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MODELING TOBACCO CONTROL POLICIES: A CASE STUDY IN TURKEY

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Supervisor
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Pınar KOCABEY ÇİFTÇİ

ABSTRACT

MODELING TOBACCO CONTROL POLICIES: A CASE STUDY IN TURKEY

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M.Sc. in Industrial Engineering

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Tobacco use has been one of the deadliest epidemics that threaten the public health of the world. Although it is a well known fact that this epidemic is preventable, the significant number of countries still have to face with the destructive effects of it. Turkey is one of these countries with relatively high tobacco consumption rate. This situation leads Turkey to apply policies that can take tobacco use under control. Turkey has performed considerable progress for tobacco control with the help of the applied policies. Even thoughthe positive consequences of the applied policies for Turkey are apparent, we are still not sure which of themhave relatively higher effect to make tobacco usersthinking to quit. In this regard, the major objectives of this research thesis are (1) to model the tobacco control policies and effects of some other tobacco control associated factors that were investigated in Global Adult Tobacco Survey (GATS) for Turkey (beliefs of people about damages of tobacco use on human health and health care providers' advices to quit smoking) using System Dynamics, (2) to analyze the effects of these policies and factors on current smokers in Turkey, and (3) to forecast the prevalence of tobacco use in Turkey for the year 2016. After system dynamics model has been setup, promising results have been obtained. The results indicate that beliefs of smokers about the damages of tobacco use on human health, taxation and anti-tobacco information policies are more effective factors on current smokers that make them thinking to quit smoking. Also, the results of the study point out that tobacco use ratio of Turkey in 2016 will decrease when compared to 2012.

Key Words: Tobacco, tobacco control policies, system dynamics, simulation.

ÖZET

TÜTÜN BIRAKTIRMA POLİTİKALARININ MODELLENMESİ: TÜRKİYE'DE BİR VAKA ANALİZİ

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Tütün kullanımı, dünya kamu sağlığını tehdit eden ölümcül bir salgın haline gelmiştir. Bu salgının önlenebilir olduğu iyi bilinen bir gerçek olmasına rağmen, çok sayıda ülke, hala bu salgının yol açtığı yıkıcı sonuçlarla yüzleşmek zorunda kalmaktadır. Türkiye yüksek tütün tüketim oranı ile bu ülkeler arasında yer almaktadır. Bu durum, Türkiye'yi tütün kullanımını kontrol altına almaya yardımcı olacak politikalar uygulamaya yönlendirmiştir. Türkiye, uygulanan politikaların yardımı ile tütün kontrolü konusunda büyük ilerleme kat etmiştir. Uygulanan politikaların olumlu sonuçlarının görünür olmasına rağmen, bu politikalardan hangilerinin tütün kullanıcılarına bırakmayı düşündürme konusunda daha etkili olduğundan emin değiliz. Bu açıdan, bu araştırma tezinin amacı 1) Türkiye Küresel Yetişkin Tütün Araştırma'sında yer alan tütün kontrol politikalarını ve tütün kontrolü ile ilişkili diğer faktörlerin (insanların tütünün insan sağlığına olan zararları hakkındaki inançları ve sağlık personellerinin tütün kullanımını bırakmaya yönelik tavsiyeleri) etkilerini sistem dinamikleri yöntemi ile modellemek, 2) modellenen politikaların ve faktörlerin Türkiye'deki tütün kullanıcıları üzerindeki etkilerini analiz etmek ve 3) 2016 yılında, tütün kullanımının Türkiye'deki durumunu tahminlemektir. Sistem dinamikleri modeli kurulduktan sonra,sonuçlar elde edilmiştir. Çalışma sonuçları tütün kullanıcılarını tütün kullanımını bırakmaya yönlendiren en etkili faktörlerin: kişilerin tütün tüketiminin insan sağlığına olan zararları hakkındaki inançları, vergilendirme ve tütün karşıtı bilgilendirme politikaları olduğunugöstermiştir. Ayrıca, 2016 yılında Türkiye'de tütün kullanım oranının 2012 yılına kıyasla düşüş göstereceği ön görülmüştür.

Anahtar Kelimeler: Tütün, tütün kontrol politikaları, sistem dinamikleri, benzetim.

To my beloved husband...

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LIST OF ABBREVIATIONS

WHO	World Health Organization
FCTC	Framework Convention on Tobacco Control
GATS	Global Adult Tobacco Survey
MoH	Ministry of Health
TAPDK	Tobacco and Alcohol Market Coordination Committee
SD	System Dynamics
GTSS	Global Tobacco Surveillance System

CHAPTER 1- INTRODUCTION

1.1 General Remarks

Tobacco epidemic is one of the most serious reasons of health problems ending with death. Although, it is a preventable reason of death, total number of tobacco associated deaths reaches to nearly six million each year (http://www.who.int/mediacentre/factsheets/fs339/en/). In addition, the statistics show that this number will exceed eight million by 2030 (http://www.who.int/mediacentre/factsheets/fs339/en/). Correspondingly, the harms of tobacco use on human health cannot be ignored.

It is a known fact that tobacco use causes many diseases, harms nearly every organ of the body (Centers for Disease Control and Prevention (CDC), 2005). It increases the risk for diseases like myocardial infarction, stroke, arteriosclerosis, hypertension, pneumonia, chronic bronchitis(Pust et al., 2008). Thus, it becomes one of the most mortal addictions that threaten the public health of the world.

The damages of the tobacco use are not restricted with only health problems. There are also social, environmental and economic consequences of it for countries (http://www.who.int/mediacentre/factsheets/fs339/en/). It increases the health care costs, productivity loses for adults, and reduces the quality of life and life expectancy (Centers for Disease Control and Prevention (CDC), 2005).

Although the negative effects of tobacco use are clear, it is still common all around the world. Figure 1.1 shows the prevalence of tobacco use at all over the world in 2005. Over 1 billion of the world population use tobacco currently (http://www.who.int/mediacentre/factsheets/fs339/en/).The number of the current smokers may give a clue for the possible future deaths unless enough precautions to prevent it are not taken. The current situation of tobacco use prevalence increases the importance of tobacco control for countries.

In order to decrease the prevalence of tobacco use and its destructive effects, several different tobacco control policies have been applied at governmental level all around

the world. Correspondingly, implementing effective control policies has become a vital issue in order to reach the defined targets of the governments. WHO developed the Framework Convention for tobacco control to protect the public health and provide new regulations for international cooperation(http://www.who.int/fctc/about/en/). This convention is the pioneering international public health treaty (http://www.who.int/tobacco/framework/background/en/) and the impact-based demand reduction measures for decreasing tobacco use set out in MPOWER (http://www.who.int/tobacco/surveillance/survey/gats/turkey/en/). MPOWER consists of six practical and achievable measures in order to help countries design and carry out policies (http://www.who.int/tobacco/mpower/publications/brochure_2013/en/).

The six factor of MPOWER are:

1. Monitor the usage of tobacco and the tobacco control policies
2. Protect people from being second-hand smoker
3. Offer help to give up using tobacco products
4. Warn about the harms of tobacco
5. Enforce bans on tobacco promotion, sponsorship, and advertising
6. Raise taxes on tobacco

Turkey has relatively high tobacco consumption rate. In order to reduce high tobacco use rate, Turkey has applied various control measures. To accelerate the tobacco control activities, Turkey signed the FCTC in 2004 (Public Health Institution of Turkey, 2014) and made a big effort to progress at tobacco control. Thus, Turkey became the first country in the world to achieve all six MPOWER measures for tobacco control (Public Health Institution of Turkey, 2014).

Before MPOWER, in Turkey, more than 1 in 3 adults used tobacco (http://www.who.int/tobacco/mpower/publications/brochure_2013/en/). The implementation of MPOWER measures has caused the reduction of smoking at Turkey (http://www.who.int/tobacco/mpower/publications/brochure_2013/en/). Although the number of current smokers is still high when compared to several developed countries, the applied policies with the orientation of MPOWER have been helpful for taking tobacco use under control for Turkey. Since the positive

consequences of the applied policies are apparent, we are still not sure which of these policies have higher effect on Turkish society.

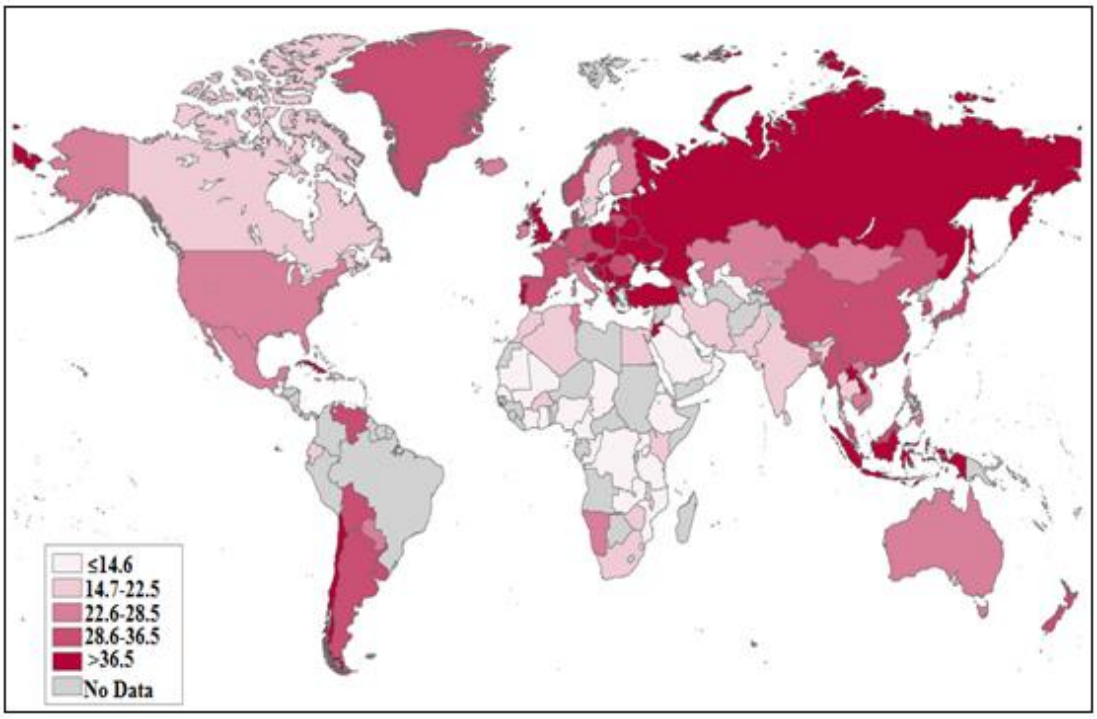

Figure 1.1The percentage of tobacco use among adults in 2005 (http://gamapserver.who.int/mapLibrary/app/searchResults.aspx)

At that point, the main purposes of this thesis are:

- To model tobacco control policies and other tobacco control associated factors those were investigated in the GATS for Turkey.
- To analyze the effects of these policies and factors on current smokers' opinions about quitting smoking in Turkey,
- To forecast tobacco usage ratio of Turkey for the year 2016 regarding the same policies and factors.

1.2 Problem Statement

Tobacco control policies have been applied for reducing the prevalence of tobacco use and damages by different countries all around the world. While some policies can be successful, others may fail to reach the desired targets. One of the main reasons of the failures may be the complexity and dynamism of the tobacco control systems.

Turkey is one of the heavily affected countries that have to face with tobacco epidemic. As seen in figure 1.1, Turkey had over 36.5% smokers in 2005. The

relatively high rate of tobacco use in Turkey leads Turkish government to take precautions and implement effective policies. In order to reduce tobacco consumption, Turkey has used:

- Warning labels on cigarette package
- Anti-tobacco information
- Taxation
- Counseling (quit lines, health care support)
- Smoke free environment
- Tobacco advertising, sponsorship and promotion bans

Turkey has performed considerable progress with these policies. Although the applied policies have taken a crucial role to reduce the prevalence of tobacco use in Turkey, we are still not sure which of these policies have higher effect to make current smokers think about quitting smoking. This thesis mainly investigates the effects of:

- Major tobacco control policies in Turkey: warning labels, anti-tobacco information, smoke-free environment, and taxation (those were investigated in GATS for Turkey).
- Beliefs of people that smoking causes serious illnesses.
- Health care providers counseling on current smokers' opinions about quitting smoking.

It also forecasts the tobacco use rate of Turkey for the year 2016 to observe the progress of Turkey at tobacco control. For this purpose, a system dynamics model is setup.

Information about the proposed model can be found in next sub-section.

1.3 A Brief Description of the Model

In this research thesis, a system dynamics model is developed in order to investigate the effects of tobacco control policies and tobacco associated factors that were investigated in GATS for Turkey. Because system dynamics is a powerful simulation method to get insight in the case of policy resistance and dynamic complexity (Sterman and Sterman, 2000). And it is increasingly used to design

more successful policies in companies and public policy settings (Sterman and Sterman, 2000).

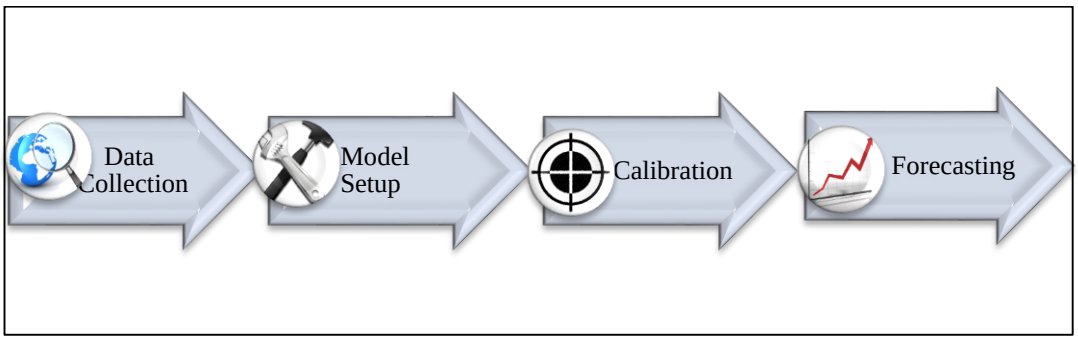

Figure 1.2 The main steps of the proposed model

The proposed model mainly follows the steps as given below (figure 1.2):

- Data collection
- Model setup
- Calibration
- Forecasting

The required data for developing the proposed model is taken from GATS reports for Turkey. Because GATS is a national interview that helps governments to monitor tobacco use in the adult population (Public Health Institution of Turkey, 2014). Also, it is one of the most reliable surveys for national tobacco monitoring researches.

The proposed system dynamics model consists of major SD elements, policies and factors, and model assumptions (figure 1.3). The major elements of an SD model are stocks and flows. The stocks of the proposed model are *current smokers* and *former smokers*. And, the flows of the proposed model are *quit* and *restart.*

In addition, the policies and factors that are adapted in the model are given below.

- Warning labels on cigarette package policy
- Anti-tobacco information policy
- Taxation policy
- Smoke free environment policy
- Beliefs of people that smoking causes serious illnesses
- Health care providers' advices to quit.

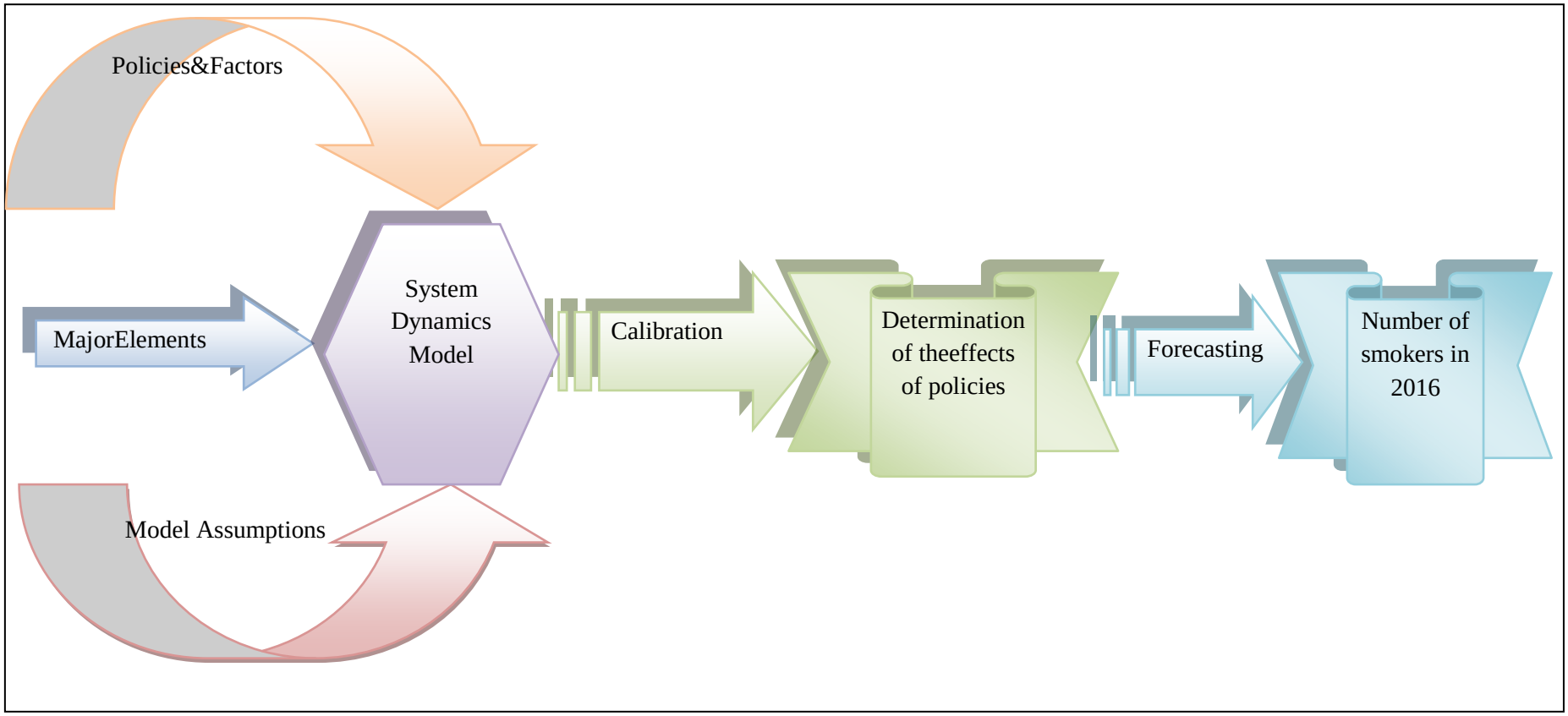

Figure 1.3 The framework for the proposed model

After model setup with mentioned inputs, we would like to find the values of missing parameters for evaluating the effects of the policies and factors. These values can reflect the current data very well.Correspondingly, a calibration analysis is performed in order to obtain missing parameters.

