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Research Article

Testing for the Rational Addiction Hypothesis in Turkish Cigarette and Alcohol Consumption

Raif Cergibozan[1]
University of Kirklareli

Abstract

In this study, the relationship between simultaneous and intertemporal cigarette and alcohol consumption for Turkey is analyzed using GMM in the context of the Rational Addiction Model for the 1994-2016 period. Firstly, the demand of alcohol and that of cigarettes are estimated separately in the study. According to the results of the analysis, alcohol and cigarette demand are both in accordance with the Rational Addiction Model. The price elasticity of demand for both substances is negative. It is also found that the demand for alcohol is more elasticated than that for cigarettes. In addition, the cross-price elasticities are not statistically significant. Based on the results of this study, it is suggested that public policy combating these addictive substances be determined separately for these goods. Based on model results, the optimal strategy for increasing the income of the government should be to increase the price of cigarettes prices rather than of alcohol. Finally, no evidence is found indicating that the previous consumption of one of these substances influences the current consumption of the other good.

Keywords

GMM estimator • Alcohol consumption • Cigarette consumption • Multiple addiction • Rational addiction model • Turkey

1 **Correspondence to:** Raif Cergibozan (PhD), Department of Economics, Kirklareli University, Kofcaz, Kirklareli 39100 Turkey. Email: raif.cergibozan@klu.edu.tr

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The use of cigarettes and alcohol is a global problem and affects the health of millions of people worldwide. As Turkey finds itself among those countries consuming the most cigarettes in the world, this issue is of vital importance for Turkey. Each year, approximately 5.4 million people in the world die as a result of tobacco use. This rate clearly demonstrates the magnitude of the negative impact that tobacco use has on people's health. In Turkey, it is estimated that an excess of 100,000 people lose their lives from tobacco use every year and that this ratio will reach 240,000 by 2030 (World Health Organization Report, 2009). The primary adverse effects of tobacco use on health are cancer, chronic lung diseases, digestive system diseases, musculoskeletal diseases, and neuro-psychiatric problems. Since most diseases caused by tobacco use are fatal, an estimated half of tobacco users die. Tobacco consumption poses an obvious an significant economic burden on Turkey's health care system (Aslan et al., 2010). Furthermore, since the use of alcohol also has negative effects on the brain, heart, respiratory, digestive, immune and reproductive systems, it has also become a serious problem.

Analyses conducted by the World Health Organization (WHO) for 30 countries including Turkey show that 85% of murders, 50% of rape, 50% of incidents of violence, 60% of traffic accidents, and 70% of violence against women are mainly caused by alcohol[2]. It is thus crucial for public policies to combat addictive substances such as alcohol and cigarettes. In this way, it will be possible to prevent the direct and indirect negative effects of cigarette smoking and alcohol use on a society.

Although there are a large number of studies focusing on those factors affecting smoking and alcohol consumption, there are few studies that model the consumption of these two goods together. The aim of this study is to analyze the Rational Addiction Model for Turkey with two addictive substances: alcohol and cigarettes. This analysis has two main purposes explained in the following paragraphs.

The first purpose is to examine the interaction between cigarette smoking and alcohol consumption, namely whether these substances are complementary and whether increasing the price of one substance reduces the consumption of both. On the contrary, if cigarette and alcohol are substitute goods, then an increase in the price of one may cause undesired results in public policies because doing so will increase the consumption of the other good. There are two principal objectives of taxing addictive goods; one is to increase public incomes whereas the other is to reduce the use of these goods. Therefore, ascertaining the interaction between these goods and their sensitivity to price changes is of great imperative in implementing optimal taxation policy.

The second main purpose of the analysis is to test whether the current consumption of one of these substances is related to the previous consumption of the other. The complementary

2 For detailed information please visit https://www.yesilay.org.tr/tr/bagimlilik/alkol-bagimliligi

relationship between these periods is called Quasi Gateway Effect. If there is a causal order between the uses of these substances and it is already known, by trying to prevent the use of the first good in the causality, more potent results can be reached.

