Distributional Effects of Environmentally-Related Taxes: Empirical Applications for the Czech Republic

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Abstract

The aim of the paper is to investigate distributional effects of environmentally related taxation in the Czech Republic. The paper makes two contributions: (i) first, it evaluates ex-post distributional effects of the components of the Czech tax system, and (ii) it estimates the distributional effects of recent proposals of the environmental tax reform. In both quantitative exercises, we use the following concepts: Suits index to measure progressivity of the tax systems and its components, and the Marginal Gini Index to measure changes in inequality indexes caused by taxes.

The empirical exercises use a microsimulation model based on individual data from the 1993-2005 Household Budget Surveys. The ex-analysis reveals that the Czech tax system is slightly progressive, and that the distributional impact of environmentally related taxation is almost neutral, which is caused by the counterbalancing effect of motor-fuel taxation (progressive) and value-added tax on energies (regressive).

To estimate ex-ante distributional effects of selected environmental tax reform proposals, we use estimation results of a demand system for energy and transport. We find that increases in taxation of energies are likely to decrease the progressivity of the tax system, but this effect can be mitigated if revenues are recycled using cuts in the labour-income taxes.

Keywords

Environmentally related taxes, environmental tax reform, tax progressivity; income inequality; Gini index; Suits index;

JEL Classification

D31; D63; I32; C15

1. Introduction & Motivation

The aim of the paper is to measure distributional effects of environmentally related taxation in the Czech Republic. The paper is divided into two parts. The first part evaluates ex-post distributional effects of the components of the Czech tax system, including environmentally related taxes (such as excise tax on motor fuels and value added tax on energies). The second part estimates the distributional effects of selected recent proposals of the environmental tax reform.

The paper is organized as follows. Section 2 describes methodology of income inequalities and tax progressivity measurement. Section 3 discusses tax-system changes and describes data used in the empirical section. The ex-post analysis of distributional and social impacts of taxation (with a particular emphasis on energy taxation) in the Czech Republic is available in Section 4. Section 5 contains results of simulation of ex-ante analysis of selected proposals of the environmental tax reform. The last section concludes and outlines intended directions for future research.

2. Methodology

2.1 Inequality of Distribution

Inequality of a distribution of given phenomena is usually measured by the Gini coefficient (Gini, 1912). The Gini coefficient is a measure of statistical dispersion, with values between 0 and 1. A low Gini coefficient indicates more equal income or wealth distribution, while a high Gini coefficient indicates more unequal distribution. Zero corresponds to perfect equality, while one corresponds to perfect inequality.
The Gini Index is equal to the Gini coefficient multiplied by 100.

Since the Gini coefficient is a measure of dispersion, it can be characterized using the distribution function for income or wealth. The formula for the Gini coefficient is therefore given as follows:

$$G = \frac{1}{E_F X} \int_\Omega \int_\Omega |x - y| dF(x) dF(y),$$

where *F* is the cumulative distribution function, $E_F X = \int_\Omega x dF(x)$ is the mean value of the distribution and Ω is the support of the distribution.

Nevertheless, income inequalities can be measured using other indexes too. One of the most used is so called **The Robin Hood Index**, or The Hoover Index. This index is equal to the portion of the total population income that would have to be redistributed for there to be perfect equality. Graphically it represents the longest vertical distance between the Lorenz curve and the 45 degree line representing perfect equality. Algebraically, it is half of the mean deviation divided by the mean.

Decile ratio or **Ratio 10:1** indexes compares two metrics of incomes; former measures the ratio of the lower bound value of 10^{th} decile to the upper bound of the 1^{st} decile of distribution, while later measures the ratio of the averages of the upper and lowest deciles.

Neither one of these indexes is a member of the Generalized Entropy Family and not thus additively decomposable by population subgroups.

The Theil Index is one of economic inequality measures that belong to the GEF family. The Theil Index is defined as:

$$T = \frac{1}{n}\sum_{i'=1}^{n}\left(\frac{x_i}{\bar{x}}\log\frac{x_i}{\bar{x}}\right),$$

where x_i is the income of the i^{th} person, $\bar{x}$ is the mean and n is the number of people. The first term can be considered the individual's share of aggregate income, while the second term denotes person's income relative to the mean. It is obvious that in the case of perfect equality, the Theil Index is equal to 0. If one person owns everything, then the limit of the index is log N.

An advantage of this measure lies in its decomposability. The Theil index is in fact a weighted average of inequality within subgroups, plus inequality among those subgroups. For example, the Theil index of inequality within the Czech Republic is the weighted average Theil indexes within all regions, weighted by the national income, plus the inequality among regions.[1]

2.2 Polarization Indexes

A related, but distinct, concept to the inequality is the polarization of the income. In other words, a distribution may highly polarized, but with a relatively low index of inequality. Consider, e.g., a situation with two income groups, with a significant difference between mean incomes of each group. Then the decrease in the variability of the income in each group decreases the inequality (since the average distance of agents' incomes decreases), but it increases the polarization (incomes become more polarized). From the technical point of view, the Gini index measures the "average" distance among the incomes, while the polarization measures take into the account the local shape of the distribution.

Technically, there are various indexes, which satisfy the axioms of polarization. Ray et al (2004) show that they can be nested in the following family

[1] If the population is divided into m certain subgroups (regions say) and s_k is the income share of group k, T_k is the Theil index for that subgroup, and $\bar{x}_k$ is the average income in group k, then the Theil index is given as: $T = \sum_{k=1}^{m} s_k T_k + \sum_{k=1}^{m} s_k \log\frac{x_k}{\bar{x}}$.

$$P_\alpha = \frac{1}{E_F X}\int_\Omega\int_\Omega f^\alpha(x)|x-y|dF(x)dF(y),$$

where $0 < \alpha \le 1$ and the meaning of other symbols is the same as in the Gini formula above. Clearly, $P_0 = G$.

A change in the tax system (or in other macroeconomic conditions) can have the opposite impact on the inequality and on the polarization. See Ray et al (1994, 2004) for further discussions.

2.3 Tax Progressivity Measurement

There are two possible approaches to tax progressivity measurement. Either it is possible to use a specific tax progressivity index (such as the Suits Index), or to compute a change in an inequality index (e.g. marginal Gini). The change can be considered either as an absolute change or as a percentage change, which is usually normed by the change in the total public-finance revenues. However, the latter approach is not well defined for revenue-neutral policies (such as Environmental Tax Reform).

The Suits Index was introduced by Suits (1977). It compares cumulated percents of total income (x-axis) and cumulated percents of total tax burden (y-axis). The index is given by

$$S = 1 - L / K,$$

where $L = \int_0^{100} T(x)\,\mathrm{d}x,\ K = 5000$.

The function *T* characterizes the tax payments by a household with income *x, i.e. it i*s an accumulated percentage of total tax burden for given household group.

