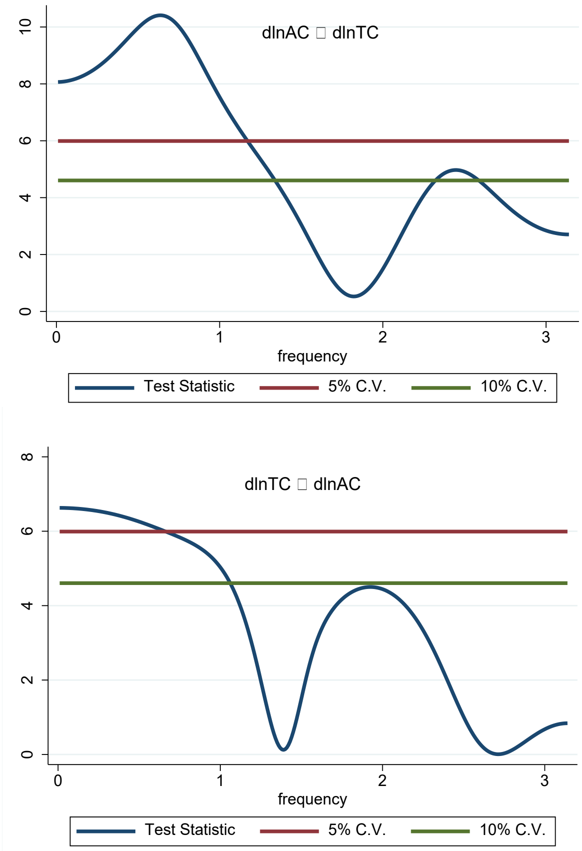
dlnTC→ dlnHE	1.137	0.014	0.06	0.10	1.83	0.11	2.02	3.32	3.82
dlnHE→ dlnTC	1.075	1.350	6.94**	2.86	2.00	2.03	2.08	6.00**	3.79
dlnTC dlnHE		0.164							
Total Corr.	0.448	1.529							

***,**,* : statistically significant at 1% , 5% level, and 10%, respectively. The proportion of feedback relations by Geweke decomposition method is in the brackets.

Table 3 displays the results of Wald-Granger (W-G), Geweke, and spectral Granger causality tests for the trivariate system (lnAC, lnTC and lnHE). Before proceeding on, the lag order selection has to be done for the VAR system. In doing so, final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC) lag order selection methods were used. Except for SBIC, the rest of the tests indicated to use of a lag length of 1. To save space, results are not reported here.

Although the Wald-Granger F-test and Geweke causality test indicate a long-term stable relationship between alcohol and tobacco consumption series at the 5% significance level, however in terms of the direction of causality, they demonstrate opposite results. While the former shows a unidirectional causality from alcohol consumption to health expenditure, the latter works in favor of the reverse causality. Geweke test also shows that the feedback decomposition of dlnAC ↔ dlnTC was insignificant. Further, except dlnAC ↔ dlnHE (at 5%), the feedback relationship between other variables was also statistically insignificant at all levels of significance. In addition, W-G test also points out a unidirectional causality from dlnAC to dlnHE at the 1% level of significance. Finally, both tests reject any statistically significant relationships between dlnTC and dlnHE.

Table 3 and Figure 5-7 demonstrate the spectral Granger causality test statistics that give the probability of Granger causality test between variables at different frequencies ranging from [0, 3]. For example, from table 5, while a bidirectional strong causality between dlnAC and dlnTC is supported at frequencies $\lambda = 0$, $\lambda = 0.5$, and $\lambda = 1$, at the higher frequencies the probability of a causality relationship turns out to be insignificant.