The rest of the study is organized as follows: In the second part, the existing literature on the analysis of smoking and alcohol use will be examined. In the third part, the theoretical framework of the Rational Addiction Model and information about the estimation methods and estimated models will be explained. In the following part, data information and analysis results will be represented. In the last section, these results will be discussed.

Previous Studies

A review of the literature reveals many studies dealing with smoking and alcohol demands separately. In this study however, instead of investigating these articles in detail, those studies examining these two addictive substances collectively following the works of Bask and Melkersson (2004) and Pierani and Tiezzi (2009) in particular.

Jones (1989) uses the Almost Ideal Demand System (AIDS) model for the United Kingdom over the 1964Q1-1983Q4 period, concluding that while wine, cider, and beer are substitute goods, spirits complement all goods and tobacco is complementary to these four alcoholic beverages. Jimenez and Labeaga (1994) employed the Spanish Family Expenditures Survey (SFES) study for Spain between 1980 and 1981 along with the Unrelated Regression Equation and 3SLS models, finding that increases in alcohol prices lead to the reduction of cigarette consumption. Their calculated cross-price elasticity coefficient was -0.78 and accordingly, cigarette and alcohol are considered complementary commodities. Using the Instrumental Variable Estimator for the United States over the 1959-1982 period, Goel and Morey (1995) assert that liquor and cigarette are substitute goods. They calculated the cross-price elasticity coefficient for liquor and cigarettes as 0.332 and 0.1, respectively. Dee (1999) concluded there to be a complementarity relationship between smoking and alcohol for adolescents after analyzing Monitoring the Future Survey (MTF) data for the US over the 1977-1992 period with the Least Squares Approach. This study, however, does not include cross-price effects. Utilizing the Behavioral Risk Factor Surveillance System (BRFSS) data for the US over the 1985-1993 period with the OLS method, Decker and Schwartz (2000) find that increases in alcohol prices decreases both alcohol consumption and cigarette consumption, while increases in cigarette prices lead to a decrease in cigarette consumption and an increase in alcohol consumption. Picone, Sloan, and Trogdon (2004), employing the Generalized Method of Moments (GMM) estimator for the data of Analysis of Health and Retirement Survey (HRS), studied the consumption of cigarette and alcohol in the US between 1992 and 2002. Their

main findings suggest that previous cigarette consumption increases current cigarette consumption, that bans on smoking reduce alcohol consumption, and that increases in cigarette prices raise alcohol consumption. Using OLS and GMM models, Bask and Melkersson (2004) investigated the use of cigarettes and alcohol in Sweden for the 1955-1999 period. Although their conclusions concur with the Rational Addiction Model for alcohol demand, it is not provided for cigarette demand. They also found that increases in both alcohol and cigarette prices reduce demand of both. In addition, cross-price elasticities were found to be negative, meaning that these goods are complementary. Tauchmann, Göhlmann, Requate, and Schmidt (2006) analyzed the data of the Population Survey on the Consumption of Psychoactive Substances in Germany for the two periods spanning from 1980 to 1986 and from 1990 to 1992, finding that alcohol and tobacco are complementary goods. They also made the claim that antismoking policies might have the undesirable effect of increasing alcohol use due to this complementary relationship. Using GMM models to focus on cigarette and alcohol consumption in Italy between 1960 and 2002, Pierani and Tiezzi (2009), found that cigarettes and alcohol are complementary goods and that both have negative price elasticities. Based on these results, they stated that public policies focusing on a single item rather than controlling both substances should be sufficient. Accordingly, they argued that the optimal strategy to increase public income should be to increase taxes on alcohol rather than those on cigarettes. Using the Dynamic AIDS model for the United Kingdom for the 1963Q1-2003Q1 period, Fanelli and Mazzocchi (2008) concluded that cigarettes and alcohol are complementary goods and that the cross-price elasticity for alcohol and tobacco are -1.16 and -0.50, respectively.