An alternative option for tax progressivity measurement can be based on calculating changes in some of income inequality indexes. Progressivity of tax changes can be measured by for instance **Marginal Gini Index** that was originally proposed by Jorgensen and Pedersen (2000), and then applied by Wier et al. (2005) to analyse progressivity of energy taxes in Denmark. Progressivity of a marginal tax change is there calculated as a difference between the Gini Index given after tax change and the Gini Index before tax change. Positive changes in the marginal Gini index then indicate regressive burden of concerned policy. Likewise, it is possible to define the **Marginal Polarization Index** as a change in the polarization index due to the tax change.

2.4 Statistical inference

The application of inequality and tax-progressivity indexes to a real-world samples yields estimates of the true, but unknown, indexes and thus it makes sense to derive the underlying statistical distributions for testing and inference purposes.

The indexes can be used either non-parametericaly, i.e., without any parametric assumptions on the underlying distribution. In such case, the Gini index can be estimated as follows:

For a population uniform on the values y_i, i = 1 to n, indexed in non-decreasing order, the Gini coefficient can be calculated as follows:

$$G = \frac{1}{n}\left(n + 1 - 2\left[\frac{\sum_{i=1}^{n}(n+1-i)y_i}{\sum_{i'=1}^{n} y_i} \right] \right),$$

The formula is also a consistent estimator of the Gini coefficient for a random sample, although in some case the first term (1/n) is replaced by 1/(n-1). This replacement is however almost irrelevant for large samples, and it does not jeopardize the consistency of the estimator.

The other possibilities to estimate the Gini coefficient is to estimate the Lorenz curve (either parametrically or non-parametrically) and then to integrate the Lorenz-curve estimate, or to estimate the area below the Lorenz curve by the trapezoid rule. The trapezoid rule approach can be considered as a non-parametric estimation *sui generis* and then the estimation of the Gini coefficient takes the form:

$$G = 1 - \sum_{i=2}^{n}(x_i - x_{i-1})(y_i + y_{i-1}) \,.$$

The analogical situation applies to the Suits index. If a sample of n data on households' incomes and tax payments are available, then the integral L can be approximated by the trapezoid rule as follows:

$$L \equiv \int_0^{100} T(x)\,\mathrm{d}x \cong \sum_{i=1}^{n} \frac{1}{2}\left[T(x_i) + T(x_{i-1})\right]\left(x_i - x_{i-1}\right),$$

where x_i is accumulated percentage of total income of, i equals to a number of household groups, and $x_0 = T(x_0) = 0$ by convention. An alternative approach may be to use splines or kernels to estimate the function T and to directly integrate this estimate. In any case, it is evident that $S \in \langle -1,1 \rangle$, where a negative number of the Suits Index indicates a regressive tax change, while a positive magnitude refers to tax progressivity (zero indicates a flat tax).

Similarly, Ray et al (2004) discuss non-parametric estimation of the polarization indexes.

Alternatively, the Gini and polarization indexes can be estimated parametrically. If a distribution function for income (or wealth) is specified, then one can estimate its parameters and then use the exact integral formulas to estimate the indexes. The popular choice is to fit the Singh-Maddala distribution, for which there are closed form formulae for both Gini and Theil indexes.

The possible problem with Singh-Maddala distribution is its unimodality, which may not be the case in data. Therefore, in this paper, we use also the semi-parametric approach. We fit the distribution using the normal mixture model, i.e. we approximate the true density by the mixture of the normal densities:

$$f(x) \cong \sum a_i \varphi(x \mid \mu_i, \sigma^2),$$

where $\varphi(x \mid \mu_i, \sigma^2)$ is the normal density with the mean μ_i and the common variance σ^2. The coefficients are required to satisfy: $\sum_i a_i = 1$, $a_i \geq 0$. The fit is done using the EM algorithm, which ensures the convergence. Although, the integrals which define the Gini and polarization measures cannot be derived easily in the closed form, it is possible to evaluate them numerically.

In our applications, we numerically evaluate them using the subspace sequences.

$$P_\alpha = \frac{1}{E_F X} \int_\Omega \int_\Omega f^\alpha(x) |x-y| dF(x) dF(y) = \frac{1}{2E_F X} \frac{1}{R} \sum_{r=1}^{R} \left| y_1{}^r - y_2{}^r \right| f^\alpha(y_1{}^r),$$

where $y_i^r = \Phi^{-1}(x_i{}^r)$, with Φ^{-1} is the inverse to the cumulative distribution function of the fitted distribution, $\{x_i^r\}_{r=1}^R$ are two Halton sequences (based on different primes), and we set $R = 10^4$.

The issue is the estimation of the variance of the estimators. An obvious approach is to use an asymptotic expansion of the underlying estimator, (in most cases researchers use the normal approximation based on the expansion up to the second order of a parametric model). The problem with this approach is that many measures are bounded (the Gini index lies in the interval [0 1], the Suits index lies in [-1 1], while the Theil index is bounded from below) and the asymptotic normal approximation is poor if an index takes a value near its boundary.

An obvious alternative is the percentile bootstrap (also wild bootstrap) introduced by Mills and Zandvakili (1997). The idea of the percentile bootstrap is simple: many times to resample the original sample, compute the statistics of interest for each resampled data, and then to approximate its distribution with the empirical distributional function of these values. However, Davidson and Flachaire (2007) argue that the percentile bootstrap does not yield an improvement over the asymptotic expansion and that – due to the presence of influential observations – both approaches fail to give accurate results. They propose the moon bootstrap as a solution to this problem. The moon bootstrap resamples the block of m observations from the set of n observations (hence the name: *m out n*).

We inquire how the observations are influential and thus we compute the histograms of percentage changes in inequality indexes after dropping a particular observation. The results for the non-parametrically estimated Gini index are shown in Figure II-1 and for Theil index in Figure II-2, and the histograms are computed for years 1993-2005. An observation is said to be influential if its remove has a large effect on the index. The results suggest that (i) the Gini index is rather robust (a removal of an observation rarely causes a percentage change in the index greater than 1%), and

(ii) the both indexes are more robust for later years. We may speculate that this reflects an improvement in data quality. The conclusion is that for the Gini index the percentile bootstrap is an appropriate method, while tests and confidence intervals for the Theil index can be improve by using another approach than the percentile bootstrap (especially for years 1993-1996). From 2003 on, the Theil index seems to be robust too. Also the variances of the estimates of the polarization measures are computed using the bootstrap.

3. A Description of the Czech Tax System and of Data

In this section, we briefly describe the Czech tax system and data used in the two exercises: the ex-post analysis of the Czech tax system and the ex-ante analysis of the distributional effects of the environmental tax reform proposals.

3.1 The Czech Tax System 1993-2005

The Czech tax system was established in the year 1993, when a new tax reform entered in force. Since 1993, the tax system and structure have become comparable with those of the EU Member States.

A major part of tax revenues originate from labour taxation; direct labour tax contributes by about 14%, and social-security contributions by even 40%. Revenues from VAT give another 20%, while excise taxes on energy products provide 7% of total tax revenues. Taxing profits generates about 10%; see[2] Figure 3-I, more details in Ščasný, 2005).