In addition, we foresee that the obtained parameter values will not change for the following two years if an event that shifts paradigm. Thus, the tobacco usage rate of the Turkey for the year 2016 is forecasted with using the adjusted values.

All details of the model can be found in Chapter 4.

1.4 The Relevance of the Thesis to Industrial Engineering

Public health basically aims to protect the health of entire population. It is defined by UK's Faculty of Public Health as "*the science and art of promoting and protecting health and well-being, preventing ill-health prolonging life through the organized efforts of society*". It is related with a vast range of study areas such as epigenetic, chronic diseases, the science of aging, mental health, disaster response, refugee health, injury intervention and tobacco control (http://www.jhsph.edu/about/what-is-public-health/). This research thesis focuses on the tobacco control issue of public health.

Tobacco usehas been a crucial threat for public health. In order to prevent the prevalence of it, several different measures have been implemented to societies. Correspondingly, implementation of efficient tobacco control policies has become a crucial point for protecting societies from the harms of tobacco use. Thus, understanding the tobacco use behaviors and evaluating the factors affecting it are relatively important in order to develop efficient tobacco control policies. However, investigating all these factors can be a really complex and dynamic process. In order to overcome the complexities and dynamism of the process, we can utilize from engineering methods.

In this research thesis, we perform an application on tobacco control policies using industrial engineering methods. System dynamics that is a simulation approach is used for modeling the tobacco control policies. Because system dynamics modeling can help to understand, model, and react the complexities of the tobacco control environment (Best et al., 2007). In addition, it can help to think differently about the tobacco control world by characterizing it in terms of feedback, stocks, and flows

(Best et al., 2007). Thus, this thesis analyzes a social issue with the help of industrial engineering methods in order to perform an example of the studies that combine social sciences and engineering methods and to show how to use engineering methods on social sciences fields.

1.5 Organization of the Thesis

This thesis is organized in six chapters. In Chapter 1, the problem statement and the objectives of the study are presented. Chapter 2 reviews the associated literature in the area of tobacco control for controlling tobacco. In Chapter 3, the background knowledge about tobacco control history of Turkey, Global Tobacco Adult Survey (GATS), and System Dynamics are given. Chapter 4 presents information about the used software, and describes the setup and calibration stages of the proposed model. In Chapter 5, results of the calibration and simulation runs of the model are discussed. In the final chapter, an overview for the results and future works are presented.

1.6 Conclusion

In the introduction chapter, the main objectives of the study and the problem statement were discussed. In the next chapter, the literature review for the tobacco use and control is presented.

CHAPTER 2- LITERATURE REVIEW

2.1 Introduction

Tobacco epidemic has been a global problem. The importance of the problem has attracted many researchers' attention to investigate the problem well and develop better solutions. Thus, tobacco use and control has become a large and growing field that is investigated by numerous researchers across multiple disciplines. In this chapter of the study, the tobacco use and control literature is reviewed.

2.2 Effects of Smoking on Health

Smoking of tobacco is defined as *act of burning cured or dried tobacco plants' leaves and inhaling the smoke* by the Tobacco Atlas (http://www.tobaccoatlas.org/products/types_of_tobacco_use/smokingandsmokeles). Tobacco products consist of different toxic and carcinogenic chemicals over 5000 (Borgerding and Klus, 2005; Talhout et al., 2011). They generally contain powerful addictive psychoactive ingredient, nicotine (http://www.who.int/topics/tobacco/en/). The ingredients of them makes them the world's leading man-made agent of death (Frieden and Bloomberg, 2007).

The damages of tobacco use and second-hand smoke on human health have been proved, based on strong scientific evidences (Yang et al., 2010). Table 2.1 represents some of the studies that investigated the relation between tobacco use and specific diseases such as cancer, cardiovascular diseases, and etc.

Table 2.1 The scientific publications that investigate the relation between tobacco use and some specific diseases

Diseases	Publications
Cancer	http://www.who.int/mediacentre/factsheets/fs339/en/;Mack et al. (1986); General, (1964); Boyle and Maisonneuve, (1995); Schairer and Schöniger, (2001); Sasco et al. (2004)
Adult on-set diabetes	Smoking and Tobacco Use; 50th Anniversary Surgeon General's Report, (2014)
Cardiovascular diseases	Ockene and Miller, (1997); Ezzati et al. (2005); Smoking and Tobacco Use; 50th Anniversary Surgeon General's Report, (2014); http://www.who.int/mediacentre/factsheets/fs339/en
Respiratory diseases	The Health Consequences of Smoking, (1984); Strachan and Cook, (1998);Cook and Strachan, (1999)
Peripheral Vascular System	The Health Consequences of Smoking, (1984)
Menstrual disturbance	Nusbaum et al.(2000)
Premature illness	Frieden and Bloomberg, (2007)
Low birth weight infants	Nusbaum et al. (2000)
Earlier menopause	Nusbaum et al. (2000)

Tobacco use is one of the important cause of cancer (http://www.who.int/topics/tobacco/en/). According the World Cancer Report in 2003, the damages of cancer is the highest in wealthy societies because of the widely observed tumors associated with smoking and the lifestyle of Western (Stewart and Kleihues, 2003).The damages of tobacco use is not only restricted with cancer. Cardiovascular disease mortality is another important harm of it (Ezzati et al., 2005). It also affects the respiratory system and cause respiratory diseases (The Health Consequences of Smoking, 1984). And, for women, tobacco use cause premature delivery, low birth infants, pelvic-floor disorders, decreased fertility, oral contraceptive failure, menstrual disturbance, earlier menopause and etc. (Nusbaum et al., 2000).

2.3 Tobacco Control

In order to preserve the societies from the destructive impacts of the use of tobacco, taking the prevalence of it under control is essential. For controlling tobacco use, various treatments, conventions and agreements are made worldwide. Table 2.2 represents the international agreements, conventions, and treaties those directly or indirectly address tobacco use (http://www.tobaccoatlas.org/solutions/rights_treaties/treaties_conventions_agree/). One of the most vital conventions among them is the Framework Convention on Tobacco Control (FCTC) that was developed by the World Health Organization. The FCTC is a treaty that considers the right of people while protecting the health of them with the highest standard and provides different regulations (http://www.who.int/fctc/about/en/). And, it is also only treaty devoted entirely to tobacco control (http://www.tobaccoatlas.org/solutions/rights_treaties/treaties_conventions_agree/).

The WHO FCTC is mainly divided for the issues (da Costa e Silva and Fishburn, 2004):

- Surveillance, research, and exchange of information
- Passive smoking and smoke-free environments
- Illicit trade for the products of tobacco
- Labeling and packaging
- Disclosure and regulation of contents of the products of tobacco and tobacco smoke
- Sales to and by minors
- Tax measures
- Tobacco advertising, promotion, and sponsorship
- The support of government for manufacturing tobacco
- Convention of the dependence of tobacco dependence
- Passive smoking and smoke-free environments
- Surveillance, research, and exchange of information
- Scientific, legal, and technical cooperation

Table 2.2 The conventions, agreements and treaties that have been used internationally to address tobacco use (http://www.tobaccoatlas.org/solutions/rights_treaties/treaties_conventions_agree/)

Year	Treaty/Convention/Agreement	Content
1948	Un Universal Declaration on Human Rights	Article 25: Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family.
1957	Treaty of Rome	European community is mandated to pursue a high degree of public health protection.
1959	Un Convention on the Rights of the Child	Defends children's right to health.
1976	International Covenant on Economic, Social, and Cultural Rights	Reference the right to safe and healthy working conditions.
1976	International Covenant on Civil and Political Rights (ICCPR)	Article 19: Defends the curtailments of freedom of speech in the interests of public health.
1979	Convention to Eliminate Discrimination Against Women (CEDAW)	Article 11: Defends the right to health for women, including the right to protection of health and to safety in working conditions.
1995	World Trade Organization (WTO)	Preamble: Replaced the 1947 General Agreement on Tariffs and Trade (GATT). In general, trade liberalization, without safeguards, has increased tobacco usage in low- and middle-income countries. The following five treaties entered into force with the establishment of WTO
1995	WTO Agreement on the Trade-Related Aspects of Intellectual Property Rights (TRIPS)	Recognizes that WTO Members may adopt measures necessary to protect public health.
1995	WTO Agreement on Technical Barriers to Trade (TBT Agreement)	Requires WTO Members to ensure that all technical regulations are not more trade-restrictive than necessary to achieve a legitimate objective such as the protection on human health.
1995	WTO General Agreement on Trade and Services (GATS)	States that nothing shall be construed to prevent the adoption or enforcement of measures necessary to protect human, animal, or plant life or health.
1995	WTO Agreement on Agriculture	Covers all agricultural products including tobacco and addresses market access, domestic support, and export subsidies.
1995	WTO Agreement on Subsidies and Countervailing Measures (SCM)	Addresses subsidies for raw tobacco and provides WTO Members a channel to seek elimination of a subsidy or to charge countervailing duties.
2003	The Un Norms on The Responsibilities of Transnational Corporations and Other Business Enterprises with Regard to Human Rights	Transnational corporations and other business enterprises shall not "produce, distribute, market, or advertise harmful or potentially harmful products for use by consumers".
2005	WHO Framework Convention on Tobacco Control	Only treaty devoted entirely to tobacco control.

In order to help to countries for implementation of beneficial policies to decrease the tobacco demand, the WHO introduced MPOWER measures that placed in the FCTC (http://www.who.int/tobacco/mpower/publications/brochure_2013/en/). MPOWER focuses on six policy areas (http://www.who.int/tobacco/mpower/en/):

1. Monitor the usage of tobacco and the tobacco control policies
2. Protect people from being second-hand smoker
3. Offer help to give up using tobacco products
4. Warn about the harms of tobacco
5. Enforce bans on tobacco promotion, sponsorship, and advertising
6. Raise taxes on tobacco

Countries use the defined measures in the WHO FCTC to protect their own society from the usage of tobacco products and the second-hand smoking (http://www.who.int/gho/tobacco/en/). A total of 168 countries implemented the WHO FCTC (http://www.who.int/fctc/signatories_parties/en/). Figure 2.1 represents the proportion of countries according to selected tobacco control policy in 2012.

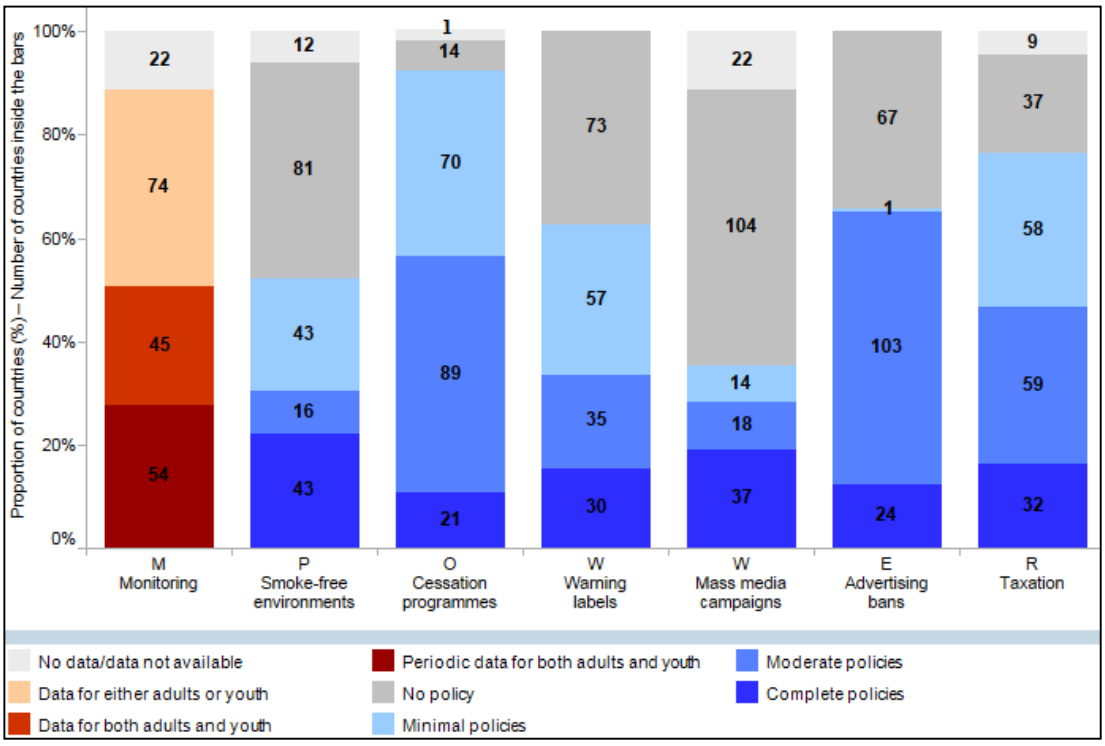

Figure 2.1 Proportions of countries according to selected tobacco control policies of MPOWER for 2012 (http://www.who.int/gho/tobacco/en/)

The number of countries that signed this convention can prove the idea about that tobacco use is a global problem. Due to the importance of this problem, it is not only a study topic for policy makers. It also takes attentions of many researchers all over the world. We can find more than hundred publications in the literature on tobacco control policies and factors that can be reason of starting to smoke. In order to develop effective policies, understanding the tobacco use behavior of people is a crucial point. That's why factors affecting tobacco use has been investigated by researchers, too. For example;Durmusoglu andCiftci (2014) investigated four different factors affecting tobacco use behaviors of students. These factors are given below.

- The school success
- Disciplinary punishment
- Part-time employment
- Alcohol usage

In the study, the relationship between these factors and also the strength of these relationships were analyzed using Fuzzy Cognitive Mapping. Extended Great Deluge Algorithm was used as training algorithm in this study. The results indicated that the relation between alcohol usage and tobacco usage was positive and had the highest strength. The relation between the low school success and tobacco usage was also positive and had the second highest strength while the strength of relation between high disciplinary punishment and tobacco usage was the third one. Lastly, the relation between part time employment and tobacco usage was positive, too and had the lowest strength.

The examples of studies that investigated factors affecting tobacco use as in the study of Durmusoglu and Ciftci (2014) can be increased. However, in this research thesis, we mainly focus on tobacco control policies. For that reason, the studies that stressed on the tobacco control policies are reviewed in this chapter. In the next sub-sections, the literature that investigated the specific tobacco control policies is given.

2.3.1 Taxation

Taxation is an effective tobacco control policy that directly affects the economics of the current smokers. It is also one of the most important measures of MPOWER measure packages. Many countries have been applying this policy for reducing

tobacco consumption rate of their own society. The figure A.1 that is given in appendices represents the distribution of retail taxes on tobacco that countries applied all around the world in 2012.

Taxation on tobacco products to reduce tobacco prevalence has been widely studied in the literature. In this sub-section of the chapter, the major studies that are associated with taxation policy is reviewed.

In 1982, Lewit and Coate investigated the impacts of tax increases on decreasing the smoking prevalence by estimating the elasticity of price for cigarettes demand. They used the 1976 Health Interview Survey for the analysis. The results indicated that there is a considerable impact of price on usage of tobacco for young men.

Subsequently, in 1986, Baltagi and Levin examined the cigarette consumption using pooled data of 46 states from 1963 to 1980 to see the effect of it on generating revenue. The effect of "bootlegging" was modeled using "neighboring" price. Two main policies were focused in this study. First one was that taxation on cigarette is an effective tool for generating revenues although, there may be spillover effects to neighboring states where bootlegging is significant. The second one was about advertising bans of cigarette consumption. They found that cigarette taxation will generate revenues. However, as an anti smoking tool, taxation may not be as effective in reducing cigarette consumption. Also, there was no proof for that advertising bans has the effect of increasing consumption rather than reducing it. In 1992, Baltagi and Levin expanded the study of the previous study by updating the results from 1980 to 1988. They studied the sensitivity of the findings to different ways of modeling the impact of bootlegging while controlling for the impacts of random and fixed state. The results showed considerable effect for the purchasing of borders, and income.

In 2001, Emery et al., examined the relation between experience with adolescents' sensitivity to prices and tobacco use in 1993 nationally. They used statistical methods for the analysis. And, the results pointed that pricing was not completely associated with experimentation.

In addition, Ahmad (2005) studied the tobacco taxation topic using dynamic simulation. Author defended that increasing taxation on cigarettes may be beneficial for economy and health. In order to prove this issue, he built a dynamic simulation

model which follows aging, migration, deaths, and the variation in the status of smoking for whole California population aged 75 years in order to evaluate the economic and health outcomes of the variations cumulatively under various tax rate. The results proved his opinion. Additional tax increase could provide benefits for economy and health of California. In 2008, Ahmad and Franz expanded the previous study. They performed the study to national level and applied sensitivity analysis on price elasticity. The results showed that 40 % tax increase on tobacco reduce the prevalence of smoking from 21% in 2004; to 15% in 2025 over 20 years. Thus, they pointed that increasing taxes on tobacco is an important way to reduce tobacco use, to generate additional tax revenue, and to result in significant savings in medical care costs.

In 2006, Gallus et al. performed a cross-sectional study in order to search the variation in tobacco demand according to tobacco products' prices across the region of Europe. This study investigated all countries of the region of Europe (a total of 52 countries). The analysis was made using cigarette consumption annually, the packages' retail prices and foreign brand tobacco products, the gross domestic product adjusted with purchasing power parities, and the adult population of the year, 2000 data. For the estimation of price elasticity, a double log multiple linear regression analysis was performed. The findings showed that the 10% raise in tobacco products' price significantly reduces the consumption of them 5-7% in Europe.