Theoretical Framework

If increased previous consumption of a commodity causes increased current consumption, it may be said that the consumer is dependent on that commodity. This form of behavior includes two basic elements, namely reinforcement and tolerance. Reinforcement means that previous consumption increases the desire for existing consumption and that consumption in different periods are complementary. Tolerance, however, means that as consumption increases, one's level of satisfaction obtained from subsequent, higher levels of consumption decreases. The reinforcement effect requires an increase in previous consumption in order to increase marginal utility from present consumption. If the consumer is myopic, this is enough to indicate addictive behavior. However, if the consumer is rational, s/he considers the future negative consequences of this harmful behavior. Therefore, the reinforcement effect should be higher than this negative effect. Suppose that the utility function of a consumer is as follows:

$$U[t] = U(a[t], c[t], G[t], H[t], y[t]) \quad (1)$$

where *a[t]* and *c[t]* indicate two addictive properties. For this study, they refer to the consumption of alcohol and cigarettes, respectively. *G[t]* and *H[t]* represent habit stocks for cigarettes and alcohol, respectively. *y[t]* shows the composition of goods without addictive effect. The marginal utility of smoking and alcohol consumption is assumed to be positive in a decreasing proportion $U_a > 0$, $U_{aa} < 0$, $U_c > 0$, $U_{cc} < 0$. The same condition is valid for other goods $U_y > 0$, $U_{yy} < 0$. It is assumed that the degree of addiction negatively affects the utility in an increasing proportion due to the effect of tolerance $U_G < 0$, $U_{GG} < 0$. Chaloupka (1991) accepts that since addictive goods negatively affect human health, they have negative effects on utility. Becker and Murphy (1988) suggest that the degree of addiction has a negative effect on productivity. Similar to the findings of Chaloupka's study (1991), Bask and Melkersson (2004) also identified a negative effect on health due to the degree of addictiveness because each good has a different reinforcement effect $U_{aG} > 0$, $U_{cH} > 0$, In the model, it is assumed that just as smoking and alcohol consumption have no effect on the marginal utility from the consumption of non-addictive goods $U_{ay} = U_{cy} = U_{Gy} = U_{Hy} = 0$, the opposite case is also true. Moreover, there also exist studies, such as that of Bask and Melkersson (2003a), that deal with situations where the consumption of one of two addictive goods decreases the consumption of the other $U_{ac} > 0$, $U_{GH} > 0$. Finally, it is assumed that alcohol consumption is independent of cigarette consumption $U_{ac} = U_{aH} = U_{cG} = U_{GH} = 0$.

The budget constraint of the consumer is as follows:

$$\sum_{t=1}^{\infty}(1+r)^{-t}(p_a[t]a[t] + p_c[t]c[t] + y[t]) = W \quad (2)$$

$$max \sum_{t=1}^{\infty}(1+\sigma)^{-t}U(a[t],c[t],G[t],H[t],y[t]) \quad (3)$$

In this case, consumer surplus is sought to be maximized under budget constraint. Since addictive behavior emphasizes the relationship between the consumption of a substance during different periods, it is important to include this relationship in the model. One of the simplest ways to do this is to connect the consumption of one period to that of a previous period.

$$G[t] = a[t-1] \text{ and } H[t] = c[t-1] \quad (4)$$

In addition to this method, there are studies in the literature that assume a common habit stock, namely the study of Bask and Melkersson (2003b) $H[t] = c[t - 1] + s\ [t - 1]$. However, since the basic assumption here is that the two substances are perfect substitute goods, the common habit stock assumption is not suitable for alcohol and cigarette consumption. One of the methods used to obtain the demand function in

the literature is to add the quadratic utility function to the maximization problem mentioned above in terms of convenience. In this case, the alcohol and cigarette demand functions are as follows:

$$a[t] = \psi_{10} + (1+r)\psi_{11}a[t-1] + \psi_{11}a[t+1] + \psi_{12}c[t-1] + \psi_{13}c[t] + \psi_{14}c[t+1] + \psi_{15}p_a[t] \quad (5)$$

where $\psi_{10} > 0, \psi_{11} > 0, \psi_{15} < 0$, and

$$c[t] = \psi_{20} + (1+r)\psi_{21}c[t-1] + \psi_{21}c[t+1] + \psi_{22}a[t-1] + \psi_{23}a[t] + \psi_{24}a[t+1] + \psi_{25}p_c[t] \quad (6)$$

where $\psi_{20} > 0, \psi_{21} > 0, \psi_{25} < 0$.