A detailed analysis of the Czech tax system and its changes is given by Brůha and Ščasný (2006a). Here we provide only a brief description of the system changes. The labour tax was based on five income bands with marginal rates ranging from 15% up to 47%; see Figure 3-II. A reduction in the number of income bands – in 1996 and 2000 – and keeping labour tax rates unchanged over 1993-2005 tended to lower labour tax progressivity. Since tax bands were nominally adjusted due to price level changes, bands were almost constant in real terms. This fact tends to increase labour tax progressivity due to increase in real wages. The real values of the bands significantly dropped due to a high inflation rate only during 1994 to 1996.

The social dimension of the labour tax is incorporated through i] progressive tax rate, and ii] tax deductibles from the tax base. Tax deductibles were set according to the number and the age of children and the number of disabled people in the household. Due to a nominal indexation, level of deductibles for employees remained almost unchanged in real terms over analysed period. A significant increase in deductibles per child in 1998 and 1999 might, however, have a positive effect on the income of bigger families.

Income Tax Act Amendment No. 669/2004 had introduced significant changes in labour taxation scheme since January 2005. Firstly, the previous labour tax system based on tax deductibles was replaced by tax credits (7,200 CZK for employee, or

[2] All figures and tables are placed in the Appendix.

6,000 CZK per child). Secondly, the Amendment introduces a shared taxation of couples having at least one dependent child. While the former change in the taxation scheme might be transferred in 2005 household incomes due to possible changes in advanced tax payments, the later adjustment can have only the effect on household's income in following tax year, i.e. in 2006.

The system of obligatory social and health security payments was introduced alongside with overall tax system reform in 1993. Initial system settings remained unchanged over 1993-2007. These payments are *de facto* a linear tax on labour income and are shared by the employees and the employers.

Excise taxes are levied on hydrocarbon fuels and health-damaging goods such as alcohol and tobacco. For the purpose of this paper, we only discuss here energy-related taxation. Excise tax was in fact only levied on propellants (petrol, diesel, oils) due to the tax rebate for fuels used for heating.[3] Changes in VAT rates are also displayed in Figure 3-III.

3.2 Data

We use a micro data for 1993-2005 of the Household Budget Surveys (HBS) collected by the Czech Statistical Office. Households are selected by a non-probability quota sampling technique of households. Basic sample contains the households of employees, self-employed, farmers and pensioners without earnings. The survey is conducted as a permanent observation based on daily records of all household incomes and expenditures. For our analysis, we use only data related to the households participating in the survey for the entire year. In total there are 35,075 observations.

Our dataset contains a variable, called PKOEF, which reflects how respective household in HBS sample is represented in the entire Czech population and is based on Microcensus surveys. This variable allows us to calculate weighted aggregates and thus provide reasonable country aggregates. Average household incomes, expenditures and expenses on concerned consumption items (energies, motor fuels and transportation services) are displayed in Figure 3-IV.

4. The Ex-post Analysis

This part of the paper illustrates the concepts of inequality and tax progressivity measures on the data of the Czech Republic for the period 1993-2005. We chose three empirical applications:

- first, we compute the inequality measures (Gini and Theil indexes);
- second, we use the Suits index to estimate the tax progressivity for selected types of taxes.
- third, we compute the polarization indexes.

[3] Since January 2004, tax on oils used for heating has been rebating up to 660 CZK per tonne (21 €) as required by Directive 2003/96/EC. There is, however, almost none consumption of oils used for heating by households in HBS dataset.

The data used are HBS, which has been described in the Section 3.2 of the paper. Labour-tax payments are those reported by the household in the HBS survey. These payments include actual pre-payments and balance between tax duty and paid taxes for the previous year. Payments of VAT and excises are recalculated from relevant household expenses by us using rates as displayed in Figure 3-III.

The unit of observation need to be decided. We use households as the observation unit. We consider ranking households according to the following three criteria:

i) a ratio given by net household income and the living minimum standard set out by the state authority,
ii) household net income, and
iii) household income divided by number of household members.

Our analysis is restricted to the current income status. Hassett et al., 2007 presents a framework for investigating inequality and incidence from the lifetime perspective.

4.1 Income inequalities in the Czech Republic 1993-2005

The first empirical application is to construct time series of inequality measures. As an exemplar measure, we chose the Gini and the Theil index. These indexes (along with the 95% confidence intervals computed using the wild bootstrap) are shown in Figures IV-1 and IV-2. We compute both indexes for (a) net income, (b) for gross income. The difference between the index for gross and net income gives us a notion how direct taxation influences the income distribution in the Czech Republic.

Figure IV-1 shows results based on the household income divided by the living minimum standard, while Figure IV-2 shows results based on the household income. Figure IV-3 shows results based on the household income divided by the number of persons.

The figures confirm that the household ranking matters: if the income is not weighed, then results suggest higher inequality than in the case of ranking according to income over the number of persons in households or according to income over the legal living-minimum standards. This feature is quite intuitive. These results survey even if we use household expenditures instead of income.

Our results are very similar to that of Večerník (2006), who uses MICROCENSUS, his results are given in Figure IV-4 (compare with Figures IV-3). Results in both figures are based on the net household income divided by the number of persons. Even, the results of the impact of labour taxation by us and by Večerník (2002) are similar in magnitude. In both cases, the labour taxation decreases the Gini index by about 0.02.

4.2 Tax progressivity in the Czech Republic 1993-2005

The second empirical application is to ex-post evaluate the progressivity of the Czech Tax system during the period 1993-2005. We define the following eight categories of tax payments:

- **total tax payments** by households;
- **labour taxation**, which includes the taxation of labour income plus the obligatory social and health insurance;
- broadly defined **ECO taxes**, which include payments of excise taxes on motor fuels, VAT on heat, electricity, solid fuels, gas, motor fuels;
- **VAT on food;**
- **rest VAT**, i.e. VAT payments not levied on food, energy, motor fuels, and transport;
- **VAT on energy** (= heat, electricity, gas, and solid fuels),
- **VAT on transport** (= bus, rails, and urban public transport)
- **VAT on motor fuels**.

Note that these categories are in general overlapping (e.g. ECO taxes include VAT on energy, transport and motor fuels). We compute the Suits index for each of them.

The graphical results are illustrated in Figures 4-V – 4-VIII. The odd figures (4-V and 4.VI) report result for the first five tax categories, while the even figures (4-VI and 4-VIII) report the results for the last three categories.

Figures 4-V and 4-VI report results for the case that the households are sorted by the household income divided by the living-minimum standard, while the sorting mechanism used in Figures 4-VII and 4-VIIII is based on the absolute household income. Again, the results suggest that there is a huge difference according to the sorting mechanism of households. Figures 4-IX and 4-X report the results with the confidence intervals computed using wild bootstrap.

We conclude that the overall tax system is close to a flat tax system, that labour taxation is the most progressive component, and that the VAT on food and energies are the most regressive taxes. While various approaches to ranking households (by the living minimum standards, by the number of persons) leave the ranking of regressivity of tax-system components unchanged, they affect the magnitude of the two measures of inequality and tax progressivity. The distributional impact of environmentally related taxation is almost neutral, which is caused by the counterbalancing effect of motor-fuel taxation (progressive) and value-added tax on energies (regressive).

If the household income (not normalized) is used, then the tax-system seems to be rather progressive, as the environmentally related taxes are. The motor-fuel taxation is then seen as rather progressive, while the VAT on energies have almost equal burden.