DeCicca et al. (2008) performed an analysis for examining the dynamics of decisions of young adults about smoking initiation and cessation. They developed an empirical model for smoking cessation and initiation. The data from 1992 to 2000 was used. Two different identification strategies were examined. First one focused on the measurement anti-smoking sentiment state directly. The second one stressed on young adults who face with various pricing policy on cigarettes because of moving to another region of the country between 1992 and 2000. The results showed that there was not any proof to think that pricing policy prevent the initiation of smoking. However, higher prices are associated with raised smoking cessations. On the other hand, DeCicca and McLeod (2008) investigated the older adult smoking behavior when pricing policy is applied on tobacco products in United States . They used the data that was obtained from the Behavioral Risk Surveillance System from 2000 to

2005. Thus, they found that large cigarette tax increase reduced smoking at older adults who are not well educated and live in poor households

Moreover, in 2011, Nonnemaker and Farrelly studied on the role of taxation and price of cigarette for different gender or race/ethnicity. They used the National Longitudinal Survey of Youth 1997 cohort and the methods of discrete-time survival. As a result of the study, they obtained that the prices of tobacco products are a considerable factor for black youth to the initiation of tobacco use.

Bader et al. (2011) investigated the effects of taxation policies on the behavior of tobacco use in risky population (dual diagnosis, youth, heavy tobacco users, young adults, and aboriginal people). For this study, they used knowledge synthesis that illustrated the value of using important approaches:

- The opinion of experts
- The review of the literature systematically

The study indicated that taxation is a strong measure for decreasing the prevalence of tobacco among youth, young adults and persons of low socioeconomic status.

Differently, Peretti-Watel et al. (2012) studied on the reactions of persistent tobacco users to taxation and factors that were correlated with their reactions. They defined the persistent smokers like tobacco users who did not give up due to taxation. They performed a telephone survey which included questions about the tobacco usage and taxation reactions. Logistic regressions were applied in order to determine the factors related with tobacco users' reactions. The results showed that the reasons of people for smoking and their personal time perspectives contributed to their reactions to taxation.

In 2013, Chen et al. (2013) focused on the idea if there are differences in price sensitivity between heavy and light smokers. They used quantile regression in order to examine price sensitivity of demand for smokers with different levels of tobacco use. They performed a survey in Taiwan for this purpose. The findings showed that pricing policies can reduce tobacco consumption for heavy smokers.

Consequently taxation literature generally focuses on two main topics: the effects of taxation on reduction of smoking and on obtaining revenue from it. The studies mainly approved that taxation help to reduce tobacco use and to increase revenue of the governments.

2.3.2 Smoke-free Environment

One of the widely used tobacco control policies is smoke-free environments. It is generally used to protect people from tobacco smoke. Figure A.2 represents the number of places that countries applied smoke-free environment for 2012. Smoke-free environments are another important tobacco control associated topic that is studied in literature. In this part of the thesis, a brief review on smoke-free environment is given.

In 1999, Conti presented a report about the agreements of a meeting that was held in January 1989 in Houston devoted to tobacco consumption in USA. In the meeting, three vital points were accepted. One of them was about the smoke-free hospitals in the country. The second one was about fostering the establishment of a smoke-free USA. And, the last one was about that USA should remain within the purview of the Prevention of Cardiovascular Disease Committee.

In 1999, Norman et al. investigated that people who needed smoke-free houses and cars, could really reach them. They applied the analysis on 6985 adults aged 18 and older that were participated in survey in California. The findings showed that smoking bans for home and car were not enough for nonsmokers who have friends who smoke.

Apart from previous studies, Wechsler et al. (2001) searched if students lives in smoke-free places can be effective to protect them from smoking comparing students who use different places in campus for accommodation. They found that smoke-free accommodation places may protect the students that were not daily tobacco users. However, the variation in the rate of tobacco use may be because of self-selection of students into smoke-free accommodation places.

In addition, Nykiforuk et al. (2007) stressed on the relations between the outcomes of the characteristics of the municipal and community smoke-free environment policy outcomes in order to explain how condition are related with bylaw strength and status. They used linear and multiple regression analyses in order for obtaining models for municipal bylaw strengths and status using the factors of community: the tobacco use rate of health regions, socio-demographics, the type of municipality, and provincial environment for tobacco measure. At the end of the study, authors pointed

that the characteristics of the community play an important role in the strength and status of municipal smoke-free bylaws.

Moreover, in 2011, Öberg et al. focused on the estimation of the worldwide damage of disease attributable to passive smoke, measured as death and disability-adjusted life-years (DALYs) lost for adult and children tobacco users. It was the first assessment of the worldwide burden of disease from exposure to smoke. They applied comparative risk assessment for 192 countries during 2004. According to the results, 35% of female and 33% of male non smokers, and 40% of children nonsmokers had been passive smokers in 2004. This exposure was estimated to have caused;

- 379,000 people 's death due to ischemic heart disease;
- 165,000 people's deaths due to lower respiratory infections;
- 36,900 people's death due to asthma;
- 21,400 people's death due to lung cancer.

Differently, in 2013, Ward et al. performed one of the pioneering study that compare the measured passive smoke concentrations among the countries that locates in the European region directly with the explicit intention of estimating the relative impact of the various levels of smoke-free laws that have been implemented across these countries. For the study, they compared the fine particles from exposure to smoke in hospitability venues before and after the applications of smoking bans in Turkey, Scotland, Portugal, Ireland, Italy, Greece, and France. The results presented that partial laws are less effective than comprehensive smoke-free laws for reducing passive tobacco use.

In 2014,Farrelly et al. investigated the influence of tobacco control program funding, smoke-free environment legislations, and cigarette prices on young adult smoking outcomes. They used experimental design method in order to understand the influence on tobacco outcomes. This study demonstrated that smoke-free environments are important policy for decreasing the tobacco use prevalence at young adults.

Smoke-free environments, second-hand smoking bans, and exposure to tobacco smoke have been widely studied topic for tobacco control literature. Lots of the

studies focus on specific smoke-free places. Table 2.3 represents some of these studies according to focal place(s).

Table 2.3 Smoke-free environment or second-hand smoke related publications according to their focal place

Place(s)	Author(s)/Year
Hospital	Sureda et al. (2010); Sureda et al. (2014),
City	Ueda et al. (2011)
Class	Schulze et al. (2006),
Home	Norman et al. (1999);Tong et al. (2008);Pereira et al. (2013);Nazar et al. (2014)
Car	Norman et al. (1999);Nguyen, (2013),
Work	Odukoya and Sekoni, (2013);Nazar et al. (2014)
Prison	Vaughn and Del Carmen, (1993);Eldridge and Cropsey, (2009)
Bar, Pub	McNabola et al. (2005); Nagelhout et al. (2011), Pieroni et al. (2013)
Outdoor Public Area	Thomson et al. (2013)
Restaurant, Cafe	Pieroni et al. (2013)
Park, Beach	Okoli et al. (2013)

2.3.3 Warning Labels

Warning labels on the cigarette packages that is an effective tobacco control activities are generally used in order to make people conscious of the dangers of tobacco use. It is also one of the widely used tobacco control policy in the world. Figure A.3 represents the size of used warning labels on tobacco products all over the world in 2012.

In this sub-section, a brief review of warning label studies is given. In 1992, Beede and Lawson examined the effect of warning labels on 568 adolescent children whose average age was 13. For this purpose, a survey was applied for the target population. In order to reflect attention of the participants to the assortment of cues presented on the cigarette packages, a measure of unaided recall was used. The results showed that the presentation of warning label on plain packages achieved a considerable higher recall rate in contrast to the packages of brand.

Differently, in 2007, Hammond et al. investigated the effectiveness of warning labels for four different countries. Adult smokers from Canada, USA, UK, and Australia were surveyed by telephone surveys. The results showed that comprehensive health warnings that placed on the packages were more possible to be seen by tobacco users. And, variation in the health warning was also related with raised effectiveness. Also, in 2007, Thrasher et al. investigated the potential effect of graphic warning labels among adult Mexican smokers. They used n'th price auction method in order to determine which cigarette package (with pictorial warning label or with only text warning label) was perceived by adult smokers. The auction method is used for revealing private preferences and evaluations of the commodities. They found that adult tobacco users of Mexico appear to perceive a high value to tobacco package with only text health warnings comparing with packages with pictorial labels. Also, the lower perceived value of package with pictorial warnings was relatively consistent across groups defined by socio-demographic, amount of smokers daily, number of attempts to quit, and perceived tobacco use risks

Moreover, in 2011, Bansal-Travers et al. searched the effect of tobacco products' package design, the descriptors of the product, and warnings for health on the perception of risk and appeal of brand. They applied a cross- sectional mall-intercept study for 197 adult smokers and 200 nonsmokers in Buffalo NY from June to July 2009. The results indicated that larger, health warnings that convey loss-framed messages as most effective for communicating health risks to adults. In addition to this, the color and product descriptors are related with wrong beliefs about risks.

In addition, McCool et al. (2012) examined the impacts of pictorial labeled cigarette packages on adolescents in order to evaluate the potential of the strategies to reduce smoking initiation. The study was performed for 80 students who are 14-16 years old in New Zealand. Textual analysis indicated that graphic warning labels on a plain package improved the attention to visual warning labels and damage perceptions caused by tobacco use, and decreased the social appeal of tobacco use.

2.3.4 Anti-Tobacco Mass Media Campaigns

MPOWER measures include anti-tobacco media campaigns in order to warn smokers about harms of tobacco use. In today's world, the effects of media on people cannot be ignored. In order to reduce the tobacco use prevalence, using media effect can be

beneficial. For that reason, many countries use the media for this aim. Figure A.4 represents anti-tobacco media campaigns applied with appropriate characteristics for 2012. In this section, the studies that investigated the tobacco associated mass media campaigns are reviewed briefly.

In 1986, Vaque and Salleras defined the anti-tobacco health information activities carried out through communication media during 1983 in Catalonia. Three groups have been centre for the activities. These were; doctors, teachers, and politicians as models, the young, and the general population.

In 2006, Biener et al. evaluated the impact of conventional tobacco usage helps such as give up tobacco usage programs and pharmaceutical therapy on cessation at the population level relative to the effect of mass media anti-smoking advertisements. A telephone survey was applied to 6739 residents of Massachusetts in 2001-2002 yielded a subsample of 787 individuals who had given up smoking within the past 2 years. The analyses of 2004-2005 indicated that advertisements were the most mentioned source of help among recent quitters. However, people who smoke for a long time found the conventional aid helpful.

Moreover, Dietz et al. (2008) investigated the reach of the anti-tobacco media activities of Florida to youths in order to a) define who were aware of the campaigns and b) analyze whether this awareness was related with an intention to give up tobacco usage in the next 30 days. A telephone survey analysis conducted for this purpose. At the end of the study, the results pointed that the campaign did not have the unintended solution of influencing intention to smoke of adults. In order to change the adults' behaviors, the campaign must stress on youths, too.

Also, Durkin et al. (2013) examined that if certain types of anti-tobacco advertisements are more possible to be perceived as beneficial across tobacco users in 10 middle or low income countries. Egypt, Bangladesh, India, China, Indonesia, Philippines, Mexico, Turkey, Vietnam, and Russia and 10 anti-tobacco advertisements were taken into account in this study. 5 advertisements were shown in all countries and the other 5 advertisements were chosen by country representatives, providing 37 anti-smoking advertisements across all countries (8 emotional stories of health effects, 10 graphic health effect advertisements, 6 simulated health effects, 7 other health effects and 6 non-health effects). The analysis showed that graphic

health effect advertisements were less likely to change for the perception of effectiveness across countries, age, gender, education, amount smoked, and parental status were less possible to be affected by differences in cultures.

Bansal-Travers et al. (2014) focused on pro-tobacco advertising and promotion effects in India. They studied on the associations between tobacco habits (smoker, smokeless tobacco user, and non-smokers), demographic characteristics, and exposure to pro-tobacco advertising and promotion, beliefs about tobacco use, including perceived risk and addiction. The result of this study showed the necessity of stronger legislation and strict enforcement of bans on direct and indirect advertising and promotion of tobacco products in India.

2.4 Tobacco Control Simulation

Tobacco control is a complex and dynamic interrelated system (Best et al., 2007). Correspondingly, in order to model tobacco control, simulation, which is an efficient way to imitate the real world systems, can be used. In this part of the study, tobacco associated simulation studies that already exists in the literature are reviewed briefly.

The main examples to these studies are SimSmoke studies. SimSmoke is discrete-time Markov process model of the tobacco use and control and smoking associated mortality that simulates the effects of tobacco control measures (Levy et al., 2014). It is a method that project population forward through births and deaths (Levy et al., 2010). SimSmoke contains from a population model, a smoking model, a smoking attributable death (SAD), and policy modules (Levy et al., 2005;Levy et al., 2005;Levy et al., 2006;Levy et al., 2012).

The SimSmoke model has been applied for different countries and states in order to examine the effects of tobacco control policies. Levy et al. (2008) performed a SimSmoke model for examining tobacco control policies of Thailand that was one of the pionerring Asian nations that apply strong tobacco control regulations. They also focused on the tobacco use related deaths and lives saved at the end of these regulations. The effect of regulations implemented was distinguished between 1991 and 2006. The results showed that tax increases and advertising bans had the highest impact for reducing tobacco prevalence for Thailand. Also, they found that 319456 lives will have saved by 2026. In other study, Levy et al, (2010) used SimSmoke model in order to investigate the impacts of tobacco control regulations that were

applied beginning in 1995 in the Republic of Korea on the usage of tobacco and deaths. The model showed that price increases and strict media campaign will prolong 1,048,123 male lives by 2027. Moreover, in 2012, a SimSmoke model for Italy is developed by Levy et al. They evaluated the effects of past tobacco control policies to project the effects of future tobacco control policies on tobacco use and tobacco use related premature death. Consequently, they found that if tobacco prices increases, and high intensity media campaigns, well cessation treatment program, strong health warnings, stricter smoke-free air regulations, advertising bans are applied, there can be a significant reduction at tobacco use and tobacco use related premature death. In addition, Levy et al. (2014) investigated the potential impact of the WHO FCTC measures on China using SimSmoke modeling. The results indicated that the WHO FCTC measures can save more than 12.8 million people from tobacco use related deaths in China by 2050. There are also studies for other countries such as Germany (Levy et al., 2013), Minnesota (Levy et al., 2012), Brazil (Levy et al., 2012), Russia (Maslennikova et al., 2014), The Netherlands (Nagelhout et al., 2012), The Czech Republic (Levy et al., 2012) and etc.

In addition to these, there are limited numbers of projectsabout Turkey, too. These projects generally focus on comparisons of the effects of policies with other countries (http://www.pire.org/internationalprojects.asp?cntry=Turkey).

Different from the SimSmoke studies, Ahmad (2005) used dynamic simulation approach for investigation of the taxation policy. Also, Ahmad and Franz (2008) expanded the study of Ahmad (2005) performing a sensitivity analysis on price elasticity. These studies were mentioned in details at the taxation review sub-section.

2.5 Conclusion

In this part of the thesis, the literature of tobacco use and control is reviewed and presented. The most of these studies significantly indicated the harms of tobacco use on health. And, the studies about tobacco control policies generally tried to find the effective polices for different target population.

CHAPTER 3- BACKGROUND KNOWLEDGE

3.1 Introduction

This chapter provides background information about tobacco use and control history of Turkey, global tobacco adult survey, and system dynamics modeling. As mentioned before, one of the major objectives of this thesis to examine the effects of the main tobacco control policies implemented by Turkish authorities. For that reason, tobacco use and control history of Turkey is first introduced in Section 3.2. In Section 3.3, Global Tobacco Adult Survey (GATS) and the results of GATS for Turkey that is used for data collection are presented. And, Section 3.4 provides information for simulation and system dynamics modeling that is used for modeling processes of this thesis.

3.2 Tobacco Use and Control History of Turkey

Tobacco epidemic is one of the biggest and preventable causes of death worldwide. Many countries suffer from the negative consequences of high tobacco consumption rate. Turkey is one of them with relatively high tobacco use. Tobacco related diseases cause over 100,000 death every year and this amount can increase to 240,000 death by 2030 (Bilir et al., 2012).

Figure 3.1 represents the sales of cigarettes in Turkey from 1925 to 2013. The number of sales can give idea about the consumption of tobacco in Turkey. From 1945 to 2000, the number of sold cigarettes dramatically increased although there was rarely decrease at some years. After 2000, the increase at the sales started to decrease. The major reason of the decrease at sales may be the applied legislations and policies for tobacco control.

In order to prevent the increase at tobacco use and protect the Turkish society from damages of tobacco consumption, Turkish government has made specific tobacco control actions and legislations. The important actions and legislations are given below according to the years.

- In 1987, the Ministry of Health (MoH) invited relevant experts in order to discuss how to control tobacco use in Turkey (Public Health Institution of Turkey, 2014).
- In 1988, the first survey for investigating tobacco use prevalence of Turkey was performed by the MoH(Ministry of Health, 2010;Bilir et al., 2012).
- In 1996, the primary tobacco control law of Turkey came into force. It was "The Law on Prevention and Control of Hazards of Tobacco Products" with the law no 4207. The aim of this law was regulating the tobacco control issues such as prohibition on public smoking; promotion; advertising; and sponsorship; education campaigns; labeling and packaging; and penalties for violations.

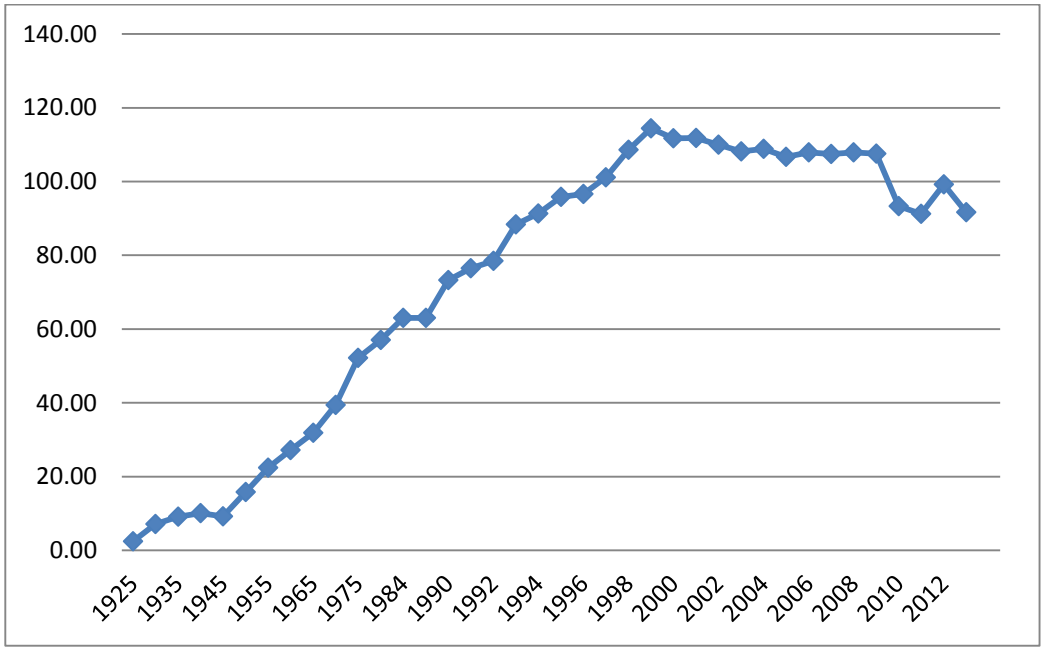

Figure 3.1 Cigarette sales 1925-2013 (billion sticks) in Turkey (http://www.tapdk.gov.tr/tr/piyasa-duzenlemeleri/tutun-mamulleri-piyasasi/tutun-mamulleri-istatistikleri.aspx, 2013)

- In 2002, the Tobacco and Alcohol Market Coordination Committee (TAPDK) was established in order to organize the procedures and principles concerning the production, internal and external purchase and sales of tobacco and tobacco products in Turkey (http://www.tobaccocontrollaws.org/legislation/country/turkey/laws).
- In 2003, Global Youth Tobacco Survey (GYTS) was conducted for the first time.