Although the level of the variables used in the study is not stationary, the first difference is. For this reason, the first difference of all variables is used. In this case, Equations 5 and 6 change into Equations 7 and 8:

$$\Delta a[t] = \psi'_{10} + (1+r)\psi_{11}\Delta a[t-1] + \psi_{11}\Delta a[t+1] + \psi_{12}\Delta c[t-1] + \psi_{13}\Delta c[t] + \psi_{14}\Delta c[t+1] + \psi_{15}\Delta p_a[t] \quad (7)$$

$$\Delta c[t] = \psi'_{20} + (1+r)\psi_{21}\Delta c[t-1] + \psi_{21}\Delta c[t+1] + \psi_{22}\Delta a[t-1] + \psi_{23}\Delta a[t] + \psi_{24}\Delta a[t+1] + \psi_{25}\Delta p_c[t] \quad (8)$$

As can be seen, Equations 7 and 8 represent, respectively, the alcohol and cigarette consumption equations, and these equations will be estimated separately in the current study. Thereafter, more realistic models in which cigarette smoking and alcohol consumption are simultaneously determined will be examined. These models are given in Equations 9 and 10[3].

$$\Delta a[t] = \psi_{30} + (1+r)\psi_{31}\Delta a[t-1] + \psi_{32}\Delta a[t+1] + \psi_{33}\Delta c[t-1] + \psi_{34}\Delta c[t+1] + \psi_{35}\Delta p_a[t] + \psi_{36}\Delta p_c[t] \quad (9)$$

$$\Delta c[t] = \psi_{40} + (1+r)\psi_{41}\Delta c[t-1] + \psi_{42}\Delta c[t+1] + \psi_{43}\Delta a[t-1] + \psi_{44}\Delta a[t+1] + \psi_{45}\Delta p_c[t] + \psi_{46}\Delta p_a[t] \quad (10)$$

It is assumed here that the consumption of each good may be influenced by the price of a commodity other than itself. In order to avoid the problem of endogeneity, the GMM estimator is used in the estimates made for this study.

Data and Empirical Results

In this study, the two-good Rational Addiction Model is tested for Turkey, using the annual time series for the 1994-2016 period. Data used in the study were collected from TURKSTAT, WHO, IMF-IFS, and the Tobacco and Alcohol Market Regulatory Authority (TAPDK in Turkish) databases. Before analyzing the time series in the study, the stationarity of the variables was checked to avoid the problem of spurious regression introduced by Granger and Newbold (1974). In the literature, the stationarity of time series variables is tested using different unit root tests such as Dickey-Fuller, Augmented

3 For more detailed information on the derivation of estimated models in the study, see Bask and Melkersson (2003a; 203b; 2004).

Dickey-Fuller (ADF), Phillips-Perron (PP), and KPSS[4]. In this study, the stationarity of variables was checked using ADF and PP unit root tests. Table 1 contains the unit root test results for the variables used in the study. According to the results of the table, not only do all the variables used in the analyses have a unit root at level, they all become stationary at their first difference. Therefore, it can be said that all the variables used in this study are I(1). In Table 1, $c[t]$ signifies cigarette consumption per person over 15 years; $a[t]$ indicates alcohol consumption per person over 15 years, $p_c[t]$ indicates real cigarette prices, $p_a[t]$ refers to real alcohol prices, and $Y[t]$ means income per capita. All variables used in this study were determined through the consumer price index.

Table 1
Unit Root Test Results

	ADF Unit root test		PP Unit root test	
Variable	T-statistic (Level)	T-statistic (First Difference)	T-statistic (Level)	T-statistic (First Difference)
$c[t]$	-2.407	-4.209***	-2.383	-4.201***
$a[t]$	-1.622	-5.339***	-1.587	-5.432***
$p_c[t]$	-1.544	-5.622***	-3.62	-5.438***
$p_a[t]$	-1.838	-4.623***	-1.964	-4.616***
$Y[t]$	-1.751	-4.054***	-1.887	-4.049***

Note. The superscripts ***, ** and * denote the significance at 1%, 5% and 10% level, respectively.