5. The Ex-ante Analysis of Scenarios of the Environmental Tax Reform

In this part of the paper, we estimate ex-ante distributional effects of selected scenarios of the environmental tax reform (ETR). First, we describe these scenarios, second, we describe the estimation of the household demand system used to estimate the responsiveness of household expenses to the change in relative prices and third, we present results of simulations.

We consider the following set of scenarios of environmental taxation:

- **SC1**, which means the implementation of the EC Directive 2003/96; without revenue –recycling, i.e., this is not strictly speaking an ETR.
- **SC2** is the implementation of the EC Directive 2003/96; with revenue recycling via labor tax cuts;
- **SC3** is the implementation of the directive with a change in the VAT rates (flat VAT);
- **SC4** is the scenario SC3 with revenue recycling via labor tax cuts;
- **SC5** is the sensitivity to scenario SC3, when ignoring elasticities of the energy demand;
- **SC6** presents a change in exercise taxes, which would correspond to the 20% increase in energy prices, revenue recycling not considered;
- **SC7** is the scenario **SC6** with revenue recycling.

5.1 Estimation of the Energy Demand for Czech Households

To evaluate the above 7 scenarios, we should have estimated elasticities of the household responsiveness to the change in relative prices. This part of the paper briefly summarizes the results of the econometric estimation, more details can be found in Bruha and Scasny (2006).

The **energy demand** is estimated for six household groups, which differ by energy appliances. I.e., it makes no sense to estimate the demand for coal by a household, which use the central heating. The first part of our group marking describes the energy source of household heating. For instance, *HEATcookGAS* characterizes the households with positive energy expenditures on heat -- heating being supplied by a centralized system. They also have expenditures on gas used for cooking, and there are – like in each group of the households - positive expenditures on electricity used for lighting and power. The group marked as *ELEKTRINA* consists only of households that have expenditures only on electricity and not on other goods. *ELEcookGAS* marks the household that heats with electricity and uses gas for cooking. *HEATblocks* describes households which use electricity for lighting and power, gas for cooking and their heat is supplied by a centralized system. These households live mostly in blocks of flats. Coal is used predominantly only in the group *COALheat*. Minor consumption of and expenditures on solid fuels also appear in *HEATblocks* (positive expenditures in 12% of households) and *GASheat*. Since expenditures on coal represent mostly a small share, solid fuels are more likely used as a fuel for picnicking or recreation rather than a heat-fuel substitute. Although the main energy carrier used in the group of *COALheat* is coal, about 20% of them also use gas. However, 56% of these gas users use gas for cooking and less than 30% as a supplementary heat source stored in gas cylinders, and only a minority of gas users (17%) are potential fuel switchers. In the end, we identify a special group marked as *INCONSISTENT* (194 households, 1.3% of the sample) that includes households which pay for electricity and gas, and use a coal heating system, however, they do not have any expenditures on solid fuels. We are not able to sensibly explain these patterns. Therefore we exclude this group from estimations and simulations.

Each household group consumes different kinds of energies; therefore the Almost Ideal Demand System differs according to the household groups. The general form of the regression equation is the following:

$$w_i = \alpha_{i0} + \sum_h \alpha_{ih} x_h + \varepsilon_i + \sum_j \gamma_{ij} \log(p_j) + \left[\beta_{i0} + \sum_h \beta_{ih} x_h\right] \log\left(\frac{y}{P}\right),$$

where w_i is the expenditure shares on the ith commodity, p_j are prices, y is the total expenditures, P is the Stone price index, x_h are household characteristics, which may enter both the intercept and expenditures slope and ε is the unobservable random effect. The AID system obeys a set of parameter restrictions:

$\sum_i \alpha_i = 1,$ where $\alpha_i \equiv \alpha_{i0} + \sum_h \alpha_{ih} x_h + \varepsilon_i$
$\sum_i \beta_i = 0,$ where $\beta_i \equiv \beta_{i0} + \sum_h \beta_{ih} x_h$,
$\gamma_{ij} = \gamma_{ji}, \sum_i \gamma_{ij} = 0$.

The Stone index satisfies:

$$\log P = \alpha_0 + \sum_i \alpha_i \log p_i + \frac{1}{2} \sum_{i,j} \gamma_{ij} \log p_i \log p_j .$$

Since the Stone index depends on model parameters, the estimation of the AID system is a non-linear econometric problem. There are two possible approaches: either to approximate the index by an empirical index which does not depend on the parameters – this approach was used e.g. by West and William (2004); or to use a non-linear estimation technique. We use the later approach, since the empirical approximation to the index can cause biased results, see Buse (1994).

Because of the parametric restriction to the AID system, one equation can be deleted from the estimation: we do it for the demand for the rest of the goods. We estimate the AID system using a non-linear minimum-distance estimator. Since prices may be potentially endogenous, we experiment with a correction of the possible price endogeneity using the general methods of moments. We instrument the consumer energy prices by world energy prices. We find little changes in the estimation results; this finding probably reflects the fact that energy prices are exogenous for a small open economy, such as the Czech Republic. Therefore, we report below the results without instrumenting only. The distribution of estimators – used to construct p-values -- is approximated by bootstrap replications of the sample.

Estimation results for all own price and income elasticities have the expected signs, except for the income elasticity for gas in *HEATblocks* used mostly for cooking (-0.19). Own price elasticities for electricity range between -0.2 to -1.0, the price responsiveness is higher in the household that uses electricity for heating. It confirms our previous estimates; Brůha and Ščasný (2005b) found a weighted own price elasticity for electricity as high as -0.63 while the highest responsiveness fits for the households of pensioners (-0.73), the lowest is in the households of farmers (-0.53). Own price elasticity for gas is about -0.9, in the households that use gas for cooking it is -2.26, for heat it amounts -0.84 and -1.22, while it is the lowest for coal at as little as -0.11 (own price elasticity for the other goods lies around -1.0). Our previous research yields lower estimates at a level of about -0.5. Most of the cross-price elasticities are positive, if a negative effect of an energy price increase occurs, it is usually counter-balanced by increased demand for other goods.

Income elasticity is the highest for gas used for cooking (+0.93) and electricity used also for heating (+0.35). In all cases, income elasticity for electricity is one of the highest among energies. The lowest income elasticity holds for heat in blocks of flats (+0.17) and for gas in the households using gas for heating (+0.10). Our previous research provided similar results. The highest weighted income elasticity was estimated for electricity (+0.9), especially holding for the farmers, the lowest one for heat (+0.66), except the household of pensioners (+0.89). Income elasticity for other goods is about +2.2.

