**Analysis of willingness to forbid tobacco products in Poland, a SEM approach.**

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**Abstract**

Through our analyses we are trying to answer the question – what is Pole’s willingness to ban tobacco products based on? To find the answer, we built a multi-equation econometric model - Structural Equations Model (SEM).  The research uses Global Adult Tobacco Survey (GATS) data collected in Poland in years 2009-2010. In the end we prove that people’s willingness to forbid the usage of tobacco products is stimulated only by advertisements and infomercials. Additional traits of ban followers and antagonists are also discovered.

**Introduction**

The purpose of our analyses is to point out which factors have statistically meaningful influence on Pole’s willingness to ban tobacco products and to verify whether the influence of these factors is consistent with intuition[[1]](#footnote-1).

For our analyses we use structural equations model (SEM). This is a type of econometric model composed of several equations which applies to the description of dependencies between variables that mutually and simultaneously affect each other. The case of mutual simultaneous impact is a standard for macroeconomic models, because it shows how complex relations between indicators and variables in the real world are and it does it much better than a simple regression model with one equation. Interested reader is directed to directed to more professional materials[[2]](#footnote-2)[[3]](#footnote-3).

Multi-equation methods can usually be written in several ways, with different forms of model recording having different interpretations and applications. Undoubtedly, the most important form of the multi-equation model is the structural form (Equation 1), which is shown below.

Equation 1

…

where:

           stands for dependent variable

           stands for independent variable

         stands for structural random disorders

    γ stands for coefficient of dependent variable

β stands for coefficient of independent variable

Choosing SEM for our analyses enabled us to use more data, build more equations and find more relations between variables than while using a simple model.

# Data and Methods

Information being processed here come from the Global Adult Tobacco Survey conducted by the World Health Organization in Poland. The questionnaires were being filled in a time spanning from November 2009 to March 2010[[4]](#footnote-4). The sample consisted of 7840 men and women. 325 variables were measured in the study.

The date at which survey has been conducted is not arbitrary. On the day of 15.11.2010 a law has been put in life in Poland which forbids usage of tobacco products in public places.

For the purposes of SEM groups of dataset’s variables were selected. The groups and their representative variables were checked to correspond meaningfully to the phenomenon they are describing, to not arise any doubt in the way they were acquired and to not be represented in a coding greatly deviating from the coding of variables in the same group. After creation of group the Cronbach’s α was calculated and the inability to pass a 0.6 mark, in a significant manner, was used as a ground to discard the group. All of the independent variables are of binary type. As the Cronbach’s α is not a perfect measure for this type of structures we allow for minor deviations form discard mark.

Prepared groups were then ready to become latent variables and to be used in Structural Equations. Below, a Table 1 consisting of phenomenon a latent variable is describing, the variables affecting that latent variables and the Cronbach’s α is presented.