In the study, Equation 7 was first estimated using GMM. In GMM estimations, lagged prices, lead prices, lagged current income, and lead income variables are used as instrument variables. The results for estimated alcohol demand are given in Table 2. According to these results, current alcohol consumption is positively and significantly affected by previous and future alcohol consumption. Additionally, while alcohol consumption is negatively affected by increases to its price, existing cigarette consumption leads to an increase in alcohol consumption. Based on these results, the alcohol demand for Turkey seems to be highly compatible with the Rational Addiction Model.

Table 2
Estimation Results for the Alcohol Demand

Dependent variable: Alcohol Consumption ($\Delta a[t]$)		
Regressors	*Coefficients*	*T-values*
$\Delta a[t-1]$	0.416 **	2.563
$\Delta a[t+1]$	0.323 ***	3.864
$\Delta c[t-1]$	0.064	0.379
$\Delta c[t]$	0.805 **	2.233
$\Delta c[t+1]$	0.199	0.759
$\Delta p_a[t]$	-0.169 ***	-5.357
Constant	3.334	1.274
$\overline{R}^2$	0.74	

Note. The superscripts ***, **, and * denote a significance at 1%, 5%, and 10%, respectively.

4 In order to get more information about unit root tests, see Dickey and Fuller (1979), Phillips and Perron (1988), and Kwiatkowski, Phillips, Schmidt, and Shin (1992).

Referring to cigarette demand for Turkey, Equation 8 is used as the study's second estimate. The results of the GMM estimation are given in Table 3. Here also, lagged prices, lead prices, lagged current income, and lead income are used as instrument variables in this estimate. According to the estimation results, current demand for cigarettes is positively and significantly affected by previous and future consumption. In addition, increases in cigarette prices reduce the demand for cigarettes. Based on these results, cigarette demand for Turkey is also compatible with the Rational Addiction Model. However, contrary to alcohol estimates, cigarette demand is not significantly affected by current alcohol consumption. It was furthermore found that the price elasticity of alcohol consumption is higher than that of cigarette consumption.

The above estimates include the results of models for which alcohol and cigarette consumption are determined separately. In order to provide more realistic estimations, models for which cigarette and alcohol consumption are simultaneously examined are given in the following section. As has been the case for previous GMM estimates, lagged prices, lead prices, lagged current income, and lead income are used as instrument variables.

Table 3
Estimation Results for the Cigarette Demand

Dependent variable: Cigarette Consumption ($\Delta c[t]$)		
Regressors	*Coefficients*	*T-values*
$\Delta c[t-1]$	0.693 ***	5.306
$\Delta c[t+1]$	0.427 **	2.252
$\Delta a[t-1]$	0.017	0.314
$\Delta a[t]$	0.092	0.891
$\Delta a[t+1]$	-0.058	-0.625
$\Delta p_c[t]$	-0.053 ***	-3.730
Constant	0.434	0.892
$\overline{R}^2$	0.76	

Note. The superscripts ***, **, and * denote a significance at 1%, 5% and 10%, respectively.

The estimation results obtained from the model in which alcohol consumption is a dependent variable are represented in Table 4. According to these results, the

Table 4
Simultaneous Estimation Results for Alcohol and Cigarette Demand

Dependent variable: Alcohol Consumption ($\Delta a[t]$)		
Regressors	*Coefficients*	*T-values*
$\Delta a[t-1]$	0.484***	5.832
$\Delta a[t+1]$	0.106***	4.924
$\Delta c[t-1]$	0.386	1.472
$\Delta c[t+1]$	0.535	1.716
$\Delta p_a[t]$	-0.449***	-3.536
$\Delta p_c[t]$	0.596	1.654
Constant	0.061	0.059
$\overline{R}^2$	0.57	

Note. The superscripts ***, **, and * denote a significance at 1%, 5%, and 10%, respectively.

demand for alcohol is positively and significantly affected by previous and future consumption. Moreover, an increase in alcohol price reduces alcohol consumption in accordance with expectations. Finally, it has been concluded that changes in cigarette prices do not have a statistically significant effect on alcohol consumption.