The **transport demand** system consists of demand for motor fuels, buses, rails and public urban transport. We estimate the demand for separate household groups depending on the location and the socio-economic group of the household. The justification is following: the size of the city (rural or urban area) significantly determines the availability of transport means. Since public urban transport exists only in bigger cities, it would not be sensible to include expenditures on public urban transport in a demand system for the households living in rural areas. Meanwhile, due to missing or limited occurrence of public means of transport, passenger car ownership and fuel expenditures are likely higher in rural areas than in cities. Similarly, different consumer patterns can be expected for the households with and without a child. Indeed, the car ownerships and car vintage that influences the expenditures on motor fuels and transport-related services differ significantly between these groups. The oldest cars are owned by the households of pensioners (the mean age is 15 years) and of farmers living in villages (the mean age is 12.5 years). Newest cars are owned by groups EA2, EA2+ and farmers living in bigger cities. Moreover, there are only less than 15% of those who do not own any car. On the other hand, the households of pensioners living in big cities and one-member households more probably do not own any car: 60% - 70% of such households do not own a car. Also for the transport demand, the Almost Ideal Demand System is used. The estimation results are summarized in Figure V-II.

Similarly to energy elasticities, our estimates made for fuel and transport have the expected signs. Estimates for public urban transport are not significant in some household groups, mainly due to the fact that this transport service is not widely provided, especially in rural areas or small cities. Estimates of own price elasticities give relatively similar numbers, about -0.50, however they differ along the household groups. For instance, we can find the highest price responsiveness to bus and rail prices in the households of pensioners living in cities of above 2,000 inhabitants. Relatively highest own price elasticity for motor fuels also holds for pensioners living in medium-sized cities (-0.67), on the other hand the pensioners living in small and big cities have the lowest price responsiveness (-0.44) among the household groups. Although our previous research showed that the own price elasticity for motor fuels is significantly higher in the households of pensioners than average, we could not identify this special consumer behavior fitting for different households of pensioners.[4]

Income elasticity is the highest for motor fuels (+0.71) and the lowest for railways (+0.66). Income effect for all kinds of transport is then relatively the lowest in the households of pensioners and the highest in the households of economically active with more members (children). These results are in line with our previous estimates.

5.2 Simulations Results

We evaluate seven scenarios defined above and use the estimated demand system. Based on it, we can estimate the change in expenditures for each household in the HBS statistics and estimate the impact of the policy measures on the Gini index, and the Suits index. The quantitative results are summarized in Figures 5-III through 5-VI. Now, we will comment them briefly.

The simulations suggest that that if the environmental taxation is not accompanied with cuts in the labour income taxation, then the regressivity of the overall tax system will decrease. See, results for scenarios SC1, SC3 and SC6. If the revenus are recycled using the labour-income tax cuts, the effect on the progressivity can be maintained and moreover, in the case of ambitious scenarios, the overall tax system progressivity may even increase (see results for scenario SC7). This pattern is robust to ways of households ranking.

6. Concluding Remarks

In the future research, we plan to use available data and procedures more deeply. First, we plan to decompose the inequality measures also within regions and households groups.

Second, since the HBS is not a perfect random sampling, and certain household groups (such as unemployed and households living in small villages) are underreported, we will adapt more appropriate statistical techniques. We plan to use unobserved component techniques (initiated in the econometrics of household surveys by Pfefferman, 1991) to track moments of the unobserved statistical distributions of the households' income and other relevant characteristics. The MICROCENSUS observations will be used for obtaining unbiased estimations of these moments, while in the years without MICROCENSUS the moments will be tracked using the Kalman filter. The HBS will provide additional pieces of information about the consumption characteristics of various household groups.

We also plan to extend the analysis by the polarization measures. Our preliminary results surprisingly indicate that the income polarization was decreasing during the whole sample (contrary to inequality). We plan to analyze whether and to what extend the decrease was caused by the tax system, and how the ETR proposals will influence the income polarization.

[4] Households of farmers have relatively smaller price elasticity for motor fuels than the weighted average. Price elasticity for the households of farmers living in villages is in fact the lowest (-0.06).

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Figures:

Figure 2-I. Influential observations – the Gini index

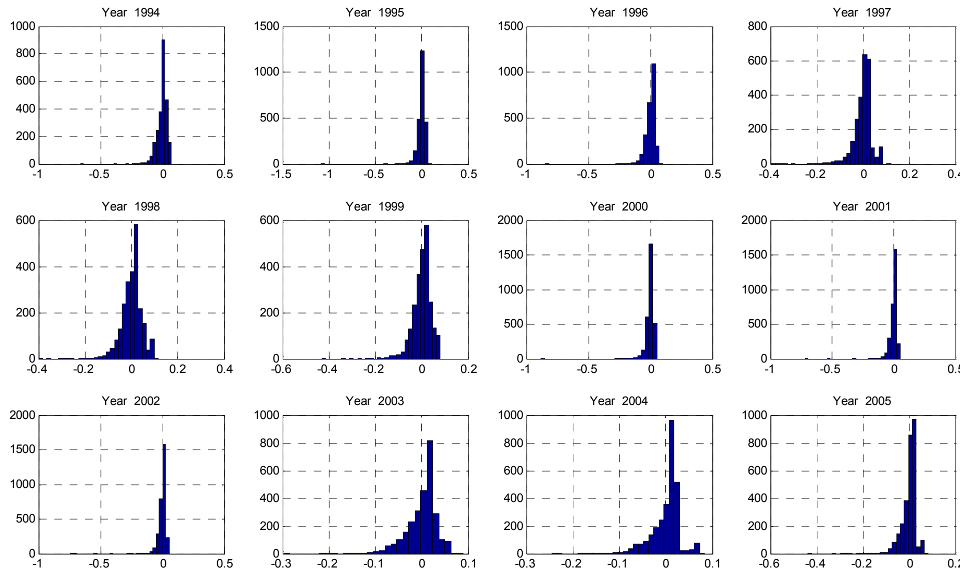

Figure 2-II. Influential observations – the Theil index

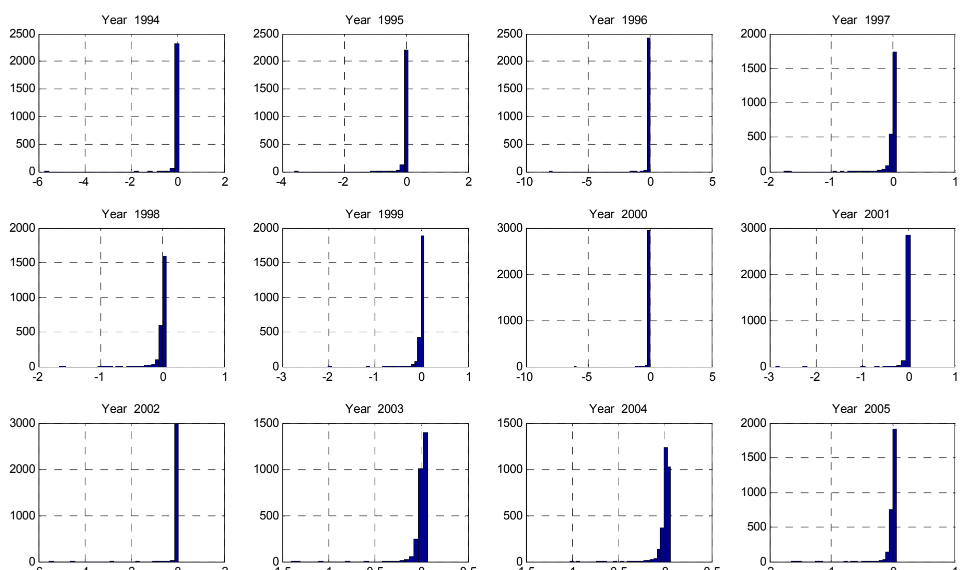

Figure 3-I: Public revenues in the Czech Republic, 1993-2005.