- In 2004, Turkey signed the WHO FCTC in order to become a party of this vital treaty.
- In 2005, a regulation on methods and essentials concerning the manufacture type, surveillance and labeling was applied in order to protect from the damages of tobacco use.
- In 2008, with the law 5727, the law 4207 was strengthened. The TAPDK started to regulate the size, contents, formats, and shapes of no-smoking signs in the places where smoking is forbidden, the health warnings signs that must appear in the fields that are separated for tobacco use (http://www.tobaccocontrollaws.org/legislation/country/turkey/laws).
- In 2008, the first Global Adult Tobacco Survey (GATS) for Turkey was conducted for adults aged 15 years and older using a standardized protocol including a survey, sample design, and data management (Public Health Institution of Turkey, 2014).
- In 2009, the format, rotation, and size of warning labeled on the products were regulated. Also, the implementation of smoke-free provisions in restaurants, bars, and places in the other hospitability industry were arranged.
- In 2009, the second GYTS was conducted.
- In 2012, the ingredients in tobacco products were regulated.
- In 2012, the second GATS for Turkey was conducted.

One of the most crucial tobacco control activity of Turkey was to become a party of the WHO FCTC in 2004. The WHO FCTC has helped to Turkey for providing required methods to tobacco control. The FCTC shows three main approaches (Bilir et al., 2012):

1. Measures for decreasing the demand for tobacco products that include regulations for (Ministry of Health, 2010):
    - Taxation and pricing
    - Control of the products
    - Smoking cessation
    - Public information
    - Environmental tobacco smoke
    - Promotion, advertising, and sponsorship

2. Policies for decreasing the tobacco products' supply that include regulations for (Ministry of Health, 2010):
    - Accessibility to youths
    - Illicit trade
    - The production of tobacco and new policies
3. Observing the tobacco use and tobacco control measures.

Turkey has been one of the most willing countries to reduce the harms of tobacco use. Figure 3.2 represents an outline for tobacco control activities of Turkey. Although the tobacco use rate is still high, Turkey has achieved great successes in tobacco control (Public Health Institution of Turkey, 2014). The primary reason of the success of Turkey at tobacco control is the applied tobacco control policies. For implementation of those tobacco control policies, the requirement of the WHO FCTC has been implemented to the society. Consequently, Turkey became the first country to meet all six MPOWER criteria (Public Health Institution of Turkey, 2014).

In order to monitor the progress at tobacco control, Global Adult Tobacco Survey (GATS) and Global Youth Tobacco Survey (GYTS) has been conducted. In the context of this study, GATS will be investigated. Because GATS is one of the most reliable researches that are conducted in order to monitor only tobacco use and control status of countries. The information about the GATS will be presented in the next sub-section.

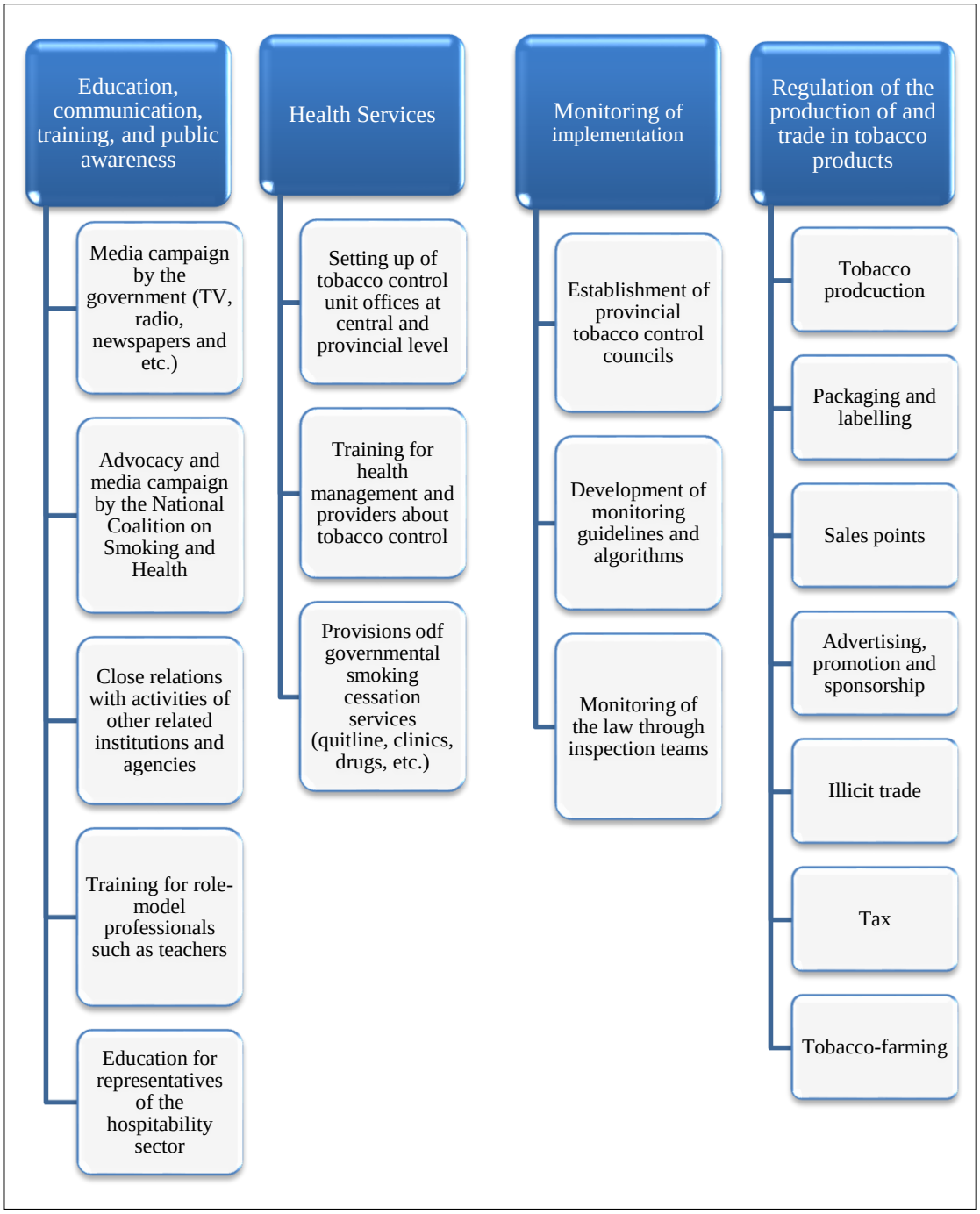

Figure 3.2 Outline of tobacco activities of Turkey based on GATS, GYTS, health professionals survey and individual surveys (Bilir et al., 2012)

3.3 Global Adult Tobacco Survey

The Global Adult Tobacco Survey (GATS) is a household survey that is conducted nationally and launched in February, 2007 as a new factor of the ongoing Global Tobacco Surveillance System (GTSS) (http://www.who.int/tobacco/surveillance/survey/gats/en/). GATS is a global standard that helps governments to monitor tobacco use in the adult population and key tobacco control measures systematically (Public Health Institution of Turkey, 2014). The major objective of the GATS is to obtain data for the usage of tobacco and the measures of tobacco control applying a standardized interview, sample design, and data collection/management procedures among adults aged 15 years and older (Ministry of Health, 2010). For that reason, GATS is one of the most reliable surveys for monitoring tobacco use and control status of countries. The GATS includes the topics (http://www.who.int/tobacco/surveillance/survey/gats/en/):

- Cessation
- Tobacco use prevalence,
- Second-hand smoking and policies
- Media
- Economics
- Beliefs, attitudes, perceptions, and knowledge

The GATS generally divides the households in three main categories: current smokers, former smokers, and never smokers.

- *Current smokers* is defined as people who currently tobacco users as daily or occasional basis.
- *Former smokers* is defined as people who used tobacco products in the past. However, they quitted smoking.
- *Never smokers* is defined as people who never use tobacco products.

The results obtained from the GATS help governments in the formulation, tracking, and tobacco control policies' implementation, and also compare the results with the results of other countries (http://www.who.int/tobacco/surveillance/survey/gats/en/).

3.3.1 GATS Application for Turkey

The GATS for Turkey was first conducted in 2008. After 4 years, in 2012, the second GATS for Turkey was performed to monitor the change at tobacco use profile of Turkey and the contributions of applied tobacco control policies.

For the study of Turkey (Ministry of Health, 2010;Public Health Institution of Turkey, 2014):

- *Populationunder Interest*: All settlements in Turkey were participated to the survey except for villages with populations less than 200. All people who are living in private household and aged 15 and older living in private were conducted. According to the GATS Sample Design Manual, at least 8000 respondent surveys (2000 each for urban men and women and rural men and women) are required. However, for Turkey, 51,151 in 2008, 54,548 people in 2012 were surveyed. In order to calculate the number of households who would be surveyed in 2012, the results of the GATS 2008 for Turkey were taken into account. And, the response and eligibility rates for 2008 were used. (Table 3.1 represents the response and eligibility rates.) Then, required study population was calculated with the formulations given below.

  *Male Sample Size=4000/(PER*PRR Men)* *(3.1)*

  *Female Sample Size=4000/(PER*PRR Women)* *(3.2)*

  *Initial Total Sample Size=(Male Sample Size + Female Sample Size)/(HER*HSR*HRR)* *(3.3)*

Table 3.1 Response and eligibility rates for 2008 GATS results (Public Health Institution of Turkey, 2014)

Response and Eligibility Rates	**Percentage**
Household Eligibility Rate (HER)	0.88
Household Response Rate (HRR)	0.94
Household Screening Rate (HSR)	0.94
Person Eligibility Rate (PER)	1.00
Person Response Rate-Men (PRR Men)	0.88
Person Response Rate-Women (PRR Women)	0.89

- *Sampling Design:* The survey's sampling method was a three-stage, stratified systematic cluster sample method. In the first stage, the base weights were calculated that were proportional to the probabilities of selection for each sample respondent inversely. At the first stage, calculations contained probabilities for the selection of Primary Sampling Units (PSU), households, and eligible individuals. At the second stage, base weights were adjusted in order to balance for losses in the sample outcome due to non-response. Clusters from urban and rural areas were selected (Primary Sampling Units (PSU)). The household non-response adjustment was performed using the formulation given below based on each PSU. In the last stage, calibration adjustments were performed. The required terms for the calibration adjustments are given in the table 3.2.

  Household Response Rate= (I+P)/[(I+P)+(R+NC+O)+(UH+UO)] *(3.4)*

  Household Adjusted Value=1/(Household Response Rate) *(3.5)*

Table 3.2 The definition of the terms used in the formula of Household Response Rate (Public Health Institution of Turkey, 2014)

Term	**Definition**
I	The number of fully completed households
P	The number of partially completed households
R	The number of refusals
NC	The number of non contacts
O	Any other reason for not obtaining household data from eligible households
UH	Household with unknown eligibility
UO	Any other reason for not obtaining household data from units with unknown eligibility.

After weighting stages, the multiplicative effect (Meff) was calculated in order to point if there is a need to adjust for minimum and maximum extreme values. The Meff is calculated as given below.

$$\text{Meff}_w = 1 + \frac{S_w^2}{\bar{w}^2} \qquad (3.6)$$

$S_w^2$is the variance of the weight. And, $\bar{w}^2$ is the mean of the weights.

- *Sampling Error Estimation*: Standard error (SE) calculations were made. SE was calculated by using Statistical Analysis System (SAS) software.

- *Survey:* GATS for Turkey was prepared seeking for the answers under8 factors. These are: background characteristics (gender, age, education, and etc.), tobacco smoking, smokeless tobacco, cessation, second-hand smoke (SHS), economics, media, knowledge and attitudes.
- *Statistical Analysis:* Analysis was performed using SAS programs.

You can find further details for survey methodology on the GATS reports for Turkey.

3.3.2 GATS Results of Turkey

The survey that was conducted in 2008, represented 51,151,000 adults (25,096,000 male, 26,055,000 female) who aged 15 years and older while the survey in 2012 represented 54,548,000 adults (26,862,000 male, 27,686,000 female). The major findings obtained from the GATSs of Turkey are given below.

- In 2008, 31.2% of the adult population was current smokers which could be daily or occasional smokers, 52.8% of the adult population was never smokers who never tried smoking, and 15.9% of them was former smokers who quitted smoking while in 2012, 27.1%, 59.8% and 13.1% of the adult population were respectively current smokers, never smokers and former smokers. Thus, although, the population increased, the prevalence of tobacco use decreased in Turkey.
- In 2008, 44.8% of the current smokers and former smokers who have been abstinent for less than 12 months made quit attempt. And, 15.8% of them have been successful to quit. In 2012, 46% of the current smokers and former smokers who have been abstinent for less than 12 months made quit attempt. And, 13.1% of them have been successful to quit.
- In 2008, 46.9% of the current smokers and former smokers who have been abstinent for less than 12 months visited a health care provider (HCP). 49% of them were asked by HCP if a smoker and among the smokers 83,1% were advised to quit by the HCP. In 2012, 40.8% of the current smokers and former smokers who have been abstinent for less than 12 months visited a health care provider (HCP). 51.4% of them were asked by HCP if a smoker and among the smokers 83.5% were advised to quit by the HCP.

- Among current smokers who made quit attempt in the past 12 months and former smokers who have been abstinent for less than 21 months, 9.3% of them used pharmacotherapy, 1.8% of them used counseling and the remaining 88.9% quitted with traditional medicines, other products or without assistance in 2008, while 13.6%, 8.0%, and 78.1% of them quitted with pharmacotherapy, counseling, and traditional medicines, other products or without assistance respectively in 2012.
- In 2008, 11.3%, 6.0%, 55.9%, and 16.5% of the adults were exposed to tobacco smoke at public (state) buildings, health care facilities, restaurants, and public transportation respectively in the past 30 days while in 2012, 6.5%, 3.8%, 12.9%, and 10.4% of them were exposed to tobacco smoke at public (state) buildings, health care facilities, restaurants, and public transportation respectively in the past 30 days. 31.6% nonsmokers (never smokers and former smokers) were exposed to tobacco smoke at work in 2008, while 12.3% of them were exposed in 2012.
- In 2008, a current smoker paid for manufactured cigarettes on average 86 Turkish Liras (TRL) per month in 2012. It became 157.6 TRL in 2012.
- In 2008, 91.6% of the current smokers noticed anti-tobacco information during the last 30 days somewhere(TV, newspaper, internet, magazines, and etc.) while 94.1% of them noticed in 2012. Also, 53.7%, 87.8%, 24.9%, 43.9%, and 6.0% of them noticed anti-tobacco information respectively at newspapers, television, radio, billboards, and other in 2008. And, in 2012, 44.8%, 91.6%, 28.4%, 32.9%, 30.0%, and 2.8% of them noticed the anti-tobacco information respectively at newspapers, television, radio, billboards, internet, and other.
- In 2008, 95.1% of manufactured cigarette smokers noticed health warning labels on cigarette package and 46.5% of them thought about quitting because of warning labels. In 2012, 94.3% of current smokers noticed health warning labels on cigarette package, and 53.0% of them thought about quitting due to labels. Also, 92.5% of current smokers noticed pictorial warnings on the package and 48.5% of them thought about quitting due to pictorial labels.
- In 2008, 95.5% of current smokers believe that smoking cause serious illnesses while this figure is 96.0% for 2012.

The comparison of the detailed results is given in Appendix B.

3.4 Simulation

Complex and dynamic systems cause multiple problems to learning (Sterman and Sterman, 2000). Modeling is a way of finding solution for the real world problems and allows you to optimize systems prior to implementation(Borshchev and Filippov, 2004). Conducting experiments on a real world problem may be impossible or impractical due to the dynamism and complexity. For this kind of case, simulation modeling is used widely (Ciancio and Mukerji, 2008). Because simulation imitates the operation of a real-world process or system over time (Banks et al., 2004).

Simulation can be categorized in four main approaches (Borshchev and Filippov, 2004). These approaches are given below.

- Discrete-Event Simulation (DE) is the modeling of systems in which the state variable changes only at discrete set of points in time (Banks et al., 2004).
- Agent-Based (AB) is a relatively recent modeling method that is widely used in order to model complex and dynamic systems composed of interacting, autonomous agents (Macal, 2010).
- Dynamic Systems (DS) stays a bit aside as it is used to model and design physical systems (Borshchev and Filippov, 2004).
- System Dynamics (SD) is used for designing more effective policies and organizations and assumes a high level of aggregation of the object being modeled (http://www.anylogic.com/system-dynamics).

Figure3.3 represents the main characteristic of the mentioned simulation approaches in detail. In the context of this study, in order to model tobacco control policy of Turkey, system dynamics modeling is used. The next subsection gives information for system dynamics.