Table 1

|  |  |  |
| --- | --- | --- |
| Latent variable | Manifest variable | Cronbach’s α |
| Willingness to forbid usage of tobacco products(η1). | y1 - (Are you in favour of implementing in Poland a complete ban on smoking in the mentioned places?) In a government office?  y2 - (Are you in favour of implementing in Poland a complete ban on smoking in the mentioned places?) In healthcare facilities?  y3 - (Are you in favour of implementing in Poland a complete ban on smoking in the mentioned places?) In schools and other educational facilities?  y4 - (Are you in favour of implementing in Poland a complete ban on smoking in the mentioned places?) In cultural facilities?  y5 - (Are you in favour of implementing in Poland a complete ban on smoking in the mentioned places?) In sport facilities?  y6 - (Are you in favour of implementing in Poland a complete ban on smoking in the mentioned places?) In restaurants?  y7 - (Are you in favour of implementing in Poland a complete ban on smoking in the mentioned places?) In bars, night and music clubs? | 0,832 |
| Noticing a tobacco commercial in the last 30 days(η2). | y1 - (In the last 30 days, have you noticed any \*advertisements or signs promoting\* cigarettes in the following places?) On foreign television channels?  y2 - (In the last 30 days, have you noticed any \*advertisements or signs promoting\* cigarettes in the following places?) In foreign newspapers or magazines?  y3 - (In the last 30 days, have you noticed any \*advertisements or signs promoting\* cigarettes in the following places?) On the internet? | 0,62 |
| Noticing a commercial informing on the dangers of usage of tobacco in the last 30 days(η3). | y1 - In the last 30 days, have you noticed \*information\* about the dangers of smoking cigarettes or that encourages quitting in any of the following places? In newspapers or in magazines?  y2 - (In the last 30 days, have you seen any \*information\* about the dangers of smoking cigarettes or that encourages quitting in any of the following places?) On television?  y3 - (In the last 30 days, have you heard any \*information\* about the dangers of smoking cigarettes or that encourages quitting in any of the following places?) On the radio?  y4 - (In the last 30 days, have you noticed \*information\* about the dangers of smoking cigarettes or that encourages quitting in any of the following places?) On billboards?  y5 - (In the last 30 days, have you noticed \*information\* about the dangers of smoking cigarettes or that encourages quitting in any of the following places?) On the internet?  y6 - (In the last 30 days, have you noticed \*information\* about the dangers of smoking cigarettes or that encourages quitting in any of the following places?) In educational/health materials? | 0,75 |
| Opinion on whether smoking can cause diseases in passive smokers(η4). | y1 - Do you think that inhaling tobacco smoke by non-smokers causes the following diseases? Heart diseases in adults?  y2 - (Do you think that inhaling tobacco smoke by non-smokers causes the following diseases?) Lung diseases in children?  y3 - (Do you think that inhaling tobacco smoke by non-smokers causes the following diseases?) Lung cancer in adults?  y4 - (Do you think that inhaling tobacco smoke by non-smokers causes the following diseases?) Delay in child development? | 0,552 |
| Awareness of the diseases caused by smoking(η5). | y1 - Based on what you know or believe, does smoking tobacco cause the following...Brain stroke (haemorrhage that may cause paralysis)?  y2 - (Based on what you know or believe, does smoking tobacco cause the following...) Heart attack? | 0,657 |
| Opinion on how addictive tobacco products are(η6). | y1 - Do you think that using the following tobacco products leads to an addiction? Smoking of cigarettes?  y2 - (Do you think that using the following tobacco products leads to an addiction?) Smoking of other smoking tobacco products?  y3 - (Do you think that using the following tobacco products leads to an addiction?) Using smokeless tobacco? | 0,605 |
| Wealth of a family house(η7). | y1 - (Please tell me whether this household or any person who lives in the household has the following item:)Fixed telephone?  y2 - (Please tell me whether this household or any person who lives in the household has the following item:)Cell telephone?  y3 - (Please tell me whether this household or any person who lives in the household has the following item:)Television?  y4 - (Please tell me whether this household or any person who lives in the household has the following item:)Radio?  y5 - (Please tell me whether this household or any person who lives in the household has the following item:)Refrigerator?  y6 - (Please tell me whether this household or any person who lives in the household has the following item:)Car?  y7 - (Please tell me whether this household or any person who lives in the household has the following item:)Moped/scooter/motorcycle?  y8 - (Please tell me whether this household or any person who lives in the household has the following item:)Washing machine?  y9 - (Please tell me whether this household or any person who lives in the household has the following items:)Computer?  y10 - (Please tell me whether this household or any person who lives in the household has the following items:)Internet?  y11 - (Please tell me whether this household or any person who lives in the household has the following items:)Satellite or cable television?  y12 - (Please tell me whether this household or any person who lives in the household has the following items:)Dishwasher?  y13 - (Please tell me whether this household or any person who lives in the household has the following items:)Home theatre set?  y14 - (Please tell me whether this household or any person who lives in the household has the following items:)Video camera? | 0,734 |

We create models consisting of multiple equations, every one of which explains different sets of relationships between latent variables. Every model is designed in a way that lets it be solved in recursive fashion. We use the Diagonally Weighted Least Squares (DWLS) estimator as the non-normal distribution of observable variables makes the typically used Maximum Likelihood (ML) estimator inappropriate.

For the model to be solvable and to contain meaningful relations latent variables had to be hand-picked in such a way that no cycles exist in the model and at the same time the statistical indicators have backing in the real world.

