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**Comparative analysis of factors influencing  
children's smoking**

*Bakalářská práce*

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## **Abstrakt**

Kouření u dětí je sociální problém, který se snaží řešit vlády po celém světě. Některé jsou úspěšné, jiné již méně. Tato práce se zaměřuje na velmi dobrou situaci v USA a naopak na horší v České republice. Na to, jestli je dítě kuřákem nebo ne, působí mnoho vlivů a právě tato práce se snaží najít ty nejdůležitější v obou zemích. Druhý cíl je porovnat významnosti faktorů v USA a České republice.

Popisná statistika dat z výzkumu NYTS v USA v roce 2009 a výzkumu GYTS v České republice v letech 2002 a 2007 ukazují, že v USA je méně než deset procent dětských kuřáků a že v ČR se situace sice lepší, ale pořád je zde množství kuřáků třikrát větší. Efekt jednotlivých faktorů je odhadnut pomocí LPM, probitového a logitového modelu. Americké děti jsou více ovlivněny kouřením jiných osob v jejich přítomnosti a školními kurzy poučujícími o nebezpečí kouření než české děti, které jsou naopak více ovlivněny kamarády a rodiči, kteří kouří.

## **Abstract**

Smoking of children definitely is a huge social problem, which many governments around the world try to solve. Some of them are successful, other less. This paper focuses on the USA with the very good situation and, on the other hand, on the Czech Republic, where the situation is not so satisfactory. There are many factors that influence if a child smokes or not. And the main aim of this paper is to find the important factors in the both countries. Other aim is to compare significance of the factors' influence in the USA with the ones in the Czech Republic.

Statistical description of datasets from NYTS survey in the USA in 2009 and from GYTS surveys in the Czech Republic in 2002 and 2007 show that there are less than 10% of child smokers in the age of 14 in the USA and the situation in the Czech Republic is getting

better, although the amount of children who smoke is still three times higher. The influences of the factors are estimated by LPM methods, probit and logit models. American children are more affected by school class explaining danger and by other people who smoke in their presence, while the Czech children are mostly influenced by smokers among their closest friends and their parents.

## **Klíčová slova**

Děti, kouření, vliv, faktory, ekonometrie, Česká republika, USA

## **Keywords**

Children, smoking, influence, factors, econometrics, the Czech Republic, the USA

**Rozsah práce:** 72 tisíc znaků

## **Prohlášení**

1. Prohlašuji, že jsem předkládanou práci zpracoval samostatně a použil jen uvedené prameny a literaturu.
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V Praze dne 14. 5. 2011

Bc. Tomáš Tesař

## **Poděkování**

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## TEZE BAKALÁŘSKÉ PRÁCE

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Garant studijního programu Vám dle zákona č. 111/1998 Sb. o vysokých školách a Studijního a zkušebního řádu UK v Praze určuje následující bakalářskou práci

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Charakteristika tématu, současný stav poznání, případné zvláštní metody zpracování tématu:

Children's smoking is huge social problem, which many European governments are trying to solve. Some of them are successful in eliminating this problem but most countries of the Central and Eastern Europe are not. This thesis deals with comparative analysis of ineffective anti-smoking campaign in Czech Republic and policy in the United States of America, which was very successful in the second half of 90's. The goal of this thesis is to find the differences between policy objectives with econometric model, too. The conclusion is theoretical recommendations, which suggests what the Czech Republic should do to minimize the children's smoking.

Struktura BP:

Introduction  
1. Current theoretical approach  
2. Anti-smoking campaigns in CZE  
    a. Development in CZE  
    b. Comparisons in the Central and Eastern Europe  
3. Development in USA  
4. Comparative analysis between CZE and USA  
5. Econometric model  
6. Recommendations  
Conclusion



Seznam základních pramenů a odborné literatury:

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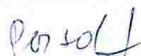
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## Introduction

One can simply say that economics is a human science dealing with money. However, even rich people know that they cannot buy health for money. And the most important for humankind is the health of children. The smoking children are a huge social problem, which many governments around the world try to solve. Some of them are successful, others less.

This paper focuses on the very good situation in the USA and tries to compare it with the situation in the Czech Republic. There are many factors which influence the fact that a child smokes or not and the main aim of this paper is to find the most important factors in both countries. Another aim is to compare the significance of the influence of factors in the USA with the ones in the Czech Republic.

Statistical descriptions of datasets from the NYTS survey in the USA in 2009 and from GYTS surveys in the Czech Republic in 2002 and 2007 show that there are less than ten percent of smoking children in the age of 14 in the USA and the situation gets better in the Czech Republic, although the amount of smoking children is still three times higher. The influences of the factors are estimated by methods LPM, probit and logit model, where the parameters show the probability of being a smoker. This dummy variable is most affected by variables *Smoking friends*, *Smoking in their homes*, *Smoking in their presence* and *School project*. The American children are more affected by lessons about the danger of smoking in the schools and smoking in their presence, while the Czech ones are influenced by their closest friend's smoking and parents' smoking.

The paper is structured as follows. The chapters 1 and 2 summarise the situation in the Czech Republic and in the USA. The different views on the influence of children are given in the chapter 3. The chapter 4 describes the econometric model and its results, which are discussed in the chapter 5.

# 1 Situation in the Czech Republic

During the last few years several surveys have measured the share of smoking children in the Czech Republic. The methods and results of three most important international surveys are summarized in the first part of this chapter. The other part focuses on comparing situation in the Czech Republic with other countries in the region of Central and Eastern Europe.

## 1.1 Surveys in the Czech Republic

Many local and international surveys have tried to find significant relationships or simply to measure the issue of smoking children in the Czech Republic in the few past years. The World Health Organization has measured the influence of bad habits (also smoking) on health through the Health Behaviour in School-aged Children. Smoking and alcohol drinking belong to drugs using, so every drug survey is counted like the European School Survey Project on Alcohol and Drugs. In the third part of this chapter I describe the Global Youth Tobacco Survey, which serves as the source of data for this paper.

### 1.1.1 The Health Behaviour in School-aged Children (HBSC)<sup>1</sup>

This part is about the international system of surveys that focus on health and health behaviour of eleven-, thirteen- and fifteen-year-old children and young people. The first study was carried out in co-operation with the World Health Organization almost thirty years ago. The measuring was done only in England, Denmark, Finland, Norway, Austria and Denmark, but the seventh and the last survey in 2005-2006 was held in 41 countries and regions across Europe and North America. As the amount of regions also rises, the aim of study is wider. Physical, social and emotional well-being or social context are new topics of researching, too. After the four last surveys The WHO Regional Office for Europe published reports, where it tried to describe interesting data and to compare countries and regions in many categories. The reports and also the data is a huge resource for policy-makers such as government, health or nongovernmental organizations, reporters or teachers.

The last two surveys in 2001-2002 and 2005-2006 are described in more details below. The data were collected in 35 and 41 countries and regions through school-based surveys. All of them had the same international questionnaire and targeted the three ages of young people: when they start to be adolescents; when they face physical and emotional changes; when they decide about their future life and career. It is the explanation why children in the age of 11,

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<sup>1</sup> Currie, 2004; Currie, 2008

13, 15 years are included. In every country or region were chosen about 1500 respondents by clustered sampling design and specially trained surveyors, teachers, or school nurses helping with completion of the surveys in classrooms.

HBSC did not focus only on smoking, but also on alcohol consumption, use of cannabis, physical activity, eating habits, body image, injuries, sexual health, and many more. The second survey's approach was very similar, but the report has more systematic view. The main theme was health inequalities in health and well-being connected with gender or age and geographic or socioeconomic dimensions, too. The purpose of this change was to show the results of different anti-smoking campaigns and policies in the countries. This information could lead to make better policy or start successful policy in countries where they have problems with smoking or drinking children.