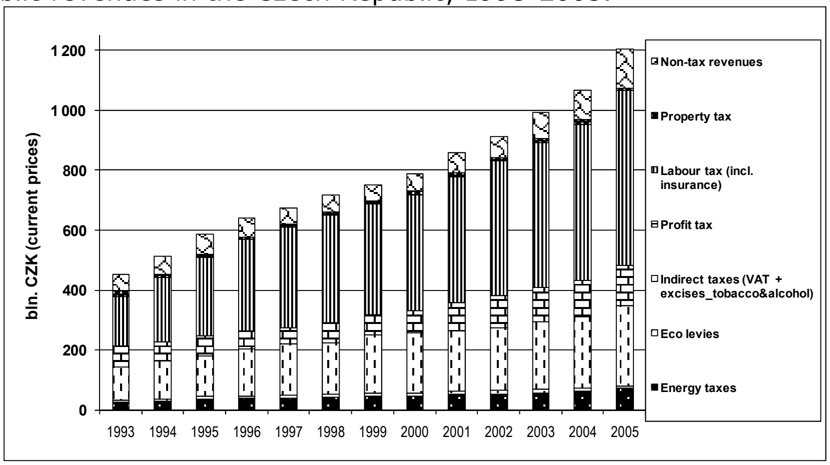

Figure 3-II: Labour taxation scheme in the Czech Republic, 1993-2005.

	Bands for labour tax, thousands CZK					Rates of labour tax						Deductibles, in CZK	
	band 1	band 2	band 3	band 4	band 5	rate 1	rate 2	rate 3	rate 4	rate 5	rate 6	per employee	per child
1993	60.0	120.0	180.0	540.0	1,080.0	15%	20%	25%	32%	40%	47%	20 400	9 000
1994	60.0	120.0	180.0	540.0	1,080.0	15%	20%	25%	32%	40%	44%	21 600	10 800
1995	60.0	120.0	180.0	540.0	1,080.0	15%	20%	25%	32%	40%	43%	24 000	12 000
1996	84.0	144.0	204.0	564.0	n.a.	15%	20%	25%	32%	40%	n.a.	26 400	13 200
1997	84.0	168.0	252.0	756.0	n.a.	15%	20%	25%	32%	40%	n.a.	28 800	14 400
1998	91.4	183.0	274.2	822.6	n.a.	15%	20%	25%	32%	40%	n.a.	32 040	18 000
1999	102.0	204.0	312.0	1,104.0	n.a.	15%	20%	25%	32%	40%	n.a.	34 920	21 600
2000	102.0	204.0	312.0	n.a.	n.a.	15%	20%	25%	32%	n.a.	n.a.	34 920	21 600
2001	109.2	218.4	331.2	n.a.	n.a.	15%	20%	25%	32%	n.a.	n.a.	38 040	23 520
2002	109.2	218.4	331.2	n.a.	n.a.	15%	20%	25%	32%	n.a.	n.a.	38 040	23 520
2003	109.2	218.4	331.2	n.a.	n.a.	15%	20%	25%	32%	n.a.	n.a.	38 040	25 520
2004	109.2	218.4	331.2	n.a.	n.a.	15%	20%	25%	32%	n.a.	n.a.	38 040	25 560
2005	109.2	218.4	331.2	n.a.	n.a.	15%	20%	25%	32%	n.a.	n.a.	7 200	6 000

Figure 3-III: Excise tax and VAT on energies, motor fuels and transport services.

	Excise taxes (CZK)			**Value Added Tax**			
	petrol	**diesel**	**oils**	**motor fuels**	**oils**	**gas, coal, electricity**	**heat, food, public transport**
1993	8.20	6.95		23%	5%	5%	5%
1994	8.71	6.95		23%	23%	5%	5%
1995	8.79	7.03	2.00	22%	22%	5%	5%
1996	8.79	7.03	7.59	22%	22%	5%	5%
1997	8.79	7.03	7.92	22%	22%	5%	5%
1998	9.84	8.15	7.92	22%	22%	22%	5%
1999	10.84	8.15	8.15	22%	22%	22%	5%
2000	10.84	8.15	8.15	22%	22%	22%	5%
2001	10.84	8.15	8.15	22%	22%	22%	5%
2002	10.84	8.15	8.15	22%	22%	22%	5%
2003	10.84	8.15	8.15	22%	22%	22%	5%
2004	11.84	9.95	9.95	19%	19%	19%	5%
2005	11.84	9.95	9.95	19%	19%	19%	5%

Figure 3-IV: Household income and expenditures, mean and s.d. in CZK; HBS 1993-2005.

Year	**Number of obser.**	**Household income**				**Household expenses**			
		net income	**earnings**	**labour taxes**	**social benefits**	**total expenses**	**energy expenses**	**public transport**	**motor fuels**
1993	2 923	113 483	106 733	20 207	20 883	108 984	7 423	1 925	4 979
		52 823	69 882	15 585	18 670	55 272	3 038	2 159	5 430
1994	2 409	127 543	118 740	22 865	24 138	121 416	8 374	2 032	5 305
		64 057	84 067	19 266	20 700	64 551	3 585	2 393	6 201
1995	2 391	148 328	138 858	28 108	28 137	141 164	9 411	2 257	5 658
		80 141	101 752	25 155	26 114	78 390	4 047	2 573	6 457
1996	2 462	171 131	161 664	32 340	31 607	163 587	11 119	2 752	6 285
		84 134	119 107	29 174	32 085	88 833	4 728	3 296	6 897
1997	2 453	186 982	176 351	34 697	35 766	183 303	13 327	2 903	6 954
		89 803	130 149	31 469	37 952	105 079	5 597	3 544	7 420
1998	2 383	200 985	189 691	36 519	38 095	194 579	16 772	3 210	7 080
		96 441	140 090	33 894	42 418	121 725	7 073	3 938	7 406
1999	2 457	213 076	198 440	37 161	40 494	207 271	18 604	3 342	7 669
		105 245	147 084	34 737	44 233	122 454	8 004	4 229	7 901
2000	2 994	218 756	201 737	38 154	44 476	209 363	19 616	3 453	8 634
		112 882	152 325	36 511	46 416	127 611	8 197	4 416	9 105
2001	3 045	235 328	217 022	40 921	47 071	220 937	21 351	3 516	9 003
		121 787	164 101	38 900	49 899	136 621	9 103	4 673	9 308
2002	3 038	241 084	218 275	41 224	51 746	225 342	23 612	3 514	8 502
		124 815	168 805	40 172	53 061	135 856	10 050	4 771	8 991
2003	2 760	256 389	242 974	46 807	47 335	239 015	24 087	3 148	9 201
		125 002	178 196	44 623	53 117	132 424	10 049	3 998	9 330
2004	2 883	270 237	257 154	49 992	49 951	247 655	24 017	3 796	9 860
		127 017	182 671	46 211	55 118	132 515	10 042	4 684	9 843
2005	2 877	271 222	253 525	49 682	51 856	247 016	24 186	3 652	10 411
		140 390	184 517	45 867	58 746	164 224	10 365	4 653	10 552