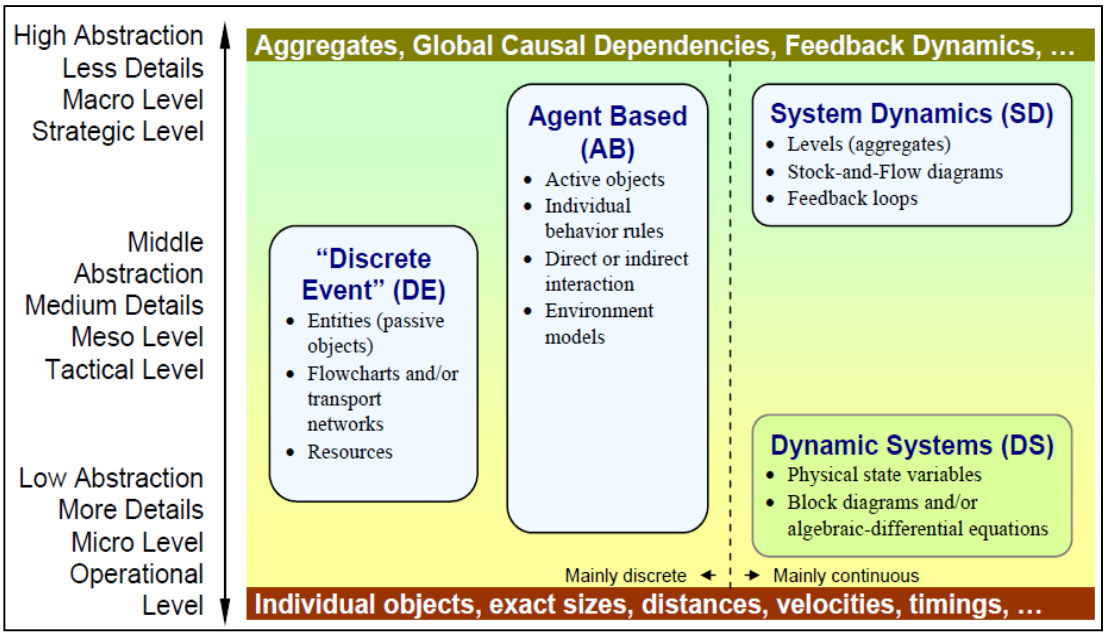

Figure 3.3 Approaches in simulation modeling on abstraction level scale (Borshchev and Filippov, 2004)

3.4.1 System Dynamics

"*System dynamics is an approach that should help in important top management problems . . . The solutions to small problems yield small rewards. Vey often the most important problems are built little more difficult to handle than the unimportant. Many people predetermine mediocre results by setting initial goals too low. The attitude must be one of enterprise design. The expectation should be for major improvement . . . The attitude that the goal is to explain behavior, which is fairly common in academic circles, is not sufficient. the goal should be to find management policies and organizational structures that lead to greater success.*" ***Jay W. Forrester***(Forrester, 1961;Sterman and Sterman, 2000).

System Dynamics (SD) modeling was developed by Jay W. Forrester who is an electrical engineer in the mid-1950s. SD was called as *Industrial Dynamics* and is defined as "the study of the information feedback characteristics of industrial activity to show how organizational structure, amplification (in policies), and time delays (in decision and actions) interact to influence the success of the enterprise by Forrester (Forrester, 1961).

SD modeling has been characterized as top down model that model a system by breaking into its major factors and modeling the factors interactions (Macal, 2010). The major principles of SD are that the complex behaviors of organizational and

social systems are the result of ongoing accumulations of states such as people, material, information, or even biological or psychological states and both balancing and reinforcing feedback mechanisms (Homer and Hirsch, 2006). SD models generally includes a small number of state variables which determine the modeled system's state and a specification of the rate of change of each of the state variables, that depends on the prior system state (Macal, 2010).

SD modeling works with only aggregates, the components of stock are indistinguishable and there is no individuality (Borshchev and Filippov, 2004). It uses mathematical simulation in order to model the structure of the system and simulate the future system behavior, including unintended results and long-term impacts (Best et al., 2007).

The SD modeling includes (http://www.systemdynamics.org/what-is-s/):

- Defining problems dynamically, in terms of graphs over time.
- Concepts of the real system are accepted as continuous quantities interconnected in loops of information feedback and circular causality.
- Determining the stock and flows.
- Formulating a behavioral model capable of reproducing.
- Producing policy insights from the model.
- Implementing the changes resulting from model-based understanding and insights.

The processes are represented in terms of stocks, flows between these stocks, and information that defines the values of the flows in SD models (Borshchev and Filippov, 2004). Figure 3.4 presents the general structure of SD models. The information about stocks and flows are given below.

*Stocks:*They are the main elements of an SD model. They are also known as state variables, accumulations, or levels. They generally represent the processes of real-world that change their value over time with given flow (http://www.anylogic.com/anylogic/help/index.jsp?topic=/com.xj.anylogic.help/). Stocks can vary according to the model. They can be materials, knowledge, money, people, and etc.

*Flows:*They areother main elements of an SD model. They are also known as rates. They are generally used for defining the rate of flow from one stock to another stock

(http://www.anylogic.com/anylogic/help/index.jsp?topic=/com.xj.anylogic.help/).v
Flows are categorized as inflows and outflows.

*Inflows:*They go from flows to stock. They represents addition to the stock (http://www.anylogic.com/anylogic/help/index.jsp?topic=/com.xj.anylogic.help/).

*Outflows:*They go from stock to flows. They represent subtraction from stock (http://www.anylogic.com/anylogic/help/index.jsp?topic=/com.xj.anylogic.help/).

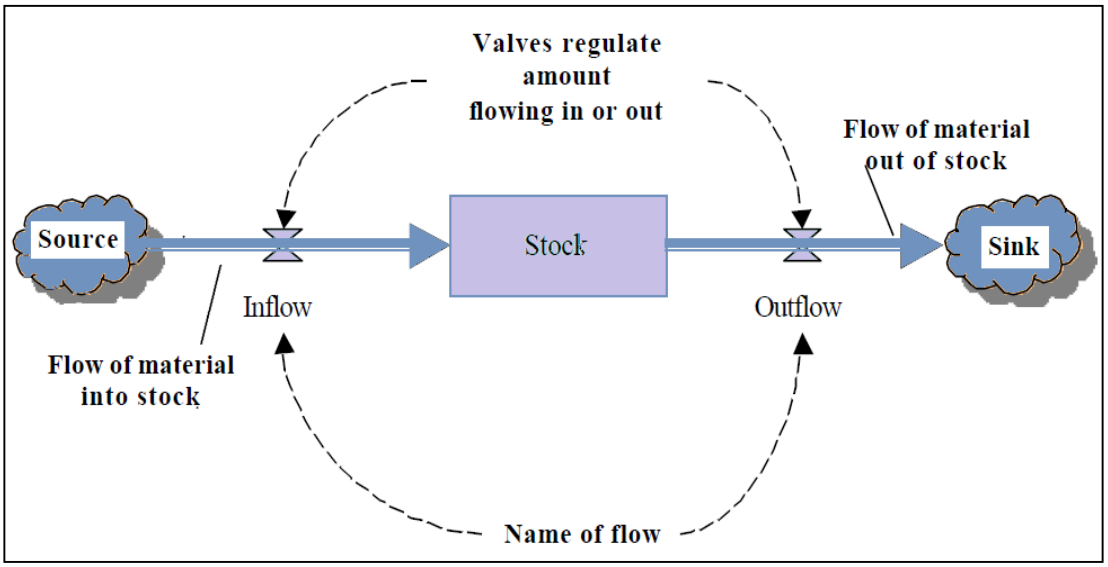

Figure 3.4 Stock and flow diagramming notation (Sterman and Sterman, 2000; Tignor W., 2003)

SD modeling helps to build an effective platform for a transdiciplinary dialogue in policy design and learning (Schwaninger et al., 2008). It is a computer simulation model that may be tested systematically in order to find effective policies for overcoming policy resistance(Homer and Hirsch, 2006). It has been applied to issues ranging from corporate strategy to the dynamics of diabetes, from the cold war arms race between the US and USSR to the combat between HIV and the human immune system (Sterman and Sterman, 2000). It has also been used for public health since 1970s (Homer and Hirsch, 2006) due to its capability to analyze the complexity of public health problems.

Examining tobacco use behaviors and tobacco control policies have been complicated and dynamic topic. Because they include so many factors that affect the tobacco use behavior or tobacco controls. There can be several different studies that

investigated the tobacco use and control in the literature. Various statistical methods were used in these studies. However, in order to understand endogenous structure of the tobacco use systems and the effects of tobacco control policies, SD modeling can be a well-fitted option. Because SD modeling is only method that is one system thinking approach to tobacco control (Best et al., 2007). SD modeling can help to learn, model, and react to the complexities and dynamism of tobacco use and control system with characterizing them in terms of feedbacks, stock, and flows (Best et al., 2007). For that reason, SD modeling is used for modeling the tobacco control policies by researchers.

In this research thesis, in order to investigate the effectiveness of tobacco control policies that have been implemented by Turkish authorities, an SD model is developed.

3.5 Conclusion

In this chapter of the thesis, basic information that is required for understanding the later chapters is given. Tobacco use and control history of Turkey is presented. Also, this chapter provides information about GATS, application of it to Turkey and the results of the survey for Turkey. In this thesis, GATS 2008 and 2012 reports for Turkey are so helpful for data collection stage of the study. Lastly, the background knowledge for SD modeling is presented in order to explain the reason of using this method for the modeling process.

CHAPTER 4- SYSTEM DEFINITION

4.1 Introduction

In order to investigate the effectiveness of tobacco control policies and some other tobacco associated factors that were surveyed in GATS for Turkey, a system dynamics model is developed. Anylogic University Researcher versionis used for the modeling process of this thesis. In tobacco control system, some of the parameters (such as the effects of policies and factors) that are essential for reaching the objectives of the study cannot be measured or obtained from any source. One way of finding these parameters are calibration experiment. For that reason, in order to find the missing data, a calibration experiment is conducted. After finding missing data for the analysis, a forecasting analysis is performed to find the tobacco use ratio of Turkey in 2016.

This chapter provides information for used software, assumption, setup, and implementation of the model, calibration and forecasting in detail respectively.

4.2 Used Software

System dynamics modeling is used in order to model the tobacco control policies of Turkey for this study. System dynamics modeling can be performed using several different softwares. Anylogic, Stella, Vensim, Vissim are some of them. In this research, Anylogic University Researcher version is used for system dynamics modeling.

Anylogic (http://www.anylogic.com/about-us):

- The first and only tool that can be used for three types of simulation modeling: discrete-event simulation, agent-based simulation, and system dynamics simulation within one modeling language and one model development environment. Figure 4.1 represents the modeling methods in Anylogic software.
- Is fast, easy to use because of the drag and drop capabilities.

- Has specific libraries to make easier the modeling process. It also has a special library for system dynamics modeling.
- Allows adding java code, and 3D animation.

Anylogic is one of the most efficient software for simulation modeling due to the mentioned properties of it. In this study, only system dynamics modeling method is used. For future works, this study can be improved by using other methods with the extended use of Anylogic, too.

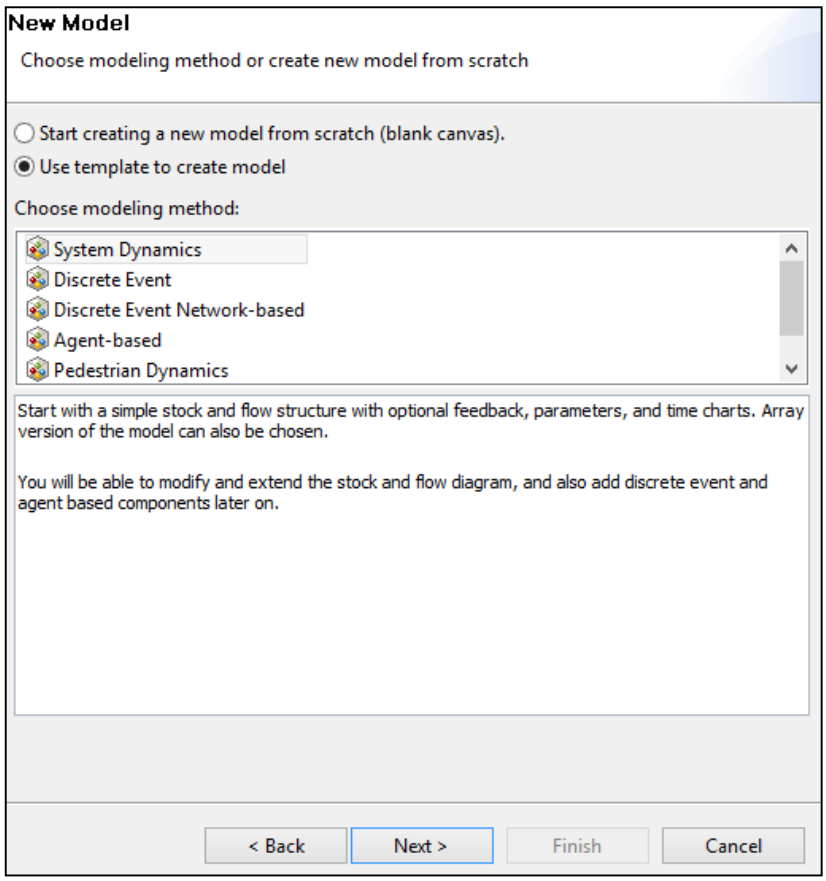

Figure 4.1 Modeling types of AnyLogic

4.3 Model Assumptions

In this subsection, the gathered data and the model assumptions that are essential for building the model are presented in detail.

a) General assumptions about the "Model"

a1) The model consists of the six main factors defined in the GATS 2008 and 2012 of Turkey to investigate. These are:

- Warning labels
- Anti-tobacco information
- Beliefs of people that smoking cause serious illnesses
- Smoke-free environment
- Health care provider effect (for smokers)
- Taxation

In the model, all quit attempts are accepted to happen due to these six factors. Quit attempts because of other elements are not taken into consideration for this study.

a2) The data required for the model is obtained from generally GATS 2008 and 2012 of Turkey. The GATS data is accepted as reliable. Because, the GATS is a credible survey that is applied for different countries all over the world in order to monitor tobacco use and control status of countries.

a3) All quit attempts can be made in three ways. These are:

- Pharmacotherapy,
- Counseling,
- Others (traditional medicines, family pressure and etc. or quit without any assistance).

b) Assumptions about the "Population"

b1) The study focuses on adult population of Turkey. Adult population is defined in GATS reports as people who aged 15 years and older.

b2)Different from the SimSmoke studies (that takes population as current, former and never smokers), population is divided into 2 categories in this research due to the lack of data about new start rate. The categories are:

- Former Smokers (FS),
- Current smokers (CS).

b3) Current smokers are accepted as defined in GATS 2008 of Turkey. Current smokers consistof:

- Occasional Smokers (former daily smokers, never daily smokers),
- Daily Smokers.

b4) Former smokers are accepted as defined in GATSs of Turkey. Former smokers consist of:

- Former Occasional Smokers,
- Former Daily Smokers.

b5) Never smokers are not included in the content of this study.

b6) Initial values of the current and former smokers are taken as given in GATS 2008.

b7) A different model for determining the growth at the population is not developed. Linear interpolation is applied for these using GATS adult population values of 2008 and 2012 of Turkey.

b8) The aging of the youth population (aged 15 years old) is accepted as the only reason of the adult population growth each year.

b9) The percentage of the current smokers among the new aged population (who became 15 years old recently) is calculated using the GYTS 2003 and 2009 values of Turkey for each year.

b10) The current smoker of the population growth (after calculated the current smokers among them) is added on current smokers. The rest of the population growth is accepted as never smokers that are not examined in this study.

b11) The growth at the number of former smokers is not taken into consideration.

c) Assumptions about the "Warning Labels"

Since the percentage of people who noticed warning labels in the last 30 days is given for noticing warning label in the GATS 2008 and 2012 of Turkey, this value is accepted as constant for the whole year in the model presented in this thesis.

d) Assumptions about the "Anti-tobacco Information"

Since the percentage of people who noticed anti-tobacco information in the last 30 days is given for noticing anti-tobacco information in the GATS 2008 and 2012 of Turkey, this value is accepted as constant for the whole year in the model presented in this thesis.

4.4 Model Setup and Implementation

This sub-section of the chapter present:

- Setup process of the model
- Simulation run of the model
- Calibration of the model

4.4.1 Model Setup and Implementation

The details of the SD model setup for Turkey case is given in this section of the study step by step.

An SD model is initially constructed with the determination of stocks and flows.

Stocks & Flows

The stocks of the model (the state variables of the model) are determined as the adult population of Turkey. They are divided into two categories for this study. These are:

- Current smokers that are labeled as "*CurrentSmokers*" in the model,
- Former smokers that are labeled as "*FormerSmokers*" in the model as presented in figure 4.2.

In order to define initial values of the stocks, the values provided in GATS 2008 for Turkey is used. The GATS 2008 was arranged for 51,151,000 people who aged 15 and over for the year 2008. The number of adults who were current and former smokers among total adult population was given as 31.2% and 15.9% respectively.

For that reason:

- A parameter is constituted for initial population in the model. It is used for representing the initial population characteristics of the model. The number of it is constant. Since the population can change over time. However, initial population only provides information about the population of the model when

model starts to run. The value of this parameter is defined as 51,151 that represent 51,151,000 adult population.

- The initial value of the *CurrentSmokers* is formulated as initial population * 0.312.
- The initial value of the *FormerSmokers* is formulated as initial population*0.159.

Also, the flows are added to the model. There are two different flows for the system:

- *Quit* is the outflow of the *CurrentSmokers* and inflow for the *FormerSmokers*(figure 4.2). It represents the number of current smoker who quitted smoking.
- *Restart* is the outflow of *FormerSmokers* and inflow for the *CurrentSmokers*(figure 4.2). It represents the number of former smokers who restarted smoking.

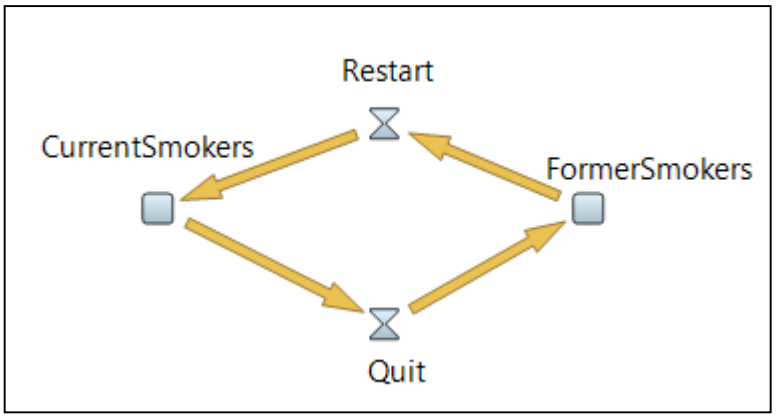

Figure 4.2 Stocks and flows of the presented model

After addition of the flows to the system, the formulation of the *CurrentSmokers* and *FormerSmokers* that are required for updating processes of the stocks are given below.