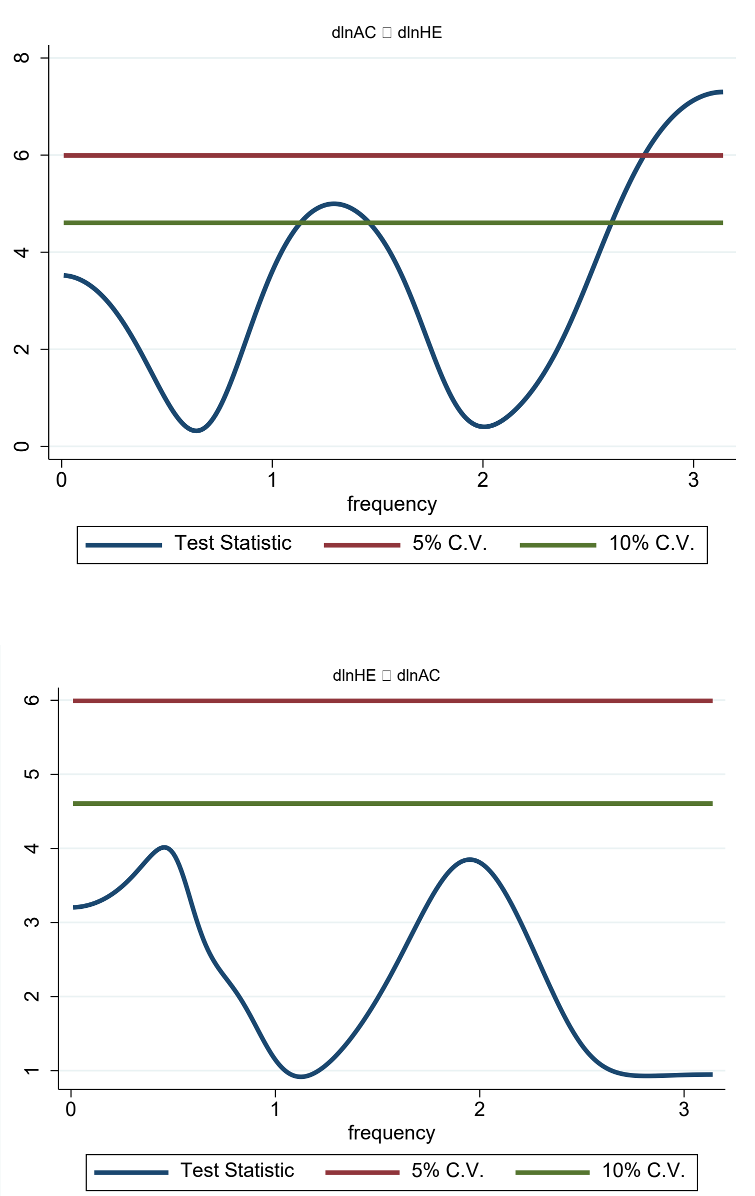


(a) (b)

Figure 5. Breitung-Candelon (2006) frequency domain Granger causality test between alcohol and tobacco consumption, conditional on health expenditure.