The situation in the Czech Republic according to the HBSC 2001-2002 is even not average in comparison with other countries. It is approximately on the fifth place in category *children reporting ever having smoked* in all age categories and in the first third in category *children who smoke at least once a week*. There is not any change in the position of the Czech Republic in these categories after four years according to the report of HBSC 2005-2006. However, the proportion of once-a-week-smokers decreases by one fourth in category of the age of 15 and decreases by one fifth in category of the age of 13.

### **1.1.2 The European School Survey Project on Alcohol and other Drugs (ESPAD)<sup>2</sup>**

This survey has its origin in Sweden. *Centralförbundet för alkohol-och narkotikaupplysning* is the main office which is responsible for this European system of surveys. It has begun to co-operate with the *European Monitoring Centre for Drugs and Drug Addiction* (EMCDDA) in Lisbon. The Swedish Government and the Swedish National Institute of Public Health support financially the coordination of the surveys and publishing the reports. More than 100 000 fifteen- and sixteen-year-old students from 35 countries over the Europe participated in the fourth and the last survey in 2007.

Although the main theme of this survey is to find data about using alcoholic beverage, cannabis, marijuana or hashish, tranquillisers, sedatives and inhalants, tobacco consumption is partly included, too. In general, daily tobacco consumption slightly decreased since 2003 to 2007. The Czech Republic is also here given as the example of a very bad situation in categories *daily smoking* (the first position), *availability of cigarettes* (second position),

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<sup>2</sup> Hibell, 2007

*lifetime prevalence* (second position) or *smoking in last 30 days* (second position). Furthermore, the trend in Czech Republic is exceptional. The Slovak Republic, Croatia and Lithuania, beside the Czech Republic, are the only countries where the trend of tobacco consumption was constant or slightly increased. The rest of Europe had verifiable decline.

### **1.1.3 The Global Youth Tobacco Survey (GYTS)**

In the first part I declare that the HBSC was realized with cooperation with WHO. However, WHO has its own system of surveys called Global Tobacco Surveillance System. This system can be divided into four separate parts according to what type of data is collected. There is description of the Global Youth Tobacco Survey (GYTS) is in this chapter. The Global School Personnel Survey (GSPS), the Global Health Professions Students Survey (GHPSS), and the Global Adult Tobacco Survey (GATS) are the rest three parts.

A demand for global information about youth smoking in the late 90's helped Tobacco Free Initiative (project of WHO) to begin to cooperate with Centres for Disease Control, United Nations Children's Fund, World Bank, and representatives countries which wanted to participate. Then GYTS was created. As well as the surveys above, this one is also school-based with the random selection of schools and classes with thirteen- to fifteen-year-old students. The basic questionnaire is anonymous and it takes about 30 – 40 minutes to fill in the answer sheet, which is then scanned by optical hardware. Whereas GYTS is global, the coordination is divided into the six regions: Africa, the Americas, the Eastern Mediterranean, Europe, South-East Asia and the Western Pacific. Each region office is responsible for the training of research coordinators who have to complete the survey within six months after training workshop. The dataset is available for public after one year. The research coordinator has to be informed about some publication or external presentation (with the exception of government's and ministry's publication) until that time (CDC, Data Released Policy; CDC, GYTS Methodology).

The research coordinator for the Czech Republic was Hana Sovinová, who wrote a couple of articles on this topic. One of them (Sovinova, Csémy, 2002) covers the situation in the Czech Republic during the first survey in March and April of the year 2002. In the first stage, it was necessary to find the right sample of students in grades 7, 8, and 9, which represents all Czech students of this age. The Ministry of Education cooperated with the US offices and they selected 50 schools, where there were only some of the classes chosen by computer to participate. There were 4716 students in 204 classes altogether. The Ministry of Health with the Ministry of Education and The National Institute of Public Health also

support this project. The Minister of Education contacted headmasters of the schools and people from NIPH was learned to the surveyors who went to schools with questionnaires. The Czech variant of the GYTS questionnaire consisted of 54 international questions which served to compare other countries and five questions included only in the Czech Republic, which should show some local context. Participation on the project was voluntary for the students and there were 4149 completed questionnaires altogether. This means near 88% of response rate.

The process of the second survey in 2007 was similar. The response rate was near 85%, but the amount of participating students decreased to 3191 (Sovinová, 2007). The datasets from these two surveys are used in this paper, so the detailed statistical description is in the chapter below.

## **1.2 Comparison between Central and Eastern Europe**

According to the surveys, the HBSC and the ESPAD, the comparison between the Czech Republic and the countries of North America and Western Europe looks negative to us. One could explain it by a different historical and cultural approach to the children smoking in the times of communism. However, it was more than twenty years ago, and so other reasons why children smoking is such a big problem could appear. Comparison with Poland, Slovakia and Hungary may offers some answers.

Mrs. Sovinová with her colleagues from these countries wrote a comparison (Baška et al., 2007) where they tried to find the differences from GYTS survey in 2002 and 2003. They focused on these four countries in Central Europe, which have had similar history in the last century. They divided students and children into two groups *current smokers* and *never smokers* according to questions such as how often they smoke. They were analysing the differences between boys and girls too. Three main themes were: what is the share of children who are exposed to smoking in their homes, or in the public places in each of four countries, and who think that smoking is harmful.

The Czech Republic was the best in the first two categories. About one quarter of never smokers and more than half current smokers are exposed to smoking in their home. These are low rates in comparing to the other three countries where the share of never smokers is approximately three quarters and current smokers more than ninety percent. More than half of Czech never smokers answered, that they are exposed to smoking in public places. This share is twenty percent higher in Slovakia and thirty percent higher in Poland and

Hungary. About 90% of Czech and Slovak current smokers are exposed to smoking in public places and in Hungary and Poland this number is even higher, almost 97%.

Shares in the last category about thinking, that second-hand smoking is harmful, are similar: approximately 70% of never smokers and more than half of current smokers. These two statistics show the important relationship between higher knowledge of harmfulness of passive smoking and smoking less. However, these shares are still too low in comparing with the USA where 90% students answered, that passive smoking is harmful to them. This information can be useful for policymakers.

Interesting thoughts appeared in the article about possibilities of legislative prohibition of smoking in public places such as bus stops, schools, hospitals or offices. It can obviously decrease the share of children who are exposed to smoking in public places and lower share of people who are exposed to passive smoking, too. However, policymakers cannot effectively help to children in their home. They should focus on smoking mothers with small children. Efficient anti-smoking campaign may solve this problem.

Another group of academics tried to compare regions of Central and East Europe with South-East Asia (Page et al., 2008). They focused on influence of two psychosocial distress, hopelessness and loneliness, on smoking of youth in the new globalization generation. They were describing development in post-communist countries. According to them, these countries came through drastic transformation to democratic society with new lifestyle and health risk at the beginning of 90's. With changes such as decline of amount of marriage, size of family, or increasing of number of single parent households have come hopelessness and loneliness into youth generation too. Additionally, tobacco advertising focused on girls and women in middle of 90's and caused strong increasing of smoking rates among women (in some particular countries exceeds men's rates). These rates among men and women in this region were the highest in the Europe. They show results from the GYTS in 2002 and 2003 and again in 2008 when amount of students reporting smoking in past thirty days is lower, but still very high. The rate decreased in the Czech Republic from 34% to 31.1%, in Hungary from 33% to 27.2%. Hungary, the Czech Republic and Poland belong to countries where the rate of smoking girls is higher than boy's one.

They created their own dataset from anonymous questionnaires where they want to know information about smoking and frequency of smoking and also used two psychological tests for finding significant hopelessness and loneliness. Hopelessness was defined by Beck Hopelessness Scale where there were questions about students' opinions on their future. For defining loneliness they used revised UCLA Loneliness Scale, which has been designed to



measure satisfaction or dissatisfaction with life and social relationships. Hopelessness and loneliness were their dependent variables, and they tested influence of being smoker or non-smoker. The difference between smoker and non-smoker significantly affect the variables hopelessness and loneliness only in the group of Central-Eastern girls.