The formulation of the *CurrentSmokers*is generated as:

$$d(CurrentSmokers)/dt = -Quit+Restart \quad (4.1)$$

The formulation of the *FormerSmokers* is generated as:

$$d(FormerSmokers)/dt = +Quit-Restart \quad (4.2)$$

Population Growth

In order to represent the population growth in the system, table functions are used.

- *Table functions* help to simply make the values of the table continuous by interpolating and/or extrapolating (http://www.anylogic.com/anylogic/help/index.jsp?topic=/com.xj.anylogic.help/).
- *Interpolation* is known as the process of defining a function that takes on specified values at specified points (http://www.mathworks.com/moler/interp.pdf).
- *Extrapolation* is known as the process finding a value beyond a set of given values (http://mathandreadinghelp.org/math_help_extrapolation.html).

The steps of the addition of the population growth are given below.

- One table function is used for the change at the total number of adult population over time. Two values that are obtained from GATS 2008 and 2012 of Turkey are entered to the table function. The values are 51,151 and 54,548 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.
- The other table function is used for defining the percentage of the current smokers among the new aged population (who has recently became 15 years old new) over time. Two values that are taken from GYTS 2003 and 2009 of Turkey are entered to the table function. The values are 0.069 and 0.084 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.

The growth at the population is only added to the *CurrentSmokers* after calculation of current smokers of new aged population. In order to add population growth to the CurrentSmokers, an event that is called as "*PopulationChange"* is defined in the system. For this event, an action is determined using java code that is to add population growth to the system.

The pseudo code of population growth is as given below.

Control 1

IF (TimeIncrease!=0)
*CurrentSmokers = CurrentSmokers + (PopulationChangeTable(TimeIncrease) - PopulationChangeTable(TimeIncrease-1)) * YouthSmokersTable(TimeIncrease)*
END IF
TimeIncrease++

The policies and other factors of the model are added to the model one by one. The next subsections provide information for the implementation processes.

Figure 4.3 represents the proposed model.

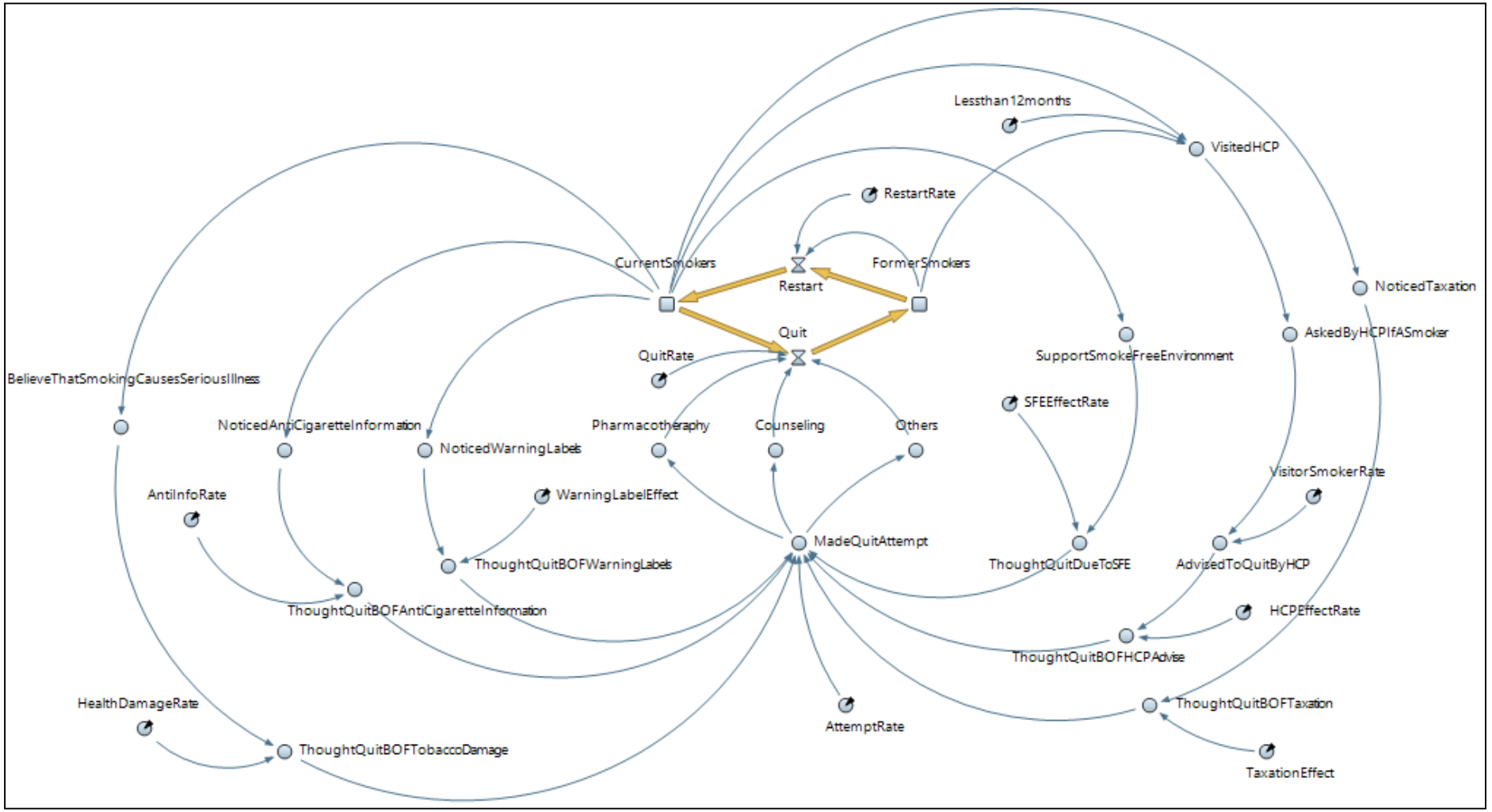

Figure 4.3 The proposed model.

Warning Labels Factor

In this part of the model, the warning labels factor is considered.

- First, a variable is generated for representing the current smokers who noticed warning labels on cigarette packages. The variable is named as "*NoticedWarningLabels"*.
- In order to obtain the percentage of current smokers who noticed health warnings, a table function that is called as "*NoticedWarningLabelsTable*" is built with the two values taken from GATS 2008 and 2012 for Turkey. These values are 0.951 and 0.943 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.
- The *NoticedWarningLabels* variable is updated with the formulation that is given below.

  *CurrentSmokers*NoticedWarningLabelsTable(time)* *(4.3)*
- Another variable is generated for representing the opinions of current smokers about quitting because of noticing warning labels. The variable is called as "*ThoughtQuitBOFWarningLabels"*.
- A parameter that is named as "*WarningLabelEffec*t" is generated.
- The variable, *ThoughtQuitBOFWarningLabels*is updated with the following formulation.

  *NoticedWarningLabels*WarningLabelEffect* *(4.4)*

Anti-Tobacco Information Factor

In this part of the model, the anti-tobacco information factor is considered.

- Primarily, a variable is created for representing the current smokers who noticed anti-tobacco information somewhere (television, radio, billboard, and etc.). The variable is named as "*NoticedAntiCigaretteInformation"*.
- In order to obtain the percentage of current smokers who noticed anti-tobacco information somewhere, a table function that is called as "*NoticedAntiCigaretteInformationTable*" is built with the two values of GATS 2008 and 2012 of Turkey. These values are 0.916 and 0.941 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.

- The *NoticedAntiCigaretteInformation* variable is updated with the formula:
  CurrentSmokers NoticedAntiCigaretteInformationTable(Time)* *(4.5)*
- Another variable is generated for representing the opinion of current smokers about quitting because of noticing anti-tobacco information. The variable is called as "*ThoughtQuitBOFAntiCigaretteInformation"*.
- The parameter that is called like "*AntiInfoRat*e" is create in the model.
- The *ThoughtQuitBOFAntiCigaretteInformation*variable is updated with the following formulation:
  *NoticedAntiCigaretteInformation * AntiInfoRate* *(4.6)*

Beliefs of People That Smoking Cause Serious Illnesses Factor

Beliefs of people that smoking cause serious illnesses is considered in this subsection of the chapter.

- A variable that represent the current smokers who believe that smoking cause serious illnesses is created. It is named as *"BelieveThatSmokingCauseSeriousIllnesses"*.
- For obtainingthe percentage of current smokers who believe that smoking causes serious illnesses, a table function that is called as "*BelieveTobaccoDamageTable*" is built with the two values of GATS 2008 and 2012 of Turkey. These values are 0.974 and 0.960 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.
- The *BelieveThatSmokingCauseSeriousIllnesses* variable is updated with the formulation:
  *CurrentSmokers * BelieveTobaccoDamageTable(Time)* *(4.7)*
- For representing the thought of current smokers about quitting because of beliefs about tobacco damages on health, a variable that is called as "*ThoughtQuitBOFTobaccoDamage*" is created.
- A parameter that is named as "*HealthDamageRate*" is generated.
- The *ThoughtQuitBOFTobaccoDamage*variable is updated with the following formulation:
  *BelieveThatSmokingCauseSeriousIllnesses * HealthDamageRate* *(4.8)*

Smoke-Free Environment Factor

The smoke-free environment policy is considered in this subsection.

- A variable that is called as "*SupportSmokeFreeEnvironment"* is created in order to represent current smokers who support smoke-free environment.
- According to the Smoke-Free Environment Policies Report of the Ministry of Turkey, 81.0% of the current smokers support the laws about smoke-free environment (http://havanikoru.org.tr/). For that reason, the *SupportSmokeFreeEnvironment* variable is updated with the formulation:
  *CurrentSmokers * 0.81* *(4.9)*
- In order to represent the thought of current smokers about quitting because of smoke-free environment regulations, another variable that is named as *"ThoughtQuitDueToSFE"* is generated.
- The "*SFEEffectRate*" parameter is also created.
- The *ThoughtQuitDueToSFE v*ariable is updated with the following formulation:
  *SupportSmokeFreeEnvironment * SFEEffectRate* *(4.10)*

Taxation Factor

The taxation policy is considered in this subsection.

- "*NoticedTaxation*" variable is created in order to find the current smokers who noticed taxation. According to the assumption of taxation, all current smokershas assumed to notice taxation. Thus, the *NoticedTaxation* variable is equal to the number of *CurrentSmokers*.
- Another variable is generated in order to find the thought of current smokers about quitting because of taxation. The variable is called as "*ThoughtQuitBOFTaxation"*.
- A parameter which is "*TaxationEffect*" is generated.
- The *ThoughtQuitBOFTaxation v*ariable is updated with the following formulation:
  *NoticedTaxation * TaxationEffect* *(4.11)*

The Effect of Health Care Provider Advise Factor

The effect of health care provider (HCP) advice factor is considered, too.

- "*VisitedHCP"* variable is created in order to find number of visitor who visited a health care provider.
- "*LessThan12Months*" parameter is also created. This parameter represents the percentage of *FormerSmokers* who have been abstinent for less than 12 months.
- In order to obtain the percentage of current smokers and former smokers (who have been abstinent for less than 12 months) who visited a HCP, a table function that is called as "*VisitedHCPTable*" is built with the two values taken from GATS 2008 and 2012 for Turkey. These values are 0.469 and 0.408 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.
- According to the GATS 2008 and 2012, the number of HCP visitor is calculated using current and former smokers (who have been abstinent for less than 12 months). For that reason, the value of *VisitedHCP*is updated with the formulation:
  (CurrentSmokers+FormerSmokers)*(LessThan12Months)*VisitedHCPTable (Time) (*4.12)*
- "*AskedByHCPIfASmoker"* variable is created in order to find how many HCP visitors are asked if he/she is a smoker by HCP.
- For finding the percentage of HCP visitors to be asked if he/she is a smoker by HCP, a table function that is called as "*AskedByHCPIfASmokerTable*" is made with two values taken from GATS 2008 and 2012 for Turkey. These values are 0.49 and 0.514 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.
- The *AskedByHCPIfASmoker* variable is updated with the formulation:
  *VisitedHCP * AskedByHCPIfASmokerTable(Time) (4.13)*
- "*AdvisedToQuitByHCP*" variable is generated in order to find the number of smokers who advised to quit by HCP among people who asked if he/she is a smoker by HCP.
- "*VisitorSmokerRate"* parameter is also created in order to find the number of current smokers among people who asked if he/she is a smoker by HCP.

- Then, "*AdvisedToQuitByHCPTable*" table function is built with two values of GATS 2008 and 2012 of Turkey. These values are 0.831 and 0.835 respectively. And, linear interpolation is made for the range and extrapolation is made for the out of range.
- The *AdvisedToQuitByHCP* variable is updated with the formulation:
  AskedByHCPIfASmoker VisitorSmokerRate*AdvisedToQuitByHCPTable(Time)* *(4.14)*
- "ThoughtQuitBOFHCPAdvise" variable is generated in order to find the thought of current smokers about quitting due to HCP advise.
- "*HCPEffectRate*" parameter is created.
- The *ThoughtQuitBOFHCPAdvise v*ariable is updated with the formulation:
  *AdvisedToQuitByHCP * HCPEffectRate* *(4.15)*

Quit Attempt

In this sub-section of the study, the modeling of the quit attempts is presented.

- Primarily, a variable that is called as "*MadeAQuitAttempt*" is added into model in order to find the number of people who made a quit attempt due to the mentioned factors.
- "AttemptRate" parameter is also created.
- The *MadeAQuitAttempt v*ariable is updated with the formulation:
  *(ThoughtQuitBOFWarningLabels+ThoughtQuitBOFAntiCigaretteInformation+ThoughtQuitBOFTobaccoDamage+ThoughtQuitBOFHCPAdvise+ThoughtQuitBOFDueToSFE+ThougthQuitBOFTaxation)*AttemptRate* *(4.16)*
- GATS studies categorized the ways of quit attempt in three groups: pharmacotherapy, counseling, and others. In order to investigate the number of people that used these three ways, "*Pharmacotherapy"*, *"Counseling*", and "*Others*" variables are created.
- *"PharmacothearphyTable*", *"CounselingTable*", and *"OthersTable"* table functions are built with two values taken from GATS 2008 and 2012 for Turkey. These values are 0.093 and 0.136 for pharmacotherapy, 0.018 and 0.08 for counseling, and 0.889 and 0.784 for others respectively. And, linear interpolations are made for the ranges and extrapolations are made for the out of ranges.

- The *Pharmacotherapy v*ariable is updated with the formulation:
  *MadeAQuitAttempt * PharmacotherapyTable(Time)* *(4.17)*
- The *Counseling v*ariable is updated with the formulation:
  *MadeAQuitAttempt * CounselingTable(Time)* *(4.18)*
- The *Others v*ariable is updated with the formulation:
  *MadeAQuitAttempt * OthersTable(Time)* *(4.19)*

Quit & Restart

- Making a quit attempt does not mean that all attempts will end with success. For that reason, "*QuitRate*" parameter is added into the model in order to find the percentage of successful quit attempts.
- The *Quit* flow formulations become as given below
  *Quit= (Pharmacotherapy + Counseling + Others) * QuitRate* *(4.20)*
- Also, some of former smokers can restart smoking. In order to calculate the rate of this amount, "RestartRate" parameter is created.
- Thus, *Restart* flow formulation become as given below.
  *Restart = FormerSmokers * RestartRate* *(4.21)*

4.4.2 Calibration of the Model

In the defined model, there are 12 different parameters. These parameters are:

- InitialPopulation
- QuitRate
- RestartRate
- AttemptRate
- VisitorSmokersRate
- LessThan12Months
- HealthDamageRate
- AntiInfoRate
- WarningLabelEffect
- SFEEffectRate
- HCPEffectRate
- TaxationRate

In a real-world problem, some of the parameters that are important for solving the problem, may not be measured or obtained from any source due to the complexity of the problem (Homer and Hirsch, 2006). Finding out the unknown parameters' values is the most crucial step of this study because the six of them represents the effectiveness of the policies that is crucial for success of this thesis. One of the ways of finding the values of missing parameters is performing a *Calibration Experiment.* The calibration experiment uses the historical data that is defined by user(s) and searches in order to find the best combination for the missing parameters (http://www.anylogic.com/anylogic/help/index.jsp?topic=/com.xj.anylogic.help/).

Among them, only the initial population value is known. In order to determine the values of others, the required data was not found. For this study, the parameters apart from *InitialPopulation* are calibrated to find out the missing values of them.

In order to perform the calibration experiment:

- The minimum and maximum values of the parameters are defined. For this study, minimum values of all parameters are determined as 0.0001 in order to avoid from finding the values of parameters as 0. Because all of the policies are influential on quitting smoking. However, the degree of their effects can differ. The maximum value of all parameters are taken as 1 (figure 4.4).
- The calibration experiment is performed using historical and current dataset of *CurrentSmokers.*
- Calibration experiment is run.

The next sub-section presents the simulation run of the model.