The GMM estimations for the model of Equation 10 are given in Table 5, where the dependent variable is cigarette consumption and where alcohol and cigarette consumption are determined simultaneously. The instrumental variables used here are the same as those in the three previous models. According to the results, cigarette consumption is positively and significantly affected both by previous and future consumption and is negatively and significantly affected by increases to its price. In addition, increases in alcohol prices do not seem to have a significant effect on cigarette consumption.

Table 5
Simultaneous Estimation Results for Alcohol and Cigarette Demand

Dependent variable: Cigarette Consumptionion ($\Delta c[t]$)		
Regressors	*Coefficients*	*T-values*
$\Delta c[t-1]$	0.629 ***	10.684
$\Delta c[t+1]$	0.323 ***	3.199
$\Delta a[t-1]$	0.044	0.264
$\Delta a[t+1]$	-0.121	-1.283
$\Delta p_c[t]$	-0.222 ***	-2.802
$\Delta p_a[t]$	0.123	1.343
Constant	0.169	0.513
$\overline{R}^2$	0.78	

Note. The superscripts ***, **, and * denote a significance at 1%, 5%, and 10%, respectively.

Conclusion and Discussion

In this study, simultaneous and intertemporal cigarette and alcohol consumption for Turkey is analyzed. There are many studies in the literature on addiction emphasizing that cigarette and alcohol consumption occur together. Understanding the relationship between these two addictive substances is of great importance in terms of public policies, for an increase in the price of one substance may lead to an increase in the other's consumption, which may in turn lead to undesirable consequences. By the same token, previous consumption of one substance may result in an increase in the other's consumption.

Knowing these relationships is crucial in deciding how public policies should be designed and implemented; as this knowledge will beget more effective results in governments' efforts to curtail the consumption of targeted addictive substances by recommending a tax policy closer to the optimum. When the separately estimated results of cigarette and alcohol demand are investigated, both cigarettes and alcohol are observed to behave according to the Rational Addiction Model for Turkey, meaning that both cigarette and alcohol consumption are positively affected by previous and future consumption.

Among these effects are that compared to previous consumption, future consumption is reduced and that both cigarette and alcohol are negatively affected by price increases. The price elasticity of alcohol was found to be higher than that of cigarettes. This fact, as emphasized by Pierani and Tiezzi (2009), may be attributed to the easy consumption of legal home-made alcohol and of illegal alcohol in place of legal alcohol, whereas illegal cigarettes cannot be easily consumed in place of legal cigarettes due to the alternatives to legal cigarettes not being substitute goods to the same degree as the alternatives to legal alcohol. Since the price elasticity of cigarette demand is lower than that of alcohol demand, it seems more reasonable for the government to increase the price of cigarettes in their efforts to increase tax revenue.

In this study, contrary to Jimenez and Labeaga (1994), Dee (1999), Bask and Melkersson (2004), Tauchmann et al. (2006), and Pierani and Tiezzi (2009), there is no evidence that cigarettes and alcohol are complementary goods in Turkey. Consequently, it cannot be expected that an increase in the price of one of these goods reduces the consumption of the other. As a result, if the public policy to reduce both cigarette and alcohol consumption were to treat these two goods separately, the success rate of the policies should be higher. However, as in other studies for Turkey, increases in cigarette prices have a negative and statistically significant effect on cigarette consumption. Similar results are also found by several researchers, such as Tansel (1993), Önder (2002), and Yürekli et al. (2010).

Finally, it is concluded that no quasi gateways effect exists when analyses for the transition between periods are examined. Accordingly, previous consumption of one of the two addictive substances does not significantly affect the current consumption of the other. There is no causal order in the use of these substances. Finally, it is not sufficient solely to increase prices to reduce consumption; rather, instituting information programs on the harms of smoking cigarettes and of alcohol consumption will be helpful in increasing the success of these public policies.

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