Nevertheless, the table below, which show the comparison in smoking prevalence between countries in Central-Eastern Europe, is more important for this thesis. Although the number of respondents is really low (datasets of GYTS have several thousands of respondents), it shows a relatively high share of smokers in this part of Europe, too. The girls in Poland are the only exception. According to Page's paper this value in the USA rates around 22%.

**Table 1: Comparison in smoking prevalence - central and Eastern Europe**

	Hungary		Ukraine		Slovakia		Romania		Poland		CZE	
Total (n)	34.2%	312	26.8%	241	27.0%	90	35.2%	118	27.5%	88	36.6%	109
Male (n)	31.4%	141	32.6%	143	23.4%	26	33.8%	53	15.3%	19	34.8%	39
Female (n)	36.9%	171	21.3%	98	28.8%	64	36.5%	65	35.2%	69	37.6%	70

Source: Page, 2008

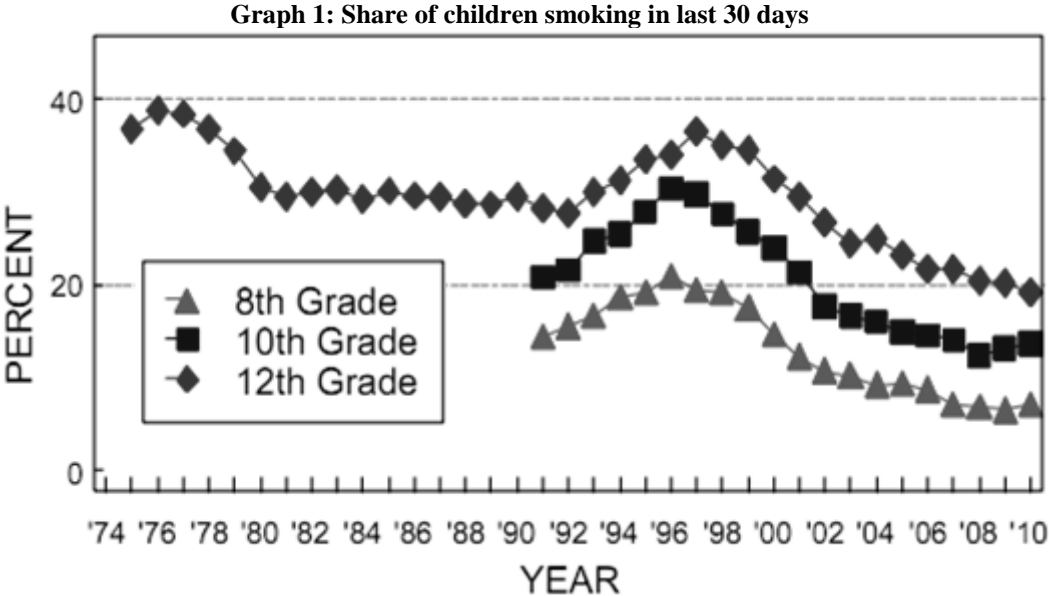
## 2 History in the USA

The beginning of this chapter describes the situation in the USA, where the rate of child smokers is really low in these days. The second half shows the two referenced important surveys in more details.

The most important survey on drugs, alcohol and smoking for the USA is Monitoring the Future surveys. It targets students in 8<sup>th</sup>, 10<sup>th</sup> and 12<sup>th</sup> grade last 36 years. University of Michigan showed findings about trends of smoking in the end of last year (Lessnau, Meyer, 2010), which then appeared in the published report this year (Johnston et al., 2011). The main conclusion of this report is: very low rates of smoking children in several past years slightly increased in 2010 in the category 8<sup>th</sup> and 10<sup>th</sup> grade. Trend in 12<sup>th</sup> grade continues on the same level. The history of trend of smoking children with possibly explanation is more important.

They have started to measure share of smokers (30-days prevalence of smoking) in 8<sup>th</sup> and 10<sup>th</sup> grade since 1991, so until this year there is only data of smokers in 12<sup>th</sup> grade available. After the peak in 1976 (39%) it continuously decreased about a quarter until 1982 (29%) where it stayed for next ten years. Since 90's the trends of 8<sup>th</sup>, 10<sup>th</sup> and 12<sup>th</sup> grade students have been very similar with some kind of delay. Naturally, the proportion of smokers is different. The situation in the USA was worse in the middle of 90's when share achieved another peak. The smoking of 8<sup>th</sup> and 10<sup>th</sup> graders increased by approximately one half and 12<sup>th</sup> graders by on third and caused public attention to the issue. New sales taxes on cigarettes

were introduced, so the prices increased sharply. In addition, the pro-tobacco advertising was exchanged for anti-smoking campaign. In the next five or six years the smoking among all graders fell down fast. In 2002 or 2003 the price of cigarette increased even slowly and the anti-smoking campaign was not as funded as at the beginning. Thus smoking graders decreased slowly to the peak in 2010, where it slightly increased. For better imagination of the situation in the USA there is a diagram below.



Source: The Monitoring the Future study, 2010

**2.1 Surveys in the USA**

**2.1.1 Monitoring the Future<sup>3</sup>**

The main difference between the GYTS in the Europe, Asia and part of the Americas and Monitoring the Future is that the second one measures all drugs among 8<sup>th</sup>, 10<sup>th</sup> and 12<sup>th</sup> graders only in the USA.

It is organized by University of Michigan (its department of Survey Research Center, Institute for Social Research) every year. The sample design is similar to ESPAD in Europe. In the first stage primary sampling units are chosen, in which, in the second stage, are chosen concrete schools. If the school does not want to participate, there is always possibility to select another school in the same geographical location and with the same size and type (public/private, non/catholic). In school with more than 350 students in grade the classes are chosen randomly. If the school has less than 350 students in grade, all of them are asked to participate the survey.

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<sup>3</sup> Johnston et al., 2008

The questionnaire is anonymous of course and there are four types of them. Each has the same core questions on demographic and drug use. Students get one of them randomly, and each has the different subset of topical questions because of demand for finding information about change in behaviour, lifestyle and future of young students. At the end the researchers get more than 450 variables. However, the smoking is not the most important variable in the survey. They focus on consuming alcohol, marijuana, LSD, cocaine, methamphetamine, injectable drugs and many others too.

Monitoring the Future is really good to measure connection between smoking cigarettes and psychological background of children (happiness, loneliness), grades in school, rate of sport activity or social and health habit. However, for purposes of this paper I need a survey that covers the theme of smoking in more details.

### **2.1.2 The National Youth Tobacco Survey (NYTS)<sup>4</sup>**

More usable surveys were applied in the USA six times from years 1999 to 2009. The National Youth Tobacco Survey is kind of similar to GYTS, but this one is local only. It measures the experiences, knowledge, and attitudes to tobacco using of school children in 6<sup>th</sup> to 12<sup>th</sup> grades. It includes children of white, black and Hispanic race, students of public, Catholic and private schools in fifty states of the USA. The sampling was three-stage as well: 80 primary sampling units defined as a county, groups of small counties or parts of the large county in the first stage; two large schools in each PSU and additional 20 medium schools and 20 small schools in all PSU together in the second stage (200 schools together); random selection of classes from the class list created from course schedules to make student's participation only one time (approximately two classes in each grade in large school).

The questionnaire consists of 81 questions divided into several parts. The majority of questions are about the experience with smoking cigarettes, which is followed by parts about smokeless tobacco, cigars, pipes, bidies and kreteks. The second half is about their thoughts, influences of anti-smoking and pro smoking advertisements in mass media or smoking habits of their friends. I use the dataset from this survey in 2009 to compare the situation in the Czech Republic and the USA in this paper.

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<sup>4</sup> NYTS, 2009

## **3 Factors influencing the children smoking**

### **3.1 Parents**

Children's parents belong to three main factors that influence the education in childhood. The second one is the social group where it depends on what types of behaviours his or her friends have. In addition, the effects of anti smoking campaigns and pro tobacco advertisement are important. Many studies try to find out if there is any connection between smoking child and smoking parents or their attitudes to smoking.