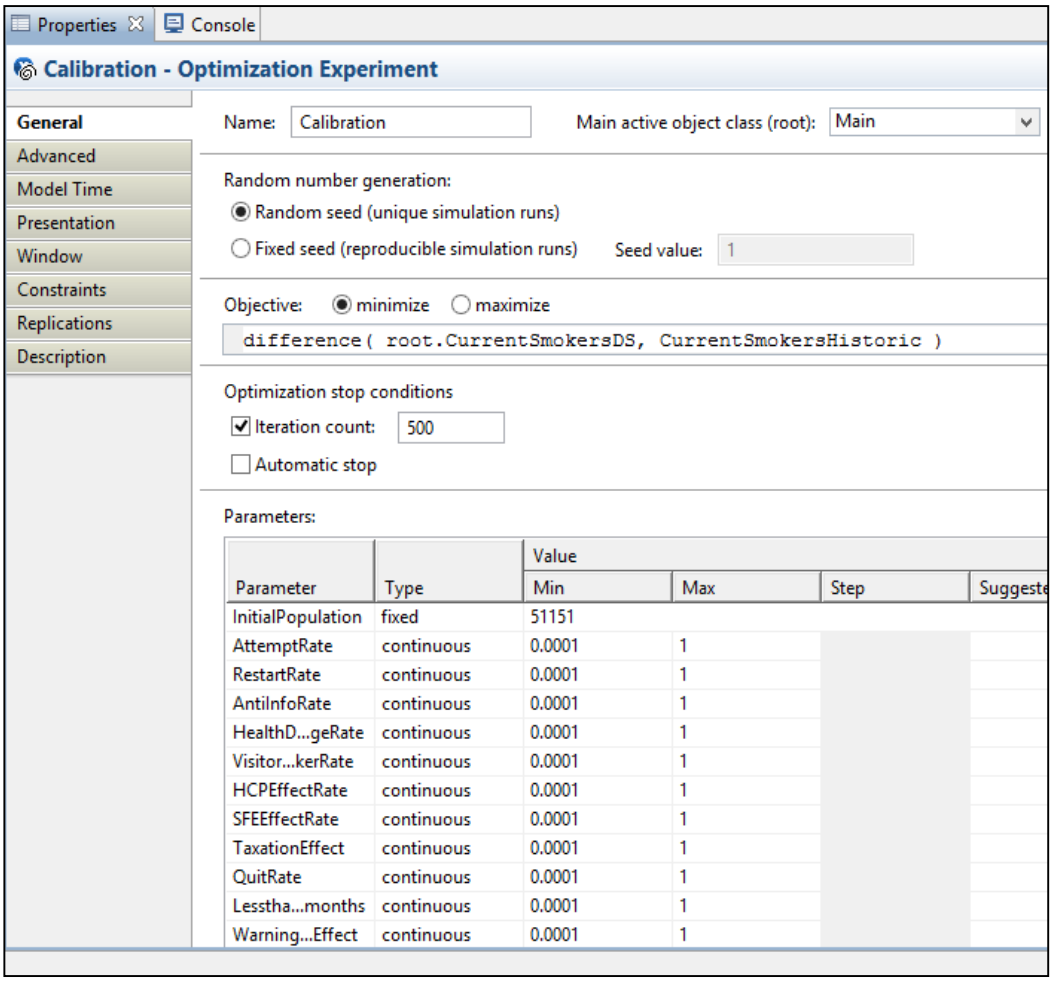

Figure 4.4 The ranges of the calibrated parameters

4.4.3 Simulation Run of the Model

After calibration process, the model is run with the obtained values of missing values.

- First, simulation time is set for four years in order to obtain the values of year 2012. The results show us the effects of the investigated policies and factors.
- Second, simulation time is set for 8 years in order to forecast the tobacco usage rate of Turkey for the year 2016.

4.5 Conclusion

In this part of the thesis, the characteristics of the used software, model assumptions, and setup, calibration and simulation run processes of the proposed model is presented.

CHAPTER 5-RESULTS & DISCUSSIONS

5.1 Introduction

In this chapter of the thesis, the results of the calibration and simulation runs of the proposed model are discussed.

5.2 Results of Calibration Experiment

Calibration experiment was conducted with 500 iterations. Figure 5.1 presents the current (that represents the last obtained values (500th iteration's values)) and best values of calibrated parameters. The results that are obtained from the calibration experiment are explained below.

- AttemptRate was found as 0.721. According to this, 72.1% of the current smokers who thought about quitting due to the effects of six factors of the model make a quit attempt.
- RestartRate was 0.375 according to the results of calibration. Thus, 37.5% of former smokers restart smoking.
- QuitRate was equal to 0.328. That means that 32.8% of the current smoker quit smoking.
- LessThan12Months parameter was calibrated with 0,565. This parameter represents the percentage of former smokers who have been abstinent from smoking less than 12 months. According to the results, 56.5% of the former smokers have been abstinent from smoking less than 12 months.
- VisitorSmoker parameter represents the percentage of current smokers among people who asked if he/she is a smoker by health care provider. The value of the parameter was found as 0.169 at the end of the study. Thus 16.9 % of them are current smokers.

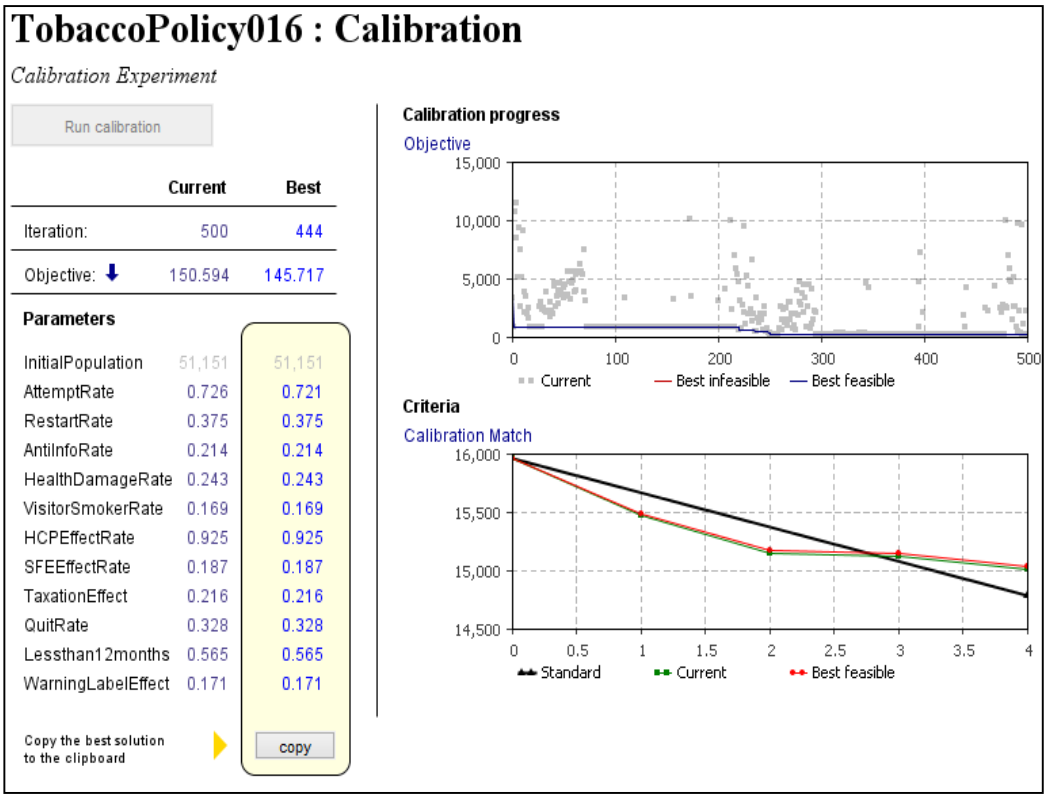

Figure 5.1 The results of calibration experiment

The remaining parameters are associated with the main factors of the model. These factors are warning labels, anti-tobacco information, smoke-free environment, taxation, beliefs about tobacco damages on human health, and health care provider advises. Thus, the values of these parameters represent the impacts of factors on thoughts of current smokers about quitting. The calibration results of are given below.

- According to the calibration results, the health care provider effect is relatively high among modeled six factors. Because the value of HCPEffectRate was found as 0.925. That means that 92.5% of smokers who were advised to quit smoking by health care provider, thought about quitting due to the advice.
- The belief of people that smoking causes serious illnesses is another high parameter that affects the opinions of current smokers about quitting. Because the value of the HealthDamageRate parameter was found as 0.243. Thus, 24.3% of smokers who believe that tobacco cause serious illnesses thought about quitting due to this.

- Also, TaxationRate parameter was equal to 0.216. Regarding this value, 21.6% of smokers thought about quitting because of taxation.
- AntiInfoRate was calibrated to 0.214. Therefore, 21.4% of smokers who noticed anti-tobacco information somewhere thought about quitting due to anti-tobacco information.
- SFEEffectRate was found as 0.187. We can say that 18.7% of smokers who supports smoke-free environments regulations thought about quitting because of smoke-free environment laws.
- Lastly, 17.1 % of smoker who noticed warning labels thought about quitting due to them because the value of WarningLabelEffect parameter was equal to 0.171.

5.3 Results of Simulation Runs

After calibration experiment, the default values of the parameters are updated with calibration results. Then, simulation time is adjusted from 0 to 4 in order to see the difference of the state values from real estate values. Time 0 represents the year 2008 for Turkey. Time 4 represents the year 2012 of Turkey.

After simulation run, the total number of current smokers was found 27.7% (15113.85 current smokers) of adult population when time was equal to 4 (2012). According to the GATS 2012 results for Turkey, the number of current smokers was equal to 27.1% (14782.508 current smokers) of adult population of 2012. There is 0.6% deviation between the presented model and real value. Thus, we may say that the model can give close values to the real state of Turkey.

After comparison of the model results and real values, simulation time of the simulation is changed from 0 to 8 in order to find the number of possible tobacco users of Turkey. The results of the simulation run are given below for 2016.

- The adult population will reach to 57,944,999.
- The percentage of current smokers will decrease to 26.3%. That means there will be still 15,249,859 current smokers
- The number of former smokers will reach to 9,472,205 from 2008 to 2016 (due to cumulative increase assumption).

Table 5.1 presents the number of people who thought about quitting because of each factor that found from the simulation runs.

- According to the results, the number of people who believe that smoking causes serious illnesses thought about quitting due to the damages of tobacco is the highest when compared to other factors. Thus, beliefs of people are the most important factor that leads smokers to quit.
- Taxation gets the second place among all factors. Because the number of people who thought about quitting because of taxation is relatively high, too.
- Anti-tobacco information policy follows taxation and takes the third important place.
- The numbers of smokers who thought about quitting because of the first three factor of the model are relatively close comparing with others.
- The effect of warning labels on cigarette package comes after anti-tobacco information. However, there is a considerable decrease at the number of affected smokers from this policy comparing with the number of smokers from anti-tobacco information.
- Smoke-free environments regulations take the fifth place among them.
- The health care providers' advices are the least effective one among them. Also, the number of smokers who are affected from it is relatively low comparing with other factors of this model.

According to this ranking, we can say that the health concerns of the smokers may lead them about thinking to quit more than other issues. Also, taxation can be theother important policy because the economics of smokers are directly affected from this policy. Smokers who have low economic conditions may need to give up smoking due to the increase at the price of sales of tobacco products.

In addition, anti-tobacco information may also be an effective policy to lead people to quit. Because they can be seen at television, radio, newspapers, internet, and etc. The usage area of them is really wide. It is easy to reach relatively high number of smokers. And, some of them have considerable visual effect. The reason of the lower effect of warning labels than anti-tobacco information may be the lack of visualization or voice messages.

Smoke-free environments are also an effective method. However the effect of them to quit is less than the first three factors. The reason of this may that the main aim of this policy is protecting people being second-hand smokers. And, current smokers may easily find a different place to smoke.

Lastly, the reason of being the least effective factor to make people think about quit for advices of health care provider may be that the analysis was made on people who went to health care services for any reason. Thus, the most of the visitors aim may not be take counseling for quitting smoking. They may look for a solution for other health problems.

The GATSs for Turkey does not include information for representing the opinions of current smokers to quit due to each relevant policies. However, the surveys pointed that the most common factor for cessations was health problems. The second factor was "being asked to quit by family". The third factor was prices of tobacco products. And, the last one was anti-tobacco information. Thus, we may say that these four factors were determined as the most important factors to lead current smokers to make a quit attempt respectively. Correspondingly, the results taken from GATS for Turkey support the results of this research thesis. Our results classified the factors investigated in the thesis respectively: the beliefs of tobacco damages on health, taxation, and anti-tobacco information.

Table 5.1 The number of current smoker who thought about quitting smoking due to each of the tobacco control factors

	Believe that smoking causes serious illnesses		Taxation		Anti-tobacco information		Warning labels		Smoke-free environments		Health-care provider advices		TOTAL	
	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
2008	23.64	3777235	21.58	3447168	19.58	3128369	16.24	2595287	15.11	2414327	3.84	613621	100	15976007
2009	23.55	3651735	21.57	3344654	19.71	3056046	16.20	2512811	15.12	2345439	3.85	596798	100	15507483
2010	23.47	3566038	21.57	3277985	19.84	3015427	16.17	2457533	15.13	2298687	3.82	580570	100	15196240
2011	23.39	3546005	21.58	3271411	19.99	3029637	16.15	2447424	15.13	2294077	3.76	569747	100	15158301
2012	23.32	3507632	21.59	3247807	20.13	3027888	16.12	2424623	15.14	2277525	3.69	555070	100	15040545
2013	23.25	3514899	21.61	3266445	20.28	3065491	16.10	2433365	15.15	2290595	3.60	544585	100	15115380
2014	23.19	3490281	21.63	3255479	20.43	3075358	16.08	2420042	15.17	2282905	3.52	529539	100	15053604
2015	23.12	3506573	21.65	3282732	20.58	3121429	16.06	2435103	15.18	2302016	3.42	518311	100	15166164
2016	23.06	3485792	21.66	3275351	20.73	3134692	16.04	2424442	15.19	2296840	3.32	502326	100	15119443

The ways to make a quit attempt were also added to the model. Table 5.2 represents the number of smokers that made a quit attempt according to used quit attempt ways**.** As seen in the table 5.2, the number of people using pharmacotherapy and counseling increases according to the years while others (quit with traditional medicine, family pressure, pregnancy or without assistance) decreases. Thus, we may say that the number of smoker who apply for professional help to quit increases.

Table 5.2 Distribution of approaches used to quit

	Pharmacotherapy		Counseling		Others		Total	
	Number	%	Number	%	Number	%	Number	%
2008	1071440	9.30	207376	1.80	10242048	88.90	11520864	100
2009	1160018	10.38	374560	3.35	9646317	86.27	11180895	100
2010	1254518	11.45	536868	4.90	9165103	83.65	10956489	100
2011	1368874	12.52	704929	6.45	8855332	81.03	10929135	100
2012	1474816	13.60	867539	8.00	8501879	78.40	10844234	100
2013	1599309	14.67	1040777	9.55	8258103	75.78	10898189	100
2014	1709449	15.75	1204755	11.10	7939443	73.15	10853647	100
2015	1839781	16.83	1383253	12.65	7711770	70.52	10934804	100
2016	1951300	17.90	1547959	14.20	7401859	67.90	10901118	100

5.4 Conclusion

In this part of the thesis, the results obtained from calibration and simulation runs of the model are presented. The effects of the investigated policies and factors of the model are discussed and the results of the forecasting analysis are also given.

CHAPTER 6- CONCLUSION

6.1 Introduction

This thesis is divided into six chapters. In Chapter 1, the problem statement, objectives of the study were presented. Chapter 2 reviewed the associated literature in the area of tobacco control. In Chapter 3, the background knowledge about tobacco control history of Turkey, Global Tobacco Adult Survey (GATS), and System Dynamics were given. Chapter 4 presented information about the used software, and described the setup and calibration stages of the proposed model. In Chapter 5, results of the calibration and simulation of the models were discussed. In this final chapter, an overview for the results and future works are presented.

6.2 An Overview of the Results

Tobacco epidemic has been one of the most crucial problems of the world that threaten the lives of people. It is a well known fact that millions of people die due to tobacco epidemic every year. In order to reduce the prevalence and damages of tobacco use, several different policies have been applied at government level. Turkey has been one of the leading countries that have been applying tobacco control policies firmly in order to avoid the negative effects of it.

In this thesis, the major tobacco control policies that have been implemented by Turkish authorities and some tobacco use associated factors were modeled using System Dynamics modeling. The main objective of this thesis was to investigate the impacts of the policies and other factors on the opinions of smokers about quitting and to forecast the tobacco use status of Turkey for 2016.

The results for the effective policies and factor analysis of the proposed model indicated those:

- The number of smokers who thought about quitting due to their beliefs about the damages of tobacco use on human health, was the highest. Thus, the effect of smokers' beliefs about the damage of tobacco was the most crucial one.

- The effect of taxation followed it. The increase at the price of tobacco products affected smokers' thought about quitting due to this increase.
- The effect of anti-tobacco information was the third effective one when compared to others.
- The fourth effective component of the model was the smoke-free environment policy. The main reason of the lower effectiveness of this policy could be that this policy is mainly implemented to protect people from being second-hand smokers. Thus, the target population of this policy may be non-smokers instead of current smokers.
- The lowest effective component was the advice of health care providers. the reason of this may be the low number of people who visit to health-care providers. Because the 92.5% of current smokers who advised to quit by a health care provider think about quitting according to results. According to the percentages, the effect of health care provider advice is the highest. However, the effectiveness classification was made regarding the number of people. The number of people who think about quitting due to health care providers' advice was the lowest when compared to others. For that reason it took the last place in the comparison.

The results for the forecasting the tobacco use status of Turkey in 2016 mainly pointed those:

- The adult population will be around 58 million in 2016.
- Although the number of current smokers will increase, tobacco use rate will decrease to 26.3% among adult population of Turkey in 2016.

According to the results, we can expect that the prevalence of tobacco use will reduce under the constant effect of applied policies. However, there will be still more than 15 million adults who smoke currently. In order to increase the quit rate, policy makers may apply more effective policies. The results of this thesis may help them while developing policies. According to results, the most effective factors were found as the beliefs of people that tobacco damages on health, taxation, and anti-tobacco information. Thus, policy makers may stress on policies that can explain the harms of tobacco use more effective, develop different taxation policies, and improve anti-tobacco information policies.

6.3 Future Work

In this thesis, main tobacco control policies and tobacco use associated factors were investigated. The model can be expanded to examine more specific tobacco control policies such as pictorial warning labels, punishments due to smoking at forbidden areas, and etc.

The demographic characteristics of the adult population were not taken into account in this study. The future studies can focus on this gap of the presented study, too.

In this study, calibration experiment was performed using really few data due to the lack of data, future studies can search for more data in order to build a better model and obtain more reliable results.