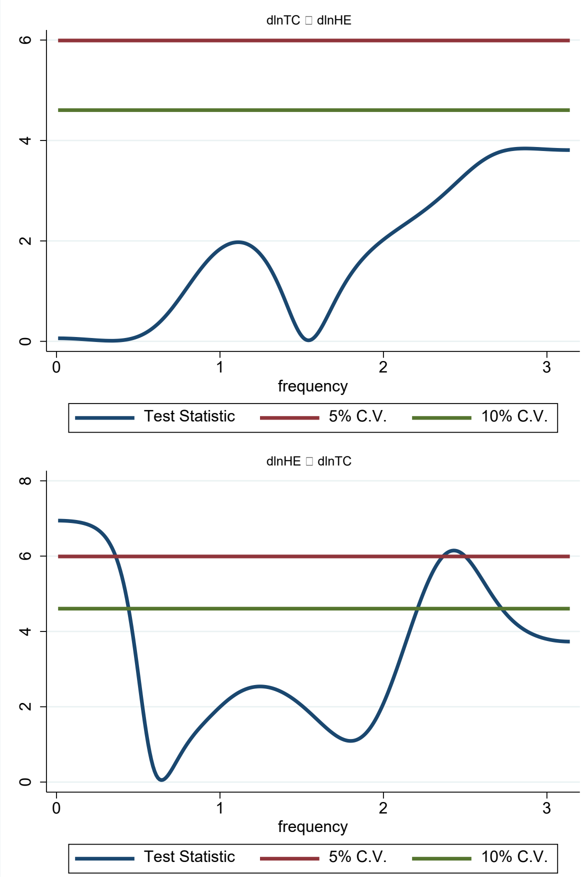
In figure 5, panel (a) shows that the log alcohol consumption is always the Granger cause of the log tobacco consumption in the frequency domain of [0 − 1.34] and [2.33 − 2.58), however, at the domains between [1.34 − 2.33] and higher than [2.58], alcohol does not Granger cause of tobacco consumption. In panel (b) the causality relationship from tobacco to alcohol is only valid at 5% level of significance in the range of [0 − 1.06]. On the other hand, Figure 6 shows while alcohol does granger cause of health expenditure in the ranges of [1.14 – 1.46] and [2.62 – 3.14] in panel (a), health expenditure does not Granger cause of alcohol consumption in any frequency range (Figure 6, panel (b)).

International Journal of Contemporary Economics and
Administrative Sciences
ISSN: 1925 – 4423
Volume: XIII, Issue: 2, Year: 2023, pp. 654-676



(a) (b)

Figure 6. Breitung-Candelon (2006) frequency domain Granger causality test between health expenditure and tobacco consumption, conditional on alcohol consumption.



(a) (b)

Figure 7. Breitung-Candelon (2006) frequency domain Granger causality test between tobacco consumption and health expenditure, conditional on alcohol consumption.

In the last Figure (7, b), only a granger causal relationship between health expenditure and tobacco consumption is just found in the first and the sixth frequencies. The spectral Granger causality test differs somewhat from the W-G and Geweke causality tests, as seen in Table 3. For example, the WF- F test supports a causation link from dlnAC to dlnTC for the whole series of years in the first row. However, it is demonstrated that the same causality is firmly maintained in the first-, second-, and third-time domains. In another case, even though the first two tests do not show a causal relationship between health expenditure and tobacco use, the hypothesis that dlnHE is a Granger cause of dlnTC is accepted by spectrum test findings in frequencies where =0 and =2.5 but rejected in other time domains.

5. Conclusion

While Granger (1969) and Geweke (1982) developed and contributed to the concept of causality between two variables, later, Hosoya (1991) and Geweke (1984) developed the conditional measure of feedback when there exists a third series and decomposed the causality relationship by frequency. The Granger causality test in the domain was strengthened by the study of Breitung and Candelon (2006) to determine whether causality between two variables occurs at a specific time-frequency. Since the theoretical contributions to the Granger causality test, many studies have carried these tests for empirical purposes.

Instead of investigating the causal relationships among variables just for a whole period, the impacts of alcohol and cigarette use on health expenditures in Turkey between 1990 and 2019 were investigated in this study by applying the spectral Granger approach. Satisfying the stationary conditions of the series, Wald statistics over all frequencies $\omega \in (0, \lambda)$ showed that while there was unidirectional causation from alcohol to health variable (significant in 1%), no causal link from health to alcohol was discovered. Furthermore, it has been found that the influence of tobacco smoking on health expenditures in previous years is bigger than the effect in the current period. This can be explained by the long-term effects of tobacco usage on human health.

REFERENCES

Anderson, P. and Baumberg, B. (2006). Alcohol in Europe: A Public Health Perspective. A Report of the European Commission. London, UK: Institute of Alcohol Studies.

Anderson, P., Baumberg, B. and McNeill, A. (2006). Alcohol in Europe A public health perspective A report for the European Commission. Peter Anderson and Ben Baumberg Institute of Alcohol Studies, UK.