One of them (Andersen et al., 2002) was interested in mothers' attitudes and concerns. They measured mothers' (or stepmothers', grandmothers') opinion in times when children were in the third grade at the age of eight years in the district of Washington. They asked about their smoking too. They assumed that mothers' attitudes could be influenced by behaviour of children in adolescence. It is the reason why they measured it in age of children where they do not even experiment with smoking. The second data collection continued nine years later, when children were in 12<sup>th</sup> grade, and came through the main period of smoking initiation. One questionnaire was set for children who focused on frequency of smoking and the other was for their parents. The most difficult part was to track almost four thousands mothers who participated in the original survey. They successfully found almost 93% because of cooperation with Hutchinson Smoking Prevention Project too.

Results confirmed that strong mothers' anti smoking attitudes have effect on smoking behaviour of their children. However, it has one condition: neither one of the parents in household can smoke. Numerically, approximately more than 30% of students, whose parents smoke or whom mother has not so strong attitudes against smoking, in 12<sup>th</sup> grade smoked cigarettes. If they had no smoking parents, and mothers' attitude was very anti smoking, only 16% of them smoked. It is 50% reduction and it does not depend on sex of children. It is quite logic, that if mother has strong anti smoking attitudes, but she or her husband smokes, child thinks, that they can break the anti smoking rules too.

The problem of influence of parental smoking on children and adolescent smoking was interesting for Chassin et al. (2002) from State of Arizona and Indiana University, too. According to them many papers had focused on connection between parents' and children smoking, but with very different results. It is because of variable definitions parent smoking or children smoking (experimental, current, lifetime smoking), demographic or geographic differences. It was one of their reasons to define the new variable: parent ex-smoker. They assumed that children living in household with ex-smoking parents have lower chance to start

smoking in adolescence. They even suggested that this chance could be lower than chance of children in household with no smoking parents because of stronger anti smoking attitudes and motivations. Their assumption was confirmed by results but only if neither parent is a current smoker. One conclusion could be following: the quitting program's effect can lie not only in treating patients, but also in helping other people in their households.

Besides parental smoking the quality of relationship between parents and children has the effect too. There is a paper (Fleming et al., 2002) that mentions variables such as positive or negative degree of relationship, degree attachment, discipline, household rules, or number of conflicts. Furthermore, they worked with children in the second or the third grade and again in eighth grade. Their results showed that higher prevalence to smoking is found among students with low academic skills, high levels of depressive symptoms, anti-social behaviour, from low-income or single parent families. They recommended to target the anti smoking prevent program on children in the age of early elementary schools.

### **3.2 Friends**

Besides the parental smoking and relationship with parents belongs according to some papers best friends, other friends and relationship between members of the same social group in general too (Vries, 2003). The authors had three hypotheses in this paper: in *time one* the small children are more influenced by their best friend; later in *time two* they have already decided to smoke or not, so the influence by their best friend is much lower; impact of parents is in both *times* the same. They confirmed these hypotheses. In the *time one* behaviour of best friends and friends strongly effected initiation of children smoking. They introduced two models in the *time two*. The first one was with variable if the child decided to smoke or not in time one. The second one was without this variable. Although the period between *times one* and *two* was only one year, smoking in *time two* was best explained by this variable. The second model had adjusted coefficient of determination about 0.02. Parents had similarly small influence in the both *times*.

They could be smaller, because the children often change their best friendships, especially in adolescence, but the group of friend stays the same. They suggested letting the children make list of friends into questionnaire and then compare the difference. In my opinion this decreases the level of anonymous and could increase the ratio of children's refusals to participate.

Group of scientists from Fred Hutchinson Cancer Research Center in Seattle focused more closely on smoking as a result of friendship with smokers (Bricker et al., 2006, 1). They

did not only research if influenced child started to smoke or not, but they also divided influencing into three stages. In the first stage a child experiments only; in the second one the best friend affects them to smoke monthly; in last stage they influences the child to smoke daily. They used the same dataset from Hutchinson Smoking Prevention Project as Anderson et al. in previous chapter. They found out that probability of influence by close friends in the first transition (no smoker to experimenting) is about 38% and then 10% and 11% in the second and the third transition (to monthly and daily smoker). Influence by parents is variable: 26% 13% and 27%. It means that the first cigarette is smoked much more due to the best friend, there is not any significant difference between influencing by parents and by best friend in the second transition and daily frequency of smoking could be due to the parents.

Bricker et al. (2006, 2) wrote another paper where they added new influence by older siblings into the original model. It is questionable, because they defined it by question put to parents. They were asked if their older children, who are in 4<sup>th</sup> grade and higher, smoked. It is possible that older siblings smoked, but parents did not know about it and answered zero. Unfortunately, according to them dataset with self reported older sibling smoking did not exist. They did not focus on dividing initiation of smoking into three stages. They worked with probability that parents, close friends or older sibling influence children to smoke daily. The results were similar: 11%, 9%, and 7%. They themselves wrote about contrast with previous study, where parents had higher probability. The others factor also had more than half higher probability (16%) and they did not explain it.

Last paper which is needed to be mentioned in this chapter is about opposite evolution of relative influence of parents and close friends. Academics from Canada (Vitaro et al., 2004) focused on first transition from no smoking to experiment or start smoking in three periods of adolescence. In each of them, they measured the influence of close friends and parents. Main predictors in the children's age 11-12 years were their behavioural, academic maladjustment and parent's smoking. The group of children who started to smoke at the age of 12-13 years was also influenced by their friends, but the last group of children between 13 and 14 years was affected only by friends, because the rest of factors were insignificant.

### ***3.3 Anti-smoking advertisement and programs in schools***

The parents and the close friends are not only factors. The television, the newspaper, the internet, the public transport, shops and sometimes the school are places where people are influenced by advertisement. Fortunately, the most of the developed countries in Europe and North America forbade pro tobacco advertisements and it was replaced by anti smoking

campaigns and projects. However, what is the probability that it can discourage children from smoking?

Through cooperation of Australian and American specialists the review of many empirical studies was created (Wakefield et al. 2003) in which they tried to summarize all known information and draw some priorities for further research. At first, they described surveys in Finland and several states of the USA. In one survey from Finland they divided six schools into two groups. Children in 7<sup>th</sup> grade of four schools in North Karelia were exposed to anti smoking programs in mass media and their teachers or external workers discussed smoking and health with them. Rest two schools in another province served as a control group, which was not affected. After four, eight and even fifteen years they measured share of the smokers and other statistics. The results showed that advertisement and school projects protected children only in the age of early adolescence and only against the initiation of smoking. Later non smokers stayed non smokers and current smokers did not want to quit. Moreover, it is not clear which of advertisement or school projects were more helpful. Similar surveys with the same conclusions were carried out in Minnesota and California.

Another survey described by Wakefield in Montana and Vermont compared differences between the group of children affected by school projects and advertisement in mass media and the group of children affected only by school projects. Not surprisingly the effect in the first group was significantly higher. But the interesting explanations of why girls are more affected by advertisement appeared: advertisements were more often broadcasted in programs targeting girls; girls can create friendships without being a smoker more likely than boys; beginning of girls' adolescence is earlier.

In general the anti smoking advertisement obviously has the effect on children, but different types of advertisement and campaigns have different influence. The second part of Wakefield's paper focuses on this issue which was measured by many methods: opinions from discussion after watching advertisements; questionnaire with rating of advertisements which children remember or have just watched; summary from similar papers. Pictures illustrating health consequences of smoking were rated high, on the other side, the campaigns that suggested to children to make a choice if to smoke or not were rated low. Different influence could be also explained by variability in the form of advertisements (casting, sound or lightning) or by tradition of anti smoking campaigns in particular states. Some of them could be more sophisticated, and so they are inappropriate for children or could be part of the complex, meaning nothing by themselves.