Figure 4-I. Inequality measures
(based on the household income divided by the living minimum standard)

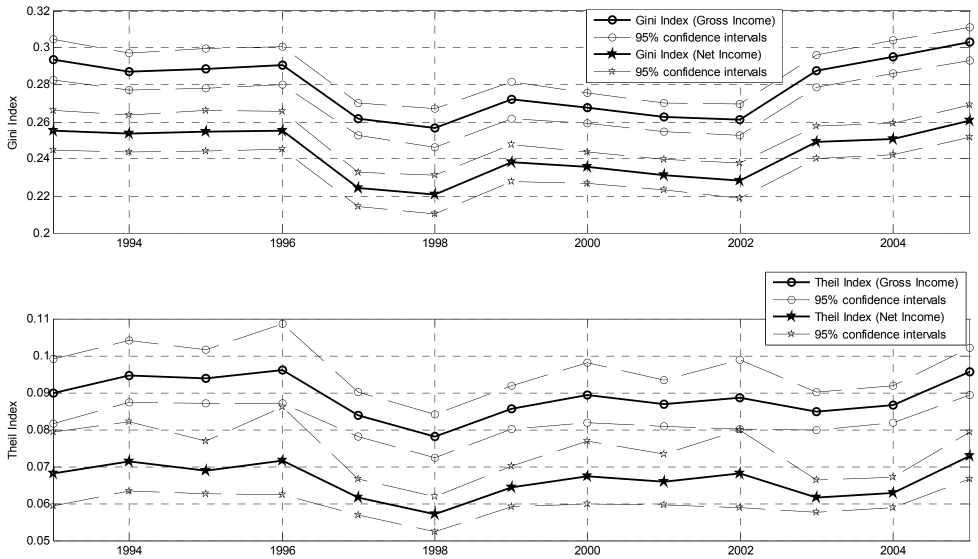

Figure 4-II. Inequality measures
(based on the household income)

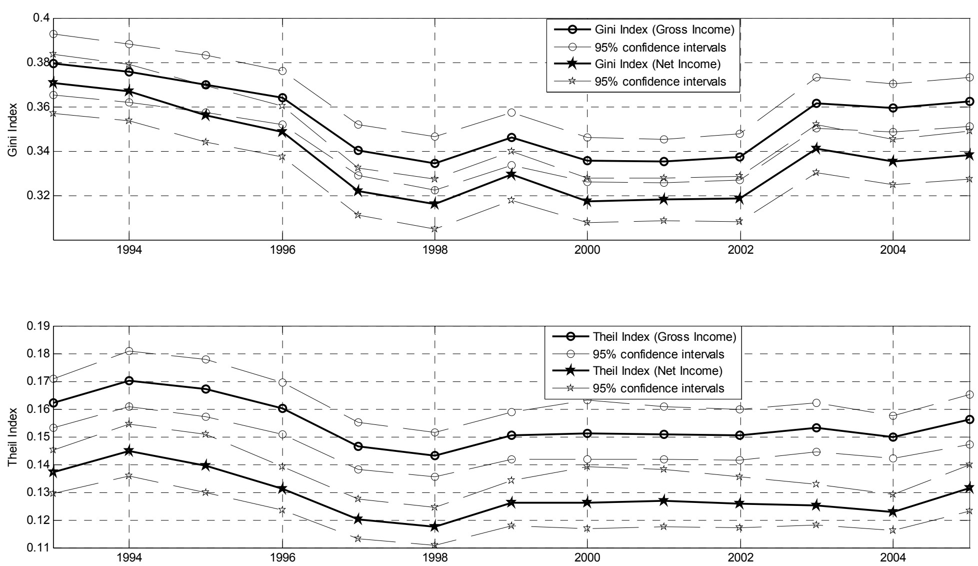

Figure 4-III. Inequality measures
(based on the household income / number of households)

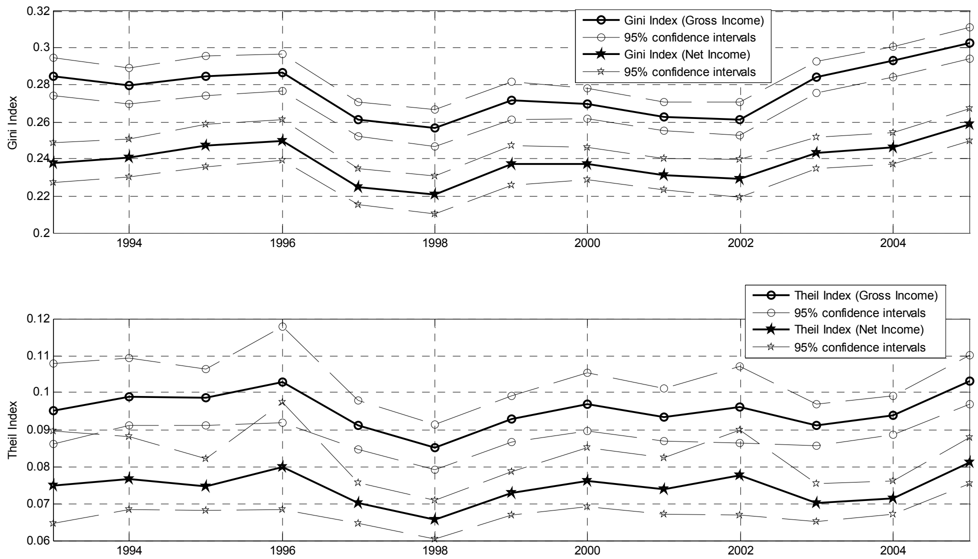

Figure 4-IV. Income inequality measurement by using MICROCENSUS surveys; according to Večerník, 2006.

	1988	1992	1996	2002
Gini coefficient				
Total gross income	0.199	0.26	0.266	0.274
Total net income	0.194		0.249	0.255
Robin Hood Index				
Total gross income	13.2	16.4	18.7	18.8

Figure 4-V. The Suits index – Broad Taxes
(based on the household income divided by the living minimum standard)