Ari, S., Kivanc, I., Altunay, Mercan, S. (2013). The relationship between alcohol consumption and skin diseases: A cross-sectional controlled study, Med Bull Sisli Etfal Hosp. 47(4): 204-208

Aydın, K., (2011). Alcoholic Beverage Culture and Household Alcohol Expenditures in Turkey, Electronic Journal of Social Sciences Electronic Journal of Social Sciences Electronic Journal of Social Sciences, 10(38), 335-347.

Başol, B. and Can, S. (2015). A Study on the Economic Effects of Tobacco Consumption and Tobacco Control Policies, Balkan Journal of Social Sciences, 4(7).

Breton, M.A. and others (2021). Understanding long-term trends in smoking in England, 1972–2019: an age–period–cohort approach, Addiction, 117(5), 1392-1403.

Buzrul, S. (2016). Alcoholic Beverage Consumption in Turkey, Journal of Food and Health Science, 2(3), 112-122.

Cawley, J. and Ruhm, C. (2011). Chapter three: the economics of risky health behaviors. Handb Health Econ, 2, 95–199.

Centers for Disease Control and Prevention (2020). *Chronic disease prevention and health promotion*. Retrieved from: https://www.cdc.gov/chronicdisease/index.htm

Çapar, M. (2021). Special Consumption Tax and its Application in Turkey, TCA Journal, 52 (120), 1-23.

Daskalopoulou, C., Stubbs, B., Kralj, C. and Koukounari, A. (2018). Associations of smoking and alcohol consumption with healthy ageing: A systematic review and meta-analysis of longitudinal studies, BJM Open, 8(4):e019540

Dinler, Z. (2008). Microeconomy, Ekin Publications 19th Edition, Bursa.

Do, Y.K. and Bautista, M.A. (2015). Tobacco use and household expenditures on food, education, and healthcare in low- and middle-income countries: a multilevel analysis. *BMC Public Health*,15, 1098

Ekpu, V.U. and Brown, A.K. (2015) The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence. Tobacco Use Insights, 8, 1-5.

Emeç, H. And Gülay, E. (2008). Alkol Tüketimi ve Sosyo-Demografik Değişkenlerin Alkol Tüketimi Üzerine Etkisi, Ekonomik Yaklaşım,19(68),115-134.

Ergüder, T. (2008). The Who Framework Convention on Tobacco Control, Ministry of Health Ankara.

GBD 2019 Universal Health Coverage Collaborators (2020)**.** Measuring universal health coverage based on an index of effective coverage of health services in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019**.** *The Lancet.* doi:10.1016/S0140-6736(20)30750-9.

Hayrullahoğlu, B. (2014), Success of Special Consumption Tax on Tobacco Products and Alcoholic Beverages in Turkey, Journal of Life Economics, 2(2), 89-112.

Hızarcı Beşer, B. and Aşkan, H. (2019). Türkiye'de Sigara Bağımlılığını Azaltmada Sigara Vergilerinin Etkisi. Strategic Public Management Journal, 5 (9), 65-78.

https://www.who.int/health-topics/alcohol#tab=tab_1, (Erişim Tarihi: 15.19.2022) https://www.oecd-ilibrary.org/, (Erişim Tarihi:17.09.2022)

https://psychiatry.uchicago.edu/news/real-cost-smoking-state, (Erişim Tarihi:18.09.2022)

Koca, B. and Oğuzöncü, A. (2010). İnönü Üniversitesi Sağlık Yüksekokulu Öğrencilerinin Sigara, Alkol, Madde Kullanımı, Madde Kullanımına Etki Eden Etmenler ve Aileden Aldıkları Sosyal Desteğin Etkisi. Kocaeli Tıp Dergisi, 4(2), 4-13.

Marcon, A., Pesce, G., Calciano, L., Bellisario, V., Dharmage, S.C., Garcia-Aymerich, J., et al. (2018). Trends in smoking initiation in Europe over 40 years: a retrospective cohort study. *PLOS ONE*, **13**(8): e0201881.