## **4 Econometric model**

The fourth chapter of this paper contains the core of my own thoughts and research. In the part below I focus on the relationship of being smoker and other variables in three different places and time. The first part is about datasets that have been used. Two of them are extracted from GYTS in the Czech Republic in 2002 and 2007 and the third one is taken from NYTS in the USA in 2009. The second part describes econometric methods, which could be useful to estimate the parameters. The ones which estimate results are explained in more details. The results are divided into two parts: descriptive statistics where the situation and progress of the Czech Republic and the USA are explained in numbers; results of estimates of models. Given to more complicated logit and probit models' interpretation, the last part of this chapter is only about interpretation.

### **4.1 Datasets**

The GYTS questionnaire consists of 58 and 60 questions, and the NYTS one has 81 questions which most of them have more than two possible answers. Because of this two problems appear. Although each survey has more than three thousands observations, the models cannot have sixty or eighty independent variables. It is impossible even due to interpretations. The task is to choose several questions that are the most corresponding to factors listed in chapter 3. The dependent variable is dummy with one when the child is the current smoker. To extract this variable from question about frequency of smoking in the last month is quite intuitive. Answer "zero times" gets this variable zero and the other answers "one" and "more times" get one. But the rest of variables cannot be extracted from answers so simply and need to be more explained or interpreted. All variables are dummy.

#### **4.1.1 CZE 2002 and 2007**

The questionnaires of GYTS in the Czech Republic in 2002 and 2007 are very similar and the questions that are important for this paper are the same. Therefore, this chapter covers explanations of variables only for questionnaire in 2002.

The dependent dummy variable (1 if current smoker) is defined according to question "During the past 30 days (one month), on how many days did you smoke cigarettes?" where first answer "0 days" means zero and rest of answers (six intervals of frequency) means one. It results, that even one day of smoking is enough to be categorized as the current smoker.

Because of some mentions in the described papers above it would be right to include sex of children. This variable is one if the answer is "Female" and is only one from questions



about personal characteristics. There is no complication in the factor of smoking of parents, too. The variable is one in case of smoking of either one or both of the parents.

Question about friends' smoking "Do any of your closest friends smoke cigarettes?" is more complicated because of four answers. For more precise estimated parameters, I decided to make two dummy variables. The first one is one if the answer "Some of them" was chosen. Second one is one if answers "Most of them" or "All of them" were chosen. Of course, both variables are zero if "None of them" was marked.

Next two dummy variables are about anti-smoking advertisement and campaigns and school projects or lessons. The question "During the past 30 days (one month), how many anti smoking media messages (e.g. television, radio, billboards, posters, newspapers, magazines, movies) have you seen or heard?" makes extracting about anti smoking campaigns easier because it includes all mass media. But it is also imprecise, because it is impossible to identify in which mass media the anti smoking message has the highest effect. The answers "A lot" and "A few" mean, that student has seen or heard some of them and could be influenced by them. So the variable is one if they answered "None". The question, if they were taught about the dangers of smoking, had three possible answers: "Yes", "No", "Not sure". If they answered "Not sure", one can assume that they did not remember it, so they could not be affected by it. It is the reason why this variable is zero only with answer "Yes".

Pro smoking advertisement and passive (second-hand) smoking are factors that have not been mentioned in this paper yet, but they could have some effect. There are four explanatory variables to identify what advertisement has the highest effect and therefore should be forbidden. Variables are zero if students chose answer "Never" on the question how many advertisements they had seen in the newspaper, TV, billboards or in the sport events during last month. Answers "A lot" or "A few" mean one, because in both cases they could be influenced. The problem of passive smoking could be solved by question "During the past 7 days, on how many days have people smoked in your home, in your presence?" This question has five answers again, so two dummy variables are appropriate: zero days means zero for both; one to four days means one for the first one; five to seven days means one for the second one.

It is obvious, that all of explanatory variables are dummy variables and they are one if the effect of factors increases the probability of being a smoker. It means that all significant variables in the model should have positive parameters. The observations with at least one missing answer were not included. Both dataset have about 3 500 observations.

### 4.1.2 The USA 2009

Fortunately, it is possible to find the most of the Czech GYTS questions in NYTS questionnaire too. Some of them are formulated different and several questions miss, so they should be replaced by others. The question creating the dependent variables is the same, so again answer “0 days” gets zero and the rest six answers get one. Furthermore, answer “Female” means one for dummy variable sex.

NYTS includes no question about the parent smoking, but the question “Does anyone who lives with you now smoke cigarettes?” is more sophisticated, because even grandparents or smoking siblings can influence the child. So this dummy variable is one if the answer “Yes” was chosen. Question about friends’ smoking is more concrete than the Czech one, but it needs two dummy variables too. “How many of your four closest friends smoke cigarettes?” has six answers: both dummy is zero if “None”; first dummy is one if “One” or “Two”; second dummy is one if “Three” or “Four”. Answer “Not sure” is considered as missing because of these reasons: if the child does not know about friend’s smoking, it is not their close friend; if the child does not know about friend’s smoking, it could not influence them to smoke; the child does not know how many of their friend smoke so which dummy should be one. These reasons are explained in more details, because this answer was chosen by more than ten percent of students.

The same question about learning of dangers of tobacco use at schools during last year makes next dummy variable one if answer “No” or “Not sure” were chosen. With anti-smoking messages in mass media it is more complicated, because there is one question for each medium, together five questions “During the past 30 days, how many times did you see anti-smoking messages ...?": ...on TV, on the radio, on the internet, on billboards or outdoor signs, in magazines or newspapers. For more precise estimators, all of them are include as a single dummy variable. With the assumption that children could not be influenced by anti-smoking messages when they had not seen it, these dummy variables equal one if they answered “None” or “I did not watch TV/ listen to the radio/ use the Internet/ read magazines or newspapers”.

In the same way another three dummy variables represent pro tobacco advertisement in the magazines or newspapers, on the internet and in the stores, or supermarkets. If children answered “Hardly ever”, “Never”, or they do not use the internet or read newspapers, dummy variables are zero.

The question about smoking in children’s present is the same, so again two dummy variables are created according to frequency of smoking during the past seven days: “0 days”

get zero for both; “1 or 2 days” or “3 or 4 days” gets 1 to the first one; “5 or 6 days” or “7 days” gets 1 to the second one.

Original dataset has more than 22 thousand observations, but for purposes of this paper only 13-, 14- and 15-year-old children are included. Excluding observations with at least one missing answer and unclear answer (friends’ smoking) the final dataset has more than 7.5 thousand observations.

## **4.2 Methods**

In view of the fact that the dependent variable in all three datasets is a dummy variable, there are three possible methods to estimate the parameters (Wooldridge, 2006). The method which uses the ordinary least squares is called the linear probability model and is described in the first part. However, more sophisticated way to get estimators is given by probit model and logit model, which both use the technique of maximizing log-likelihood function. These two methods are the main ones for this paper and therefore they are analysed in more details in the second part.

### **4.2.1 Linear probability model**

The key point of all the three methods is transforming the dependent dummy variable into the probability getting one (in this case it is probability of being smoker). If the probability is a linear function of the others model’s variables, it is defined as linear probability model (LPM). This model has the great advantage, that the estimate parameters could be interpreted easily. All estimate parameters show how much higher or lower (according to sign of the parameter) the probability is. If all independent dummy variables are zero, the probability of being smoker is equal to estimate constant. The datasets are created in this way: if at least one of the dummy variables is one, the probability is higher. It means that the probability is highest when all independent variables equal one.

LPM is problematic in two ways. In general, the eventual probability could be less than zero or more than one. In this case it could occur when all independent variables are zero and the constant is negative. Then there is no explanation of negative probability. On the other hand, if the sum of all estimate parameters is greater than one, there could be a person whose probability of being smoker is also higher than one. The quantitative independent variables increase the probability constantly with another unit of variable, so the probability could easily reach zero or one. This problem is solved again due to the reason that all independent variables are dummy variables.