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APPENDICES

APPENDIX A. CURRENT TOBACCO CONTROL POLICY USAGE OF THE COUNTRIES

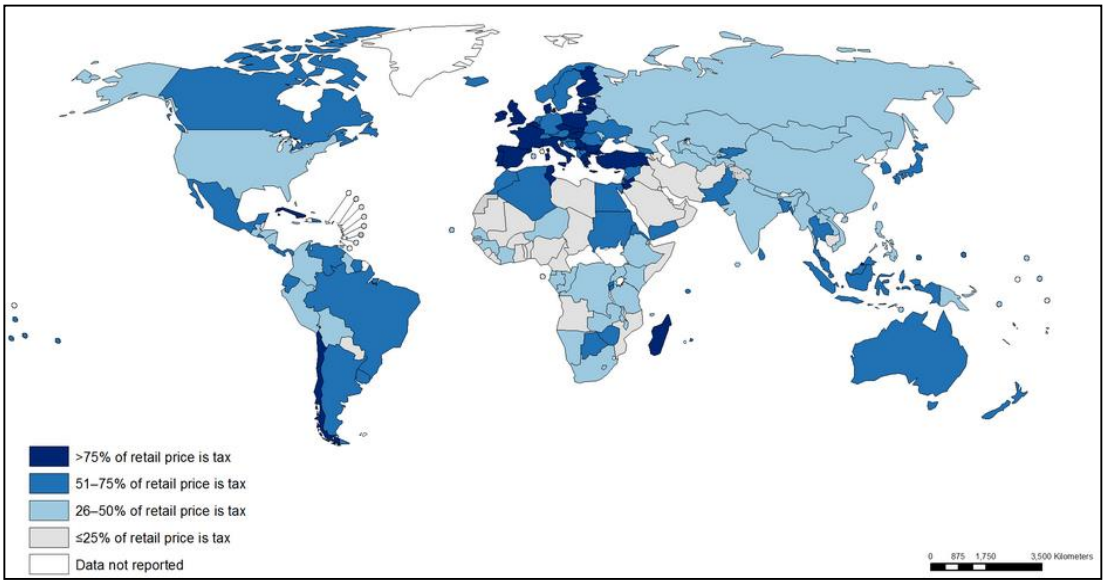

Figure A.1 Distribution of retail taxes on tobacco for countries, 2012 (http://gamapserver.who.int/mapLibrary/app/searchResults.asp)

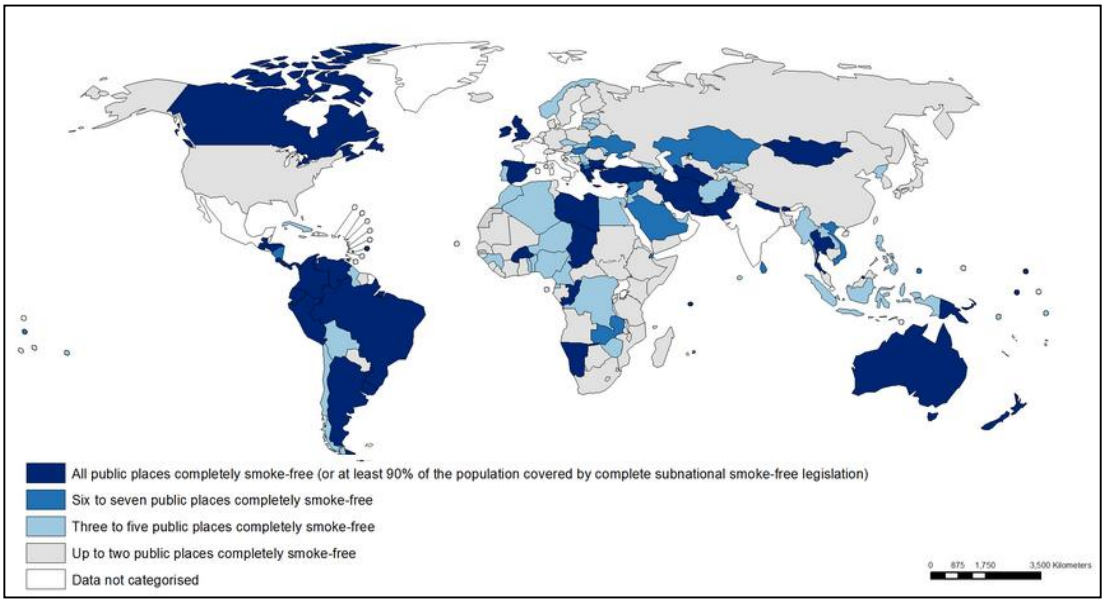

Figure A.2 The number of places that countries applied smoke-free environment, 2012(http://gamapserver.who.int/mapLibrary/app/searchResults.asp)

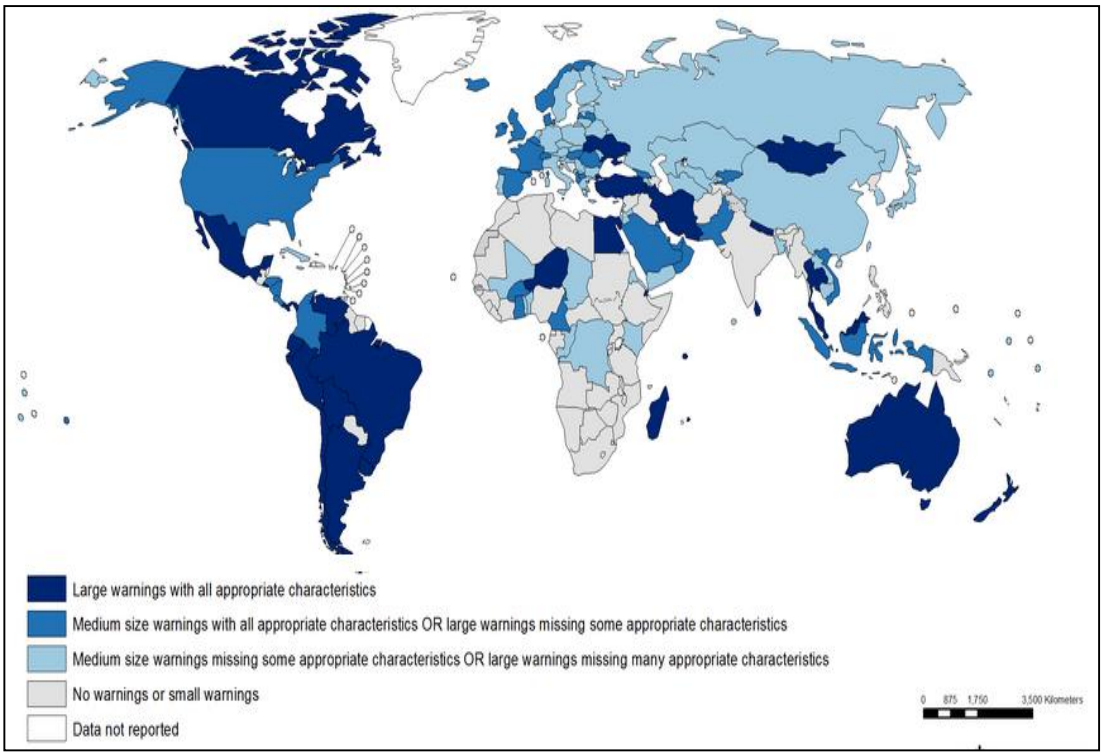

Figure A.3 The size of warning labels that countries applied for tobacco products, 2012(http://gamapserver.who.int/mapLibrary/app/searchResults.aspx)

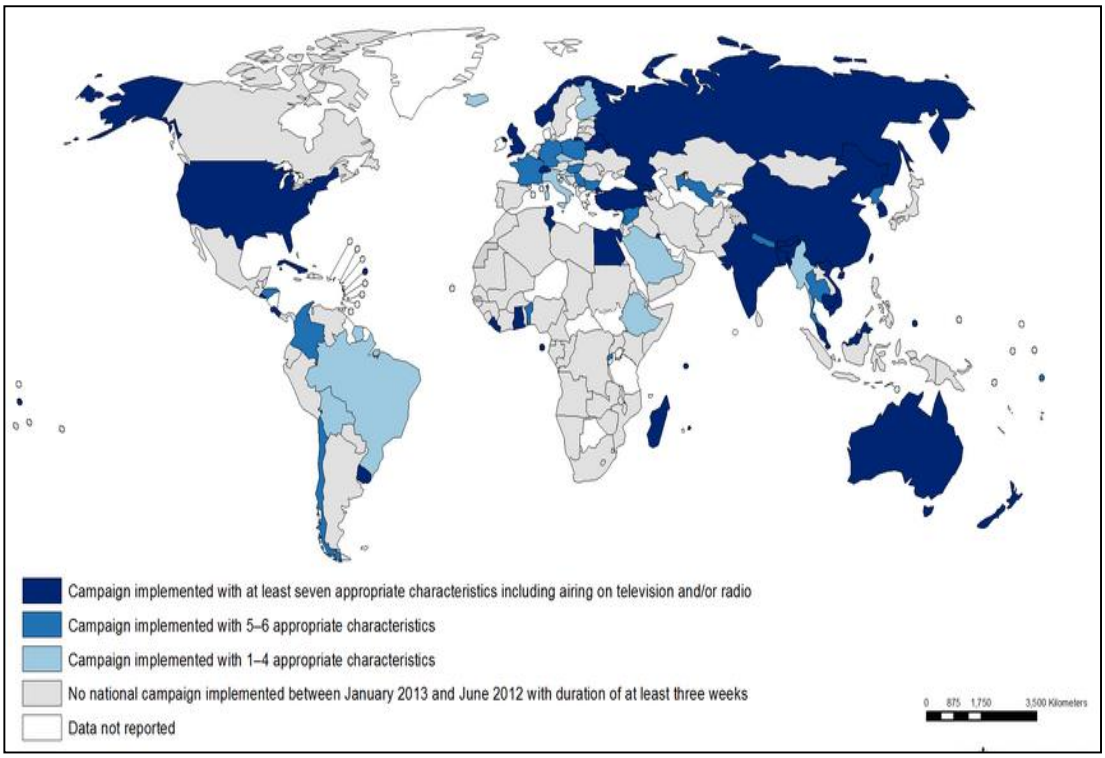

Figure A.4 Anti-tobacco media campaigns applied with appropriate characteristics, 2012 (http://gamapserver.who.int/mapLibrary/app/searchResults.aspx)

APPENDIX B. COMPARISONS OF THE RESULTS OF GATS 2008 AND 2012 OF TURKEY

Table B.1 Percentage of adults ≥15 years old, by detailed smoking status GATS Turkey 2008-2012 (Public Health Institution of Turkey, 2014)

Smoking Status	2008 Percentage	2012 Percentage	Relative Change
Overall			
Current smoker	31.2	27.1	-13.44+
Daily smoker	27.4	23.8	-13.2+
Occasional smoker	3.8	3.3	-14.6+
Occasional smoker, formerly daily	1.8	1.5	-17.0+
Occasional smoker, never daily	2.0	1.8	-12.5+
Non-smoker	68.8	72.9	6.1+
Former daily smoker	10.5	9.4	-10.1+
Never daily smoker	58.2	63.5	9.0+
Former occasional smoker	5.4	3.7	-31.4+
Never smoker	68.8	59.8	13.1+

Note: Current use includes both daily and occasional (less than daily) use; relative change (%) calculated by [(estimate of 2012 – estimate of 2008) / estimate of 2008]*100

+ $p<0.05$

Table B.2 Percentage of adults ≥15 years old who made a quit attempt in the past 12 months, by selected demographic characteristics, GATS 2008, 2012 of Turkey (Public Health Institution of Turkey, 2014)

Demographic Characteristics	Made Quit Attempt		
	2008 (%)	2012 (%)	Relative Change (%)
Overall	44.8	46.0	2.8
Gender			
Male	44.1	45.1	2.4
Female	46.9	48.8	4.1
Age(years)			
15-24	52.3	40.2	-23.2+
25-44	42.7	48.3	13.1+
45-64	44.2	44.8	1.4
65+	40.6	47.1	16.0
Residence			
Urban	44.7	46.5	4.2
Rural	45.1	44.3	-1.8
Education Level			
Not graduated	35.0	44.1	26.0
Primary	44.6	46.9	5.3
Secondary	44.9	43.3	-3.4
High school	48.0	47.4	-1.2
University	45.8	46.0	0.5

Note: Relative change (%) calculated by [(estimate of 2012 – estimate of 2008) / estimate of 2008]*100

+ $p<0.05$

Table B.3 Percentage of adults ≥15 years old who received health care provider assistance in the past 12 months, by selected demographic characteristics, GATS 2008, 2012 of Turkey (Public Health Institution of Turkey, 2014)

Demographic Characteristics	**Health Care Provider Assitance**					
	2008		2012		Relative Change	
	Asked by HCP if a smoker[2]	Advised to quit by HCP[3]	Asked by HCP if a smoker[2]	Advised to quit by HCP[3]	Asked by HCP if a smoker[2]	Advised to quit by HCP[3]
Overall	49.0	40.7	51.4	42.9	4.9	5.3
Gender						
Male	49.1	42.2	49.1	41.3	0.0	-2.2
Female	48.8	38.0	56.3	46.4	15.4+	22.2+
Age(years)						
15-24	42.0	33.3	38.1	33.3	-9.3	-0.3
25-44	45.8	36.0	50.6	40.0	10.4	11.3
45-64	57.7	51.5	57.7	50.5	0.0	-1.9
65+	60.2	59.5	64.5	63.1	7.2	6.0
Residence						
Urban	50.6	42.0	52.8	43.8	4.4	4.1
Rural	44.0	36.5	45.7	39.4	4.1	8.1
Education Level						
Not graduated	50.4	44.7	50.0	43.4	-1.0	-3.1
Primary	48.1	41.3	52.0	43.7	8.2	5.9
Secondary	53.0	42.4	45.5	37.7	-14.1	-11.1
High school	46.6	36.8	50.1	41.9	7.6	13.7
University	51.4	42.3	59.8	48.7	16.3	15.1

[2] Among current smokers and former smokers who have been abstinent for less than 12 months, and who visited a HCP during the past 12 months

[3] Among current smokers and former smokers who have been abstinent for less than 12 months, and who visited a HCP during the past 12 months and asked by HCP if a smoker

Note: Relative change (%) calculated by [(estimate of 2012 – estimate of 2008) / estimate of 2008]*100; + $p<0.05$

Table B.4 Percentage of adults ≥15 years old who made a quit attempt in the past 12 months and used various cessation methods for their last attempt, by selected demographic characteristics, GATS 2008, 2012 of Turkey (Public Health Institution of Turkey, 2014)

Demographic Characteristics	**Health Care Provider Assistance**					
	2008		2012		Relative Change	
	Pharmacotherapy	Counseling/Advice	Pharmacotherapy	Counseling/Advice	Pharmacotherapy	Counseling/Advice
Overall	9.3	1.8	13.6	8.0	45.9+	335.5+
Gender						
Male	9.4	1.7	13.3	7.5	41.4+	341.6+
Female	9.1	2.2	14.5	9.5	59.1+	324.5+
Age(years)						
15-24	9.8	0.8	10.2	4.0	4.4	415.4
25-44	9.2	1.3	13.6	8.6	48.0+	559.2+
45-64	9.9	3.6	16.4	8.7	65.6	140.8
65+	4.1	4.8	9.0	10.5	121.8	116.1
Residence						
Urban	10.4	2.4	14.4	8.4	38.8+	258.4+
Rural	6.4	0.4	10.8	6.6	68.1	1406
Education Level						
Not graduated	1.8	0.3	13.0	1.1	607.2	241.7
Primary	8.6	1.8	16.4	10.0	89.6+	467.0+
Secondary	8.6	0.9	9.6	5.8	11.0	546.7
High school	12.2	2.0	13.3	8.8	9.1	329.5+
University	11.1	4.4	12.8	6.9	15.9	58.5

HCP=Health care provider

Note: Relative change (%) calculated by [(estimate of 2012 – estimate of 2008) / estimate of 2008]*100; + $p<0.05$

Table B.5 Percentage of adults ≥15 years old who noticed anti-tobacco information during the last 30 days in various places, by selected demographic characteristics, GATS 2008, 2012 of Turkey (Public Health Institution of Turkey, 2014)

Smoking Status	2008 Percentage	2012 Percentage	Relative Change
Overall			
In newspapers or in magazines	46.3	41.1	-11.3+
On television or the radio	86.1	92.0	6.9+
On television	85.5	91.4	6.9+
On radio	23.0	25.2	9.6
On billboards	36.0	29.9	-16.8+
Somewhere else	4.5	2.6	-43.2+
Any location	88.8	93.5	5.3+
Male			
In newspapers or in magazines	53.7	45.9	-14.6
On television or the radio	86.2	92.3	7.1+
On television	85.5	91.6	7.0+
On radio	23.7	26.8	13.1+
On billboards	40.7	32.4	-20.3+
Somewhere else	5.3	2.7	-49.0+
Any location	89.9	94.1	4.7+
Female			
In newspapers or in magazines	39.2	36.5	-7.0
On television or the radio	86.1	91.8	6.6+
On television	85.4	91.2	6.8+
On radio	22.3	23.7	6.1
On billboards	31.4	27.4	-12.6
Somewhere else	3.8	2.5	-35.5+
Any location	87.8	92.9	5.8+

Table B.5 (cont.) Percentage of adults ≥15 years old who noticed anti-tobacco information during the last 30 days in various places, by selected demographic characteristics, GATS 2008, 2012 of Turkey (Public Health Institution of Turkey, 2014)

Smoking Status	2008 Percentage	2012 Percentage	Relative Change
15-24			
In newspapers or in magazines	51.5	42.8	-16.9+
On television or the radio	87.0	91.7	5.4+
On television	85.8	91.1	6.2+
On radio	24.4	24.8	1.5
On billboards	42.9	32.1	-25.1+
Somewhere else	6.2	2.9	-52.5+
Any location	91.3	93.7	2.6+
25+			
In newspapers or in magazines	44.8	40.6	-9.4+
On television or the radio	85.9	92.2	7.3+
On television	85.4	91.5	7.1+
On radio	22.6	25.4	12.2+
On billboards	34.0	29.3	-13.8+
Somewhere else	4.1	2.5	-39.0+
Any location	88.1	93.4	6.0+
Urban			
In newspapers or in magazines	51.0	44.9	-11.9
On television or the radio	86.9	92.7	6.7+
On television	86.1	92.0	6.9+
On radio	25.5	27.5	7.8
On billboards	40.2	33.8	-15.9+
Somewhere else	5.4	3.2	-41.9+
Any location	89.9	94.2	4.8+
Rural			
In newspapers or in magazines	35.7	31.5	-11.9+
On television or the radio	84.5	90.3	6.9+
On television	84.1	89.8	6.7+
On radio	17.2	19.3	12.2
On billboards	26.1	19.8	-24.2+
Somewhere else	2.5	1.1	-55.9+
Any location	86.4	91.7	6.2+

Note: Relative change (%) calculated by [(estimate of 2012 – estimate of 2008) / estimate of 2008]*100; + $p<0.05$