Graphs A and B in Figure 1 present the models we tried to research. The indices refer to the number of latent variables defined in the Table 1. Arrows inform us about the direction of a regression relationship present. Arrows start at a regressor and point to a variable being regressed.

Figure 1

3

2

1

5

6

4

B

3

2

1

5

6

4

A

# Results and Discussion

Having removed regressors with p-value lower than 0,05 and having decided which of the conflicting relations are more important we ended up with a model presented below (Figure 2).

We use widely acclaimed test values[[5]](#footnote-5), that is RMSEA, CFI and TLI, to check whether our model is of statistical significance. The test values for this model are: RMSEA - 0.035, CFI - 0.948, TLI - 0.941. All of which pass the required border values and assure us of the validity of the model.

Figure 2

3

2

1

6

4

Willingness to forbid usage of tobacco products

Noticing a commercial informing on the dangers of usage of tobacco in the last 30 days

Noticing a tobacco commercial in the last 30 days

Opinion on whether smoking can cause diseases in passive smokers

Opinion on how addictive tobacco products are

The strengths of relations between variables are presented in Table 2.

Table 2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **affected variable** | 1 | 1 | 4 | 6 | 6 |
| **affecting variable** | 2 | 3 | 1 | 1 | 4 |
| **coefficient** | 0.116 | 0.168 | -0.13 | -0.036 | -0.064 |
| **p-value** | 0.000 for all | | | | |

Important information is carried by the variables 2 and 3. Their covariance is equal to 0,01 with p-value close to 0. We can deduce that both of those variables contribute significantly to the variable 1. Similar conclusion can be found in researches concerning related issues[[6]](#footnote-6).

It is also interesting, that variable 1 influences and leads to decrease on both - variables 4 and 6. As it was mentioned, in this case p-values are lower than 0,05 which is a sign of correctness of these connections. Although it is unintuitive conclusion, an explanation of this phenomenon can be found in other researches[[7]](#footnote-7).

The last relation between variables 4 and 6 may be seen as quite unnecessary, because variable 6 depends on variable number 1 as a variable 4 does. But, as in the previous case, low values of p-value tests point to statistical meaning of this connection.

For further readings see[[8]](#footnote-8)[[9]](#footnote-9)

# Conclusions

Insight gained from the final model and the research process which created it are now used to express characteristics of the latent variables defined in Table 1 and their relations with other variables.

**Willingness to forbid usage of tobacco products(η1)** depends only on the fact that a person has had any type of contact with tobacco products in media. Factor expressed by the variables **Noticing a tobacco commercial in the last 30 days(η2)** and **Noticing a commercial informing on the dangers of usage of tobacco in the last 30 days(η3)**. Two key facts are proven.

1. Advertisements and infomercials are effective methods of putting people away from tobacco products or at least activating their willingness to ban those.
2. All of the other factors are statistically insignificant.

The second result may come as a surprise. What is seen though from the dataset is that even variable such as **Awareness of the diseases caused by smoking(η5),** which is just information from **η3** already in the consciousness of a given person, is irrelevant. We can deduce that emotions and not rational behaviour play a very big role in the overall opinion creation.

Examining **Opinion on whether smoking can cause diseases in passive smokers(η4)** and **Opinion on how addictive tobacco products are(η6)** gives another proof for emotion-driven behaviour of a typical person. The two variables show that a person willing to delegalize tobacco products is less likely to think that those products are actually harmful. The peculiar result can be explained twofold. Willingness to ban is motivated by bad emotional connections to tobacco products and not by potential loss of health stemming from rational thought. For example, a smoker ruining a dinner with his smell. The other explanation being that people not willing to ban, who are very often smokers, possess more knowledge of the dangers they incur but still smoke which is a clear sign of an addiction.

The last variable **Wealth of a family house(η7)** does not influence or is influenced by any other variable. This fact can also seem contradicting as it has been frequently shown that low income is a stimulant for tobacco usage.

Summarizing, the opinion about the need for regulating tobacco usage and tobacco usage are shaped by very different sets of motivators and demotivators. They should not be treated as a similar phenomenon. Lack of rational thought and following emotional drives are the main factors of human being to be considered when implementing regulation for those type of products.

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