Although the LPM always has heteroskedasticity, I use this method to get at least approximate estimators, and to interpret it simpler.

#### 4.2.2 Probit and logit models

The main reason to use the probit and the logit model is that the probability never overruns zero or one. It is because the probability is not given by linear function, but by new function which takes the values between zero and one and which has the original linear function as its internal function. This new function could be various, but for the logit model it is the cumulative distribution function for a standard logistic random variable and for the probit model it is the standard normal cumulative distribution function.

In spite of the fact, that both methods are sophisticated, it is really difficult to interpret the estimators due to nonlinear nature of the external function. One could simply interpret the sign of parameters, because the negative sign decreases the probability and positive sign increases the probability. For these reasons, all independent variables in this paper's probit and logit model should have positive sign. In general, the calculus is needed to find the effect of the continuous explanatory variable, simply because the rate of effect changes with different values of explanatory variable. Partial derivative helps to get this partial effect. Due to discrete and even binary nature of all explanatory variables, the calculus is simpler: the difference between two external functions, if one of them has dummy variable different, shows the effect of this variable on the probability.

It has to be noted, that neither probit or logit model does not use the method of ordinary least squares because of the nonlinearity of the external function. Instead of it they use maximum likelihood estimation.

#### 4.2.3 Equations of the model

The econometric model that is estimated as a linear probability model looks as follows:

$$P(y = 1|x) = \beta_0 + \sum_{i=1}^n \beta_i x_i \quad (1)$$

where  $y$  is dependent dummy variable,  $\beta_0$  is constant,  $\beta_i$  is parameter of explanatory dummy variable  $x_i$ . The basic equation for the logit and probit model is figured below:

$$P(y = 1|x) = G\left(\beta_0 + \sum_{i=1}^n \beta_i x_i\right) \quad (2)$$

where  $y$  is dependent dummy variable,  $\beta_0$  is constant,  $\beta_i$  is parameter of explanatory dummy variable  $x_i$  and  $G$  is external function which is different for probit and for logit model. In the logit model,  $G$  looks as follow:

$$G(z) = \frac{\exp(z)}{1 + \exp(z)} \quad (3)$$

where  $z$  is internal function from equation (2). Probit model has  $G$  external function:

$$G(z) = \int_{-\infty}^z \frac{\exp\left(\frac{-z^2}{2}\right)}{\sqrt{2\pi}} dz \quad (4)$$

where  $z$  is internal function from equation (2).

### 4.3 Results

This chapter is divided into two parts. The first one explains the results of descriptive statistics of all three datasets. It allows to show evolution in the Czech Republic during five years, and to compare situation in the Czech Republic and in the USA. It is important, because it can indicate the first conclusions of this paper. The other part summarises results of all the three models in econometric view. The interpretation of the models' results is discussed separately in the next chapter.

#### 4.3.1 Descriptive Statistics

Most of the papers which deals issues of smoking children built their theories and conclusions on descriptive statistics. The important reason is that scientists, policymakers, as well as society need to know the situation and characteristics of this issue. The situation in the Czech Republic and in the USA were slightly analysed in the first chapter through discussion about other papers. Following results come from datasets which have been recreated for the purposes of this paper.

Sex of the children is only one demographic attribute in the datasets. The distribution between male and female is in the table below. The American dataset has a little bit more girls than the Czech one, but one can say that the difference is almost insignificant.

**Table 2: Sex of respondents**

	CZE 2002	CZE 2007	USA 2009
Boy	50.4%	51.9%	48.3%
Girl	49.6%	48.1%	51.7%

Source: GYTS CZE 2002, 2007, NYTS 2009

The next table shows the most important information of datasets and it is about frequency of smoking in the last month. It shows the differences between boys and girls in each country and time.

**Table 3: Frequency of smoking in last 30 days**

	CZE 2002			CZE 2007			USA 2009		
	All	Boys	Girls	All	Boys	Girls	All	Boys	Girls
0 days	65.2%	65.5%	64.9%	72.6%	74.4%	70.6%	91.8%	91.1%	92.4%
1-2 days	8.4%	7.9%	8.9%	7.9%	7.2%	8.6%	2.7%	3.0%	2.5%
3-5 days	4.9%	5.4%	4.4%	3.8%	3.4%	4.2%	1.5%	1.3%	1.8%
6-9 days	3.8%	3.6%	4.0%	3.1%	3.4%	2.9%	0.8%	0.7%	0.8%
10-19 days	4.9%	4.5%	5.3%	4.0%	3.7%	4.2%	1.0%	1.0%	1.1%
20-29 days	4.9%	4.8%	4.9%	3.6%	3.2%	4.1%	0.8%	1.0%	0.7%
All 30 days	8.0%	8.4%	7.5%	5.0%	4.7%	5.3%	1.3%	1.9%	0.8%

Source: GYTS CZE 2002, 2007, NYTS 2009

As this paper assumes, the share of non-smokers in the USA is much greater than in the Czech Republic. While only every twelfth child smoked in the USA, there were four times more Czechs, almost one third in 2002. Good information could be that this is a little bit better situation after five years in 2007. – Every fourth child smoked. Unfortunately the measure of smoking girls is almost 15% higher than the boys' one. Possible explanation of this fact could be more tobacco advertisement targeting female, as mentioned in the first chapter, but this is not consistent with results of the year 2002. The opposite relationship between boys and girls who smoke more than twenty days in the month is in the USA, where the measure of smoking boys is twice higher.

Two most mentioned factors which significantly influence children's smoking are smoking friends and smoking of someone in the same household, most often parents. Situation in the Czech Republic has become better because of decreasing share of smoking parents. However, although American questionnaire NYTS counts every person in the households, including smoking siblings or grandparents, children have greater chance to live in smokeless environment.

**Table 4: Answers on questions about parents, households and friends**

	Parents		Household		Friends			
	CZE 2002	CZE 2007	USA 2009		CZE 2002	CZE 2007	USA 2009	
Neither of them	45.7%	49.4%	No	65.1%	None	17.7%	19.8%	72.7%
Both	21.6%	18.8%	Yes	34.9%	Some (1-2)	49.3%	53.5%	17.2%
Only father	21.7%	20.9%			Most (3-4)	33.1%	26.7%	10.0%
Only mother	9.7%	9.7%						
Do not know	1.3%	1.2%						

Source: GYTS CZE 2002, 2007, NYTS 2009

Absolutely greatest difference is in the category of smoking friends. More than 80% of Czechs had one smoking friend minimally. The form of questions in each questionnaire could explain this information. The American's one answered how many of four closest friends

smoke, but the Czech one was more general, because the question did not limit number of the closest friends.

The share of children who remembered something about danger of smoking from the school is quite the same in both countries. The number is between 57% and 63% and the American share is just in the middle of this interval. The anti-smoking messages in mass media were in the USA less effective, because the rate of children who had not seen any was stable around 68 percent in category radio, the internet and magazines. The only exception is TV with its rate around one fourth. 23% of Czech children did not see any anti-smoking message in all mass media together in 2002 and this rate even decreased to 18% in 2007.

If the smoking in the presence of the child can influence them at all, the probability of it is higher in the Czech Republic than in the USA. All the three datasets show, that the rate of no smoking in the presence is 60%. However, the rate of smoking more than five days in one week in their presence is approximately 22% or 20% in the Czech Republic. This rate is only 14% in the USA.

#### **4.3.2 Models' results**

The dependent dummy variable was obtained in three datasets and each of them was estimated by three different methods. There are nine models altogether, which were estimated by econometric software Gretl<sup>5</sup>.