Mercan, S., Onaran, Ö. İ., İlbak, A., Atasoy, H., Teloğlu, E. Ş., Torun, P. and Hayran, O. (2018). Alkol tüketim kültürü ve alkol araştırmaları ile alkol kontrol politikaları konusunda görüşler: Nitel bir araştırma. Addicta: The Turkish Journal on Addictions, 5, 473–50.

Öğel, K., Evren, C. and others (2014). Prevalence of Lifetime Tobacco, Alcohol and Drug Use Among 10th Grade Students in Istanbul. Bulletin of Clinical Psychopharmacology, 24(3), 201-10.

Pryce, R. (2019). The effect of the United Kingdom smoking ban on alcohol spending: Evidence from the Living Costs and Food Survey. Health Policy. 123(10), 936-940.

Rehm, J. (2011) The risks associated with alcohol use and alcoholism. Alcohol Res Health, 34,135–143.

Rehm, J., Shield, K.D., Rehm, M. X. et al. (2012). Alcohol Consumption, Alcohol Dependence, and Attributable Burden of Disease in Europe: Potential Gains from Effective Interventions for Alcohol Dependence. Toronto, Canada: Centre for Addiction and Mental Health.

Shield, K.D., Rehm, M.X., and Rehm, J. (2015). Social costs of addiction in Europe. In P. Anderson, J. Rehm, R. Room (Editors), The Impact of Addictive Substances and Behaviours on Individual and Societal Well-Being. Oxford, UK: Oxford University Press.

Single, E., Collins, D., Easton, B., Harwood, H., Lapsley, H., Kopp, P., and Wilson, E. (2003). International guidelines for estimating the costs of substance abuse. WHO, New York.

Sissosko, M. (2002). Cigarette Consumption in Different U.S. States, 1955–1998: An Empirical Analysis of the Potential Use of Excise Taxation to Reduce Smoking, Journal of Consumer Policy 25: 89–106.

Thavorncharoensap, M., Teerawattananon, Y., Yothasamut, J., Lertpitakpong, C., and Chaikledkaew, U. (2009). The economic impact of alcohol consumption: a systematic review. Subst Abuse Treat Prev Policy 4:20.

Turner, C. (1990). How much alcohol is in a "standard" drink? an analysis of 125 studies. Br J Addict, 85,1171–1175.

Uğur, A., Akdemir, E. and Gürsel, E. (2010), The Effect of Indirect Taxes on Cigarettes and Alcohol on Health Expenditures, Journal of Economic Sciences, 2(1).

Uğur, A. and Kömürcüler, E. (2015). Türkiye'de Sigara'nın Vergilendirilmesinin Etkinliği. Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 20 (4).

Vals, K., Kiivet, R.A. and Leinsalu, M. (2013). Alcohol consumption, smoking and overweight as a burden for health care services utilization: A cross-sectional study in Estonia. BMC Public Health, 13(1), 772.

Wechsler, H., Dacenport, A., Dowdall, G., Moeykens, B., and Castillo, S. (1994). Health and behavioral consequences of binge drinking in college. J Am Med Assoc 272,1672–1677.

Wells, S., Graham, K., and West, P. (2000). Alcohol-related, aggression in the general population. J Stud Alcohol Drugs, 61, 626–632.

World Health Organization (2011). Global status report on alcohol and health, Geneva.

World Health Organization (2018). Global Status Report on Alcohol and Health. Geneva, Switzerland: World Health Organization.

World Health Organization (2020a). Tobacco. World Health Organization.

World Health Organization (2020b). Global Health Observatory data repository. World Health Organization.

Zador, P., Krawchuk, S. and Voas, R. (2000). Alcohol–related relative risk of driving fatalities and driver impairment in fatal crashes in relation to driver age and gender: an update using 1996 data. J Stud Alcohol, 61, 387–395.