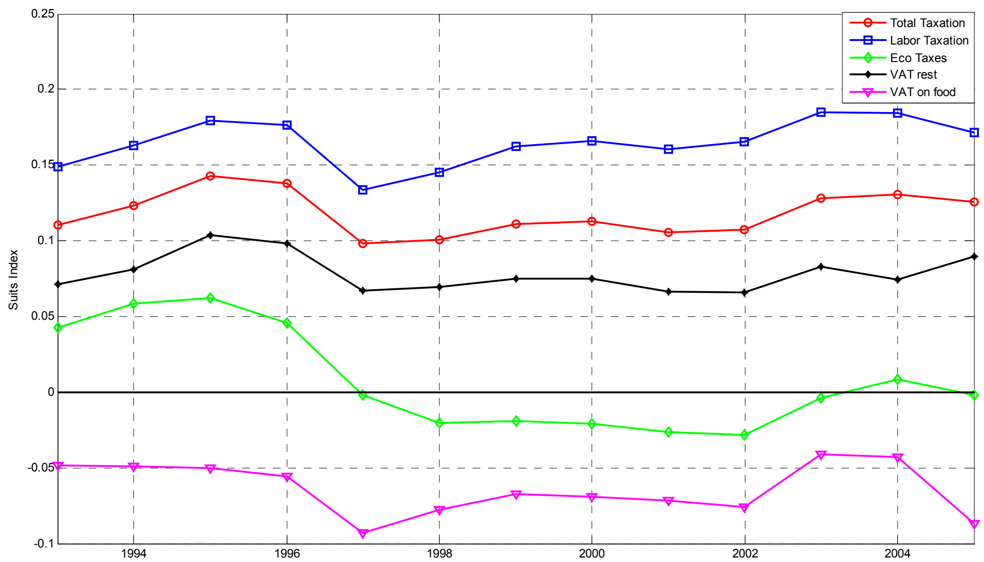

Figure 4-VI. The Suits index – Selected VAT taxes
(based on the household income divided by the living minimum standard)

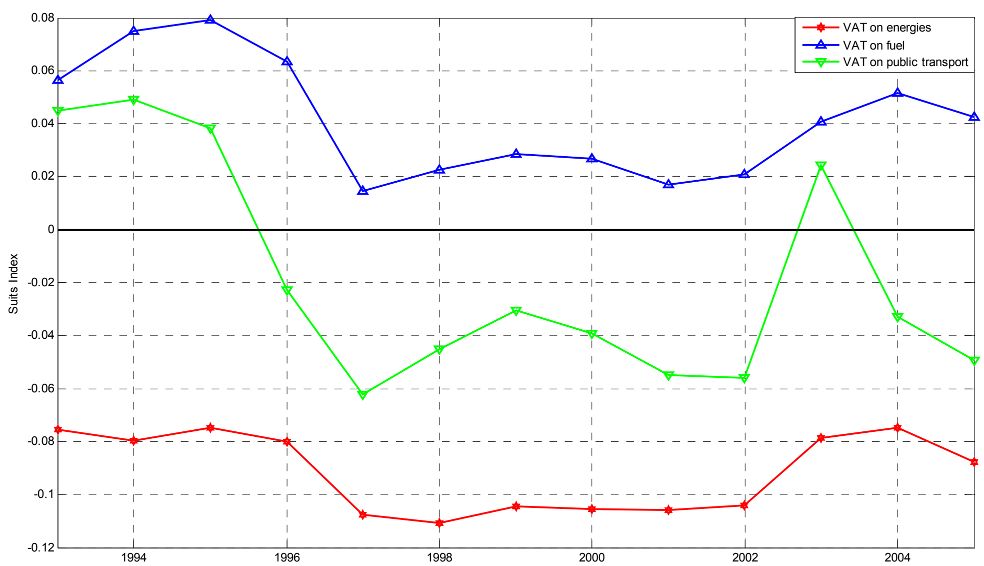

Figure 4-VII. The Suits index – Broad Taxes
(based on the household income)

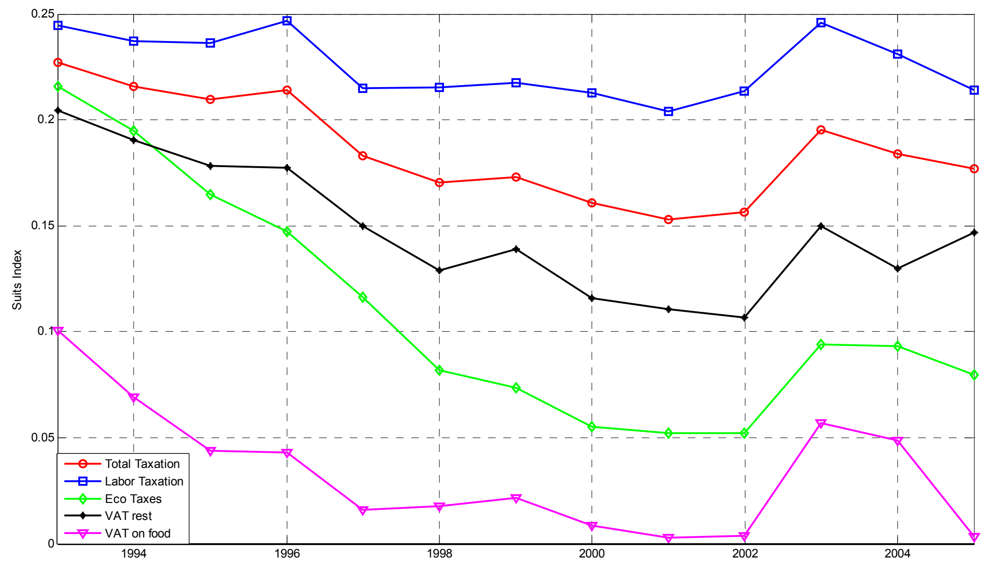

Figure 4-VIII. The Suits index – Selected VAT taxes
(based on the household income)

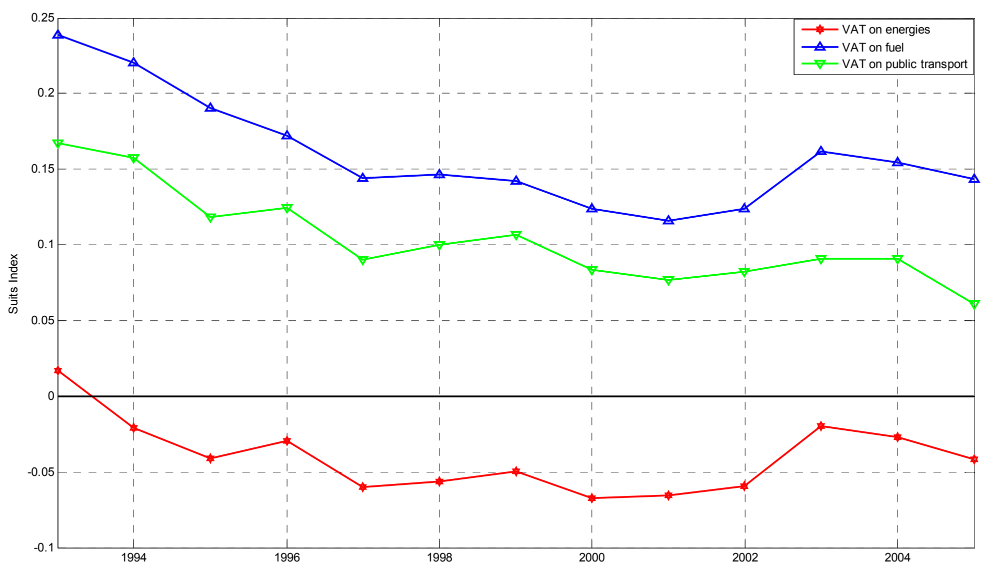

Figure 4-IX The Suits index
(based on the household income / living minimum standard)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