Three linear probability models, which were estimated by ordinary least squares, are significant according to zero p-value of F-tests. As it is described in the chapter about methods, White tests of heteroskedasticity rejected the null hypothesis about homoskedasticity. The null hypothesis about normally distributed errors was rejected, too. The collinearity or multicollinearity did not occur in the models. The number of observations and adjusted coefficient of determination are presented in the table. There are estimated parameters in the first row of each variable and number of stars shows the level of significance (1%, 5%, 10%), on which the null hypothesis (parameter equals zero) was rejected. The numbers in the second row in italics are t-statistics. The linear probability models finally could be useful, because their main disadvantages, that fitted probability is more than one or less than zero, could not happen. The sums of all significant positive parameters are 0.96, 0.89 and 0.73 and there are not significant negative parameters in the Czech datasets. The only exception is variable Female in the American dataset, which has estimated parameter -0.03.

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<sup>5</sup> Gretl 1.9.1, URL: <http://gretl.sourceforge.net>

**Table 5: Estimate parameters of all models**

	Linear probability model			Logit model			Probit model		
	CZE 2002	CZE 2007	USA 2009	CZE 2002	CZE 2007	USA 2009	CZE 2002	CZE 2007	USA 2009
Observation	3497	3294	7745	3497	3294	7745	3497	3294	7745
Constant	0.0450 <i>1.48</i>	-0.0349 <i>-1.37</i>	-0.0072 <i>-0.80</i>	-2.9897 *** <i>-12.36</i>	-4.1573 *** <i>-14.21</i>	-4.9892 *** <i>-23.41</i>	-1.6677 *** <i>-13.28</i>	-2.2502 *** <i>-16.49</i>	-2.5448 *** <i>-25.05</i>
Female	-0.0222 <i>-1.63</i>	0.0171 <i>1.26</i>	-0.0261 *** <i>-4.88</i>	-0.1347 <i>-1.57</i>	0.1207 <i>1.33</i>	-0.4611 *** <i>-4.56</i>	-0.0892 * <i>-1.80</i>	0.0650 <i>1.24</i>	-0.2616 *** <i>-4.84</i>
Household	0.0944 *** <i>5.45</i>	0.0730 *** <i>4.29</i>	0.0101 <i>1.59</i>	0.5942 *** <i>5.58</i>	0.5033 *** <i>4.47</i>	0.3111 *** <i>2.72</i>	0.3358 *** <i>5.41</i>	0.2871 *** <i>4.39</i>	0.1565 *** <i>2.58</i>
Some friends	0.1504 *** <i>7.97</i>	0.1537 *** <i>8.55</i>	0.1197 *** <i>16.22</i>	1.5417 *** <i>8.13</i>	2.1854 *** <i>8.36</i>	2.3468 *** <i>15.89</i>	0.7991 *** <i>8.77</i>	1.0721 *** <i>9.50</i>	1.0954 *** <i>16.49</i>
Most friends	0.5907 *** <i>28.29</i>	0.5366 *** <i>25.86</i>	0.3898 *** <i>40.81</i>	3.5004 *** <i>18.15</i>	3.9159 *** <i>14.84</i>	3.6386 *** <i>24.48</i>	1.9981 *** <i>21.16</i>	2.1247 *** <i>18.29</i>	1.8592 *** <i>26.56</i>
Anti-smoking	-0.0123 <i>-0.75</i>	0.0289 <i>1.60</i>		-0.0849 <i>-0.83</i>	0.2059 * <i>1.75</i>		-0.0457 <i>-0.77</i>	0.1208 * <i>1.76</i>	
Anti-smoking TV			-0.0014 <i>-0.20</i>			-0.0610 <i>-0.47</i>			0.0046 <i>0.07</i>
Anti-smoking radio			0.0107 * <i>1.76</i>			0.1871 <i>1.61</i>			0.0904 <i>1.47</i>
Anti-smoking internet			0.0022 <i>0.36</i>			-0.0050 <i>-0.04</i>			-0.0035 <i>-0.06</i>
Anti-smoking billboards			-0.0031 <i>-0.54</i>			-0.0848 <i>-0.77</i>			-0.0454 <i>-0.77</i>
Anti-smoking newspaper			-0.0004 <i>-0.07</i>			-0.0238 <i>-0.21</i>			-0.0138 <i>-0.23</i>
School project	0.0303 ** <i>2.14</i>	0.0060 <i>0.43</i>	0.0114 ** <i>2.08</i>	0.1920 ** <i>2.16</i>	0.0298 <i>0.32</i>	0.2136 ** <i>2.11</i>	0.1131 ** <i>2.20</i>	0.0168 <i>0.31</i>	0.1304 ** <i>2.42</i>
Advertisement TV	-0.0295 <i>-1.49</i>	-0.0231 <i>-1.39</i>		-0.1922 <i>-1.57</i>	-0.1586 <i>-1.41</i>		-0.1084 <i>-1.51</i>	-0.0836 <i>-1.28</i>	
Advertisement billboards	-0.0313 <i>-1.47</i>	0.0148 <i>0.81</i>		-0.1978 <i>-1.51</i>	0.1068 <i>0.86</i>		-0.1122 <i>-1.47</i>	0.0654 <i>0.91</i>	
Advertisement newspaper	0.0025 <i>0.13</i>	-0.0062 <i>-0.37</i>	0.0192 *** <i>3.10</i>	0.0085 <i>0.07</i>	-0.0364 <i>-0.32</i>	0.3147 *** <i>0.28</i>	0.0036 <i>0.05</i>	-0.0212 <i>-0.33</i>	0.1665 *** <i>0.36</i>
Advertisement sport	0.0233 <i>1.46</i>	0.0248 <i>1.64</i>		0.1503 <i>1.49</i>	0.1678 <i>1.64</i>		0.0882 <i>1.51</i>	0.0932 <i>1.57</i>	
Advertisement internet			0.0013 <i>0.21</i>			0.0309 <i>2.91</i>			0.0209 <i>2.86</i>
Advertisement supermarket			-0.0089 <i>-1.21</i>			-0.2366 <i>-1.52</i>			-0.1496 * <i>-1.88</i>
Some presence	0.0346 * <i>1.68</i>	0.0504 ** <i>2.44</i>	0.0482 *** <i>7.06</i>	0.2088 * <i>1.71</i>	0.3074 ** <i>2.38</i>	1.2023 *** <i>8.81</i>	0.1220 * <i>1.70</i>	0.1807 ** <i>2.38</i>	0.5960 *** <i>8.75</i>
Most presence	0.0588 *** <i>2.84</i>	0.0754 *** <i>3.59</i>	0.1287 *** <i>13.83</i>	0.3096 ** <i>2.55</i>	0.4122 *** <i>3.19</i>	1.6643 *** <i>11.06</i>	0.1853 *** <i>2.58</i>	0.2448 *** <i>3.20</i>	0.8683 *** <i>11.18</i>
Adj. R2	0.2963	0.2443	0.2776	0.2417	0.2164	0.3742	0.2413	0.2163	0.3732
% corr. pred.				78.1%	78.9%	92.9%	78.2%	78.9%	92.9%

Source: GYTS CZE 2002, 2007, NYTS 2009

Three logit models and three probit models were estimated by maximum likelihood estimation, so some characteristics are different. Firstly, the numbers in italics are not t-statistic, but z-statistic and the values of adjusted McFadden coefficient of determination are in the row with coefficient of determination. There is another characteristic in the last row that can show the quality of the model. The percent predicted is defined as percentage of times the predicted dependent variable matches the actual dependent variable (Wooldridge, 2006), where the predicted dependent variable is one, if counted probability is more than 0.5, and zero else. The percent correctly predicted is quite high in all three datasets, especially dataset of the USA with near 93%. In general, there could be a problem, when the distribution of the



dependent variable is not half zero and half one, especially when most of values are zero or one. This problem is concerns the high value of the USA, because the logit model correctly predicted 97.9% of zero value (non-smokers), but only 37% of one value (smokers).

#### **4.4 Interpretation**

The most significant explanatory variable in all nine models is *Most friends*. It means in the first model (CZE 2002, LPM) that if the most of a child's friends smoke, there is nearly 60% higher probability, that the child is a smoker, too. This number fell down in the next period, but it is still 35% higher than the American one. The influence of *Some friends* is quite similar, about 12 – 15%. According to Vries H. (2003) it could mean, that these children are situated in the *time one*, where the biggest influence is right the friends' one. Because of specific definition of smoker according to questions about frequency of smoking in the last month, the model and its results do not contain information how much friends could affected the frequency smoking. This is main reason why the results of this model could not be compared with the paper of Bricker et al. (2006), which focused on the influence of friends to make the daily smoker from an experimental smoker.

The second mentioned factor includes parents and households. It is quite interesting, that the effect of smoking parents or someone else in households is very small compared to friends' effect. The linear probability model of American dataset even indicates this variable as insignificant. Maybe it could be explained by the structure of the model. The American questions show these reasons more clearly. There are two explanatory variables which both outline home smoking, whether it is parents' or households' smoking or smoking in the presence of children at home. The second one is significant, too. The sum of parameters of variables *Household*, *Most presence*, which means that parents smoke and often in the presence of the child, is in the USA LPM model even higher than *Some friends*. The Czech's sum is lower, but still comparable. The second Bricker's paper (2006, 2) also cover smoking siblings and for that reason corresponds to this situations. If the variable *Most friends* was insignificant, the results that effect parents, siblings and friends are the same correspond, too. However, this thought is only hypothetical.

Facts about girls smoking are quite interesting, because information from previous chapter tells, that there are less smoking girls than boys in the USA and in the Czech Republic in 2007, but the effect of sex was proved only in American datasets. Also the probit model of dataset of the Czech Republic in 2002 has significant variable *Female* on 10% level of

significance, but the descriptive statistics does not show any difference between smoking girls and boys. The influence in the USA could be explained by some thoughts that were described in the third chapter. One of the examples was the fact, that girls can create friendships without being a smoker more likely than boys. However in general, the decreasing of the probability is not so high across all the American models to make any serious conclusions.

Last significant explanatory variable is *School project*, which confirms the importance of schools in education of children in the sense of leading them to healthy habits. However, there are still much to do, because the variable is significant only on 5% level of significance and in the Czech Republic in 2007 not at all. The question that is behind this variable is a little tricky, too. Children were asked if they had been instructed in danger of smoking in the last year or last semester. Therefore the results of this question depend on time in the year, when the children participated the survey. The model does not include the effects of school projects that were realized one or more years before survey measuring. However, this school projects in early elementary age of children are the most important according to summary of Wakefield (2003).

In general, the anti smoking messages in mass media and even the pro tobacco advertisement have no significant effect on 1% level of significance. Only exception is advertisement in newspaper in the USA, which slightly increase the probability of being smoker. There could be two possible explanations. Firstly, majority of mentioned papers that measured effects of anti smoking campaigns or tobacco advertisement use the dataset from survey of two different groups. One was affected one and the other was control one. In this case the participants were chosen randomly, so none of them was in control group. The probability, that every child had seen at least one message or advertisement was high. The second explanation is based on some kind of human's adaption. Not only children, but also people in general are surrounded by omnipresent advertisements, and so they notice only the most original, funny or else interesting campaign. In connection with almost total ban of tobacco advertisement and maybe common anti smoking campaigns there could be any influences.

It is to be questioned if this model is correct due to the identification problems. Firstly, each explanatory variable could affect dependent variable or the causality is reserved, too. The weakness of this model lies in its most significant variable – *Friends*. As well as friends influence a child, the smoking child (especially a natural group leader with great charisma) can influence their friends. Less probably children can make their parents to smoke and unlikely children's smoking make them blind to notice anti smoking messages.

Next problem is endogeneity of independent variables (Shepherd, 2008). According to OLS conditions the covariance between independent variables and error term must be zero otherwise the estimates are biased and inconsistent. The method of instrumental variable fixes this problem. All three linear probability models have uncorrelated residuals with independent explanatory variables.

Omitted variables are another problem. Wooldridge (2006) defined it as excluding a relevant variable or underspecification of the model and it causes the omitted variables bias. The possibility that the model does not mention the important factors is high. The price of cigarettes or smoking tobacco is high due to excise and so the price elasticity has an effect. Income elasticity has similar effect, but the datasets do not contain the information about disposable income (pocket money) or prices of the cigarettes in the place of measurement. In general, this issue could be called availability of cigarettes and it seems difficult to measure it due to different places where children live. Other factor, which could be called kind of repression, has the same reason of immeasurability. Each school has different repressions for students who smoke, as well as the police officers are more benevolent in some cities. Relationship between parents and children is almost immeasurable, although bad relationship or very benevolent education in a family could lead to higher probability of smoking of a child. Finally, there could be connection between consuming alcohol and smoking marijuana and smoking cigarettes.

## **5 Discussion**

The situation in the Czech Republic is quite better in 2007 than five years later, so the progress is positive. However, reaching similar results of no smoking as in the USA will be difficult and it will take long time.

The model demonstrates that children are most suggestible by their friends. These friends are in the same age and could be also affected by their friends. The progress of decreasing amount of smoking children is clear, so the effects will be lower and the probability of becoming smoker, too. This means, that the decreasing will be faster and faster, which can be called multiplicative effect.

Summary of this model pointed out, that smoking parents should smoke in another room, than their children are. The best way to reduce parents' influence is to make them to quit smoking. However, this is very difficult for policymakers or campaign creators. The anti smoking projects, which teach adult people about harmfulness of passive smoking, are easier

method, especially when it targets parents with small children. It has two outcomes: children are healthier because of decreasing passive smoking and the factors *Some presence* and *Most presence* decrease, too.

Although the anti-smoking campaigns do not seem to be efficient in this model, the school projects could work in a satisfactory manner. The great advantage is that these anti-smoking messages target children directly. The cooperation of Minister of Health and Minister of Education seems to be more efficient in organizing lectures on danger of smoking. This way of decreasing child smoking is easier for policymakers, too. As mentioned in the Chapter three, the more drastic picture of consequences of smoking are, the more are reflected. Thus the campaign of the Ministry of Transport of the Czech Republic, which was called *Nemyslíš, zaplatíš!* and was framed in very realistic way, could serve as an example for anti-smoking campaigns, too.

These projects are released only few times per year, but there should be a stable access to help for children, some kind of child psychologist in schools. These people should help children to quit smoking without punishing them. It surely increases the influence in the model. The positive synergic effect of two factors could occur in so far as schools would cooperate with parents in this education.

The last suggest is applied to repressions mentioned in previous chapter. Obviously, there are many places where children can buy cigarettes or alcohol and the sellers are not afraid of repressions, which are rather low. Changes in the form of higher fines or other hard penalties could decrease the availability of cigarettes.

## Conclusion

Smoking of children is a social problem and there are many different ways how to deal with it. Everyone cares for children's health: international organizations, e.g. World Health Organization, government institutions such as Ministry of Health, management of schools on local level and their parents, of course. Many surveys have concerned it theoretically, with statistical description only. Their results are mostly put in form of percent of population and the influence is only discussed. Some papers with more sophisticated methods use the dataset from survey to estimate econometric models. These models confirm or reject their author's hypothesis about very specific factors.

This paper is more general, because it uses combination of statistical description and econometric models to estimate influence of many factors. The theoretical facts and knowledge sources from more specific papers and datasets come from local surveys, which are organized internationally, and so they are comparable. The results show the differences between children in the USA and in the Czech Republic. This difference is important, because mentioned model tries to find the factors which stay behind the fact that American policy is successful and American children smoke three times less than Czech ones. It is obvious, that Czech policymakers are doing right decisions nowadays and decreasing amount of children smokers is significant.

On the other hand, even if the situation achieves the same satisfactory level as in the USA, there are still other problems affecting both physical and psychological health of children in the Czech Republic alarmingly. The alcohol is cheaper than non-alcoholic beverages here, in general, children are lazier and suffer from civilization diseases more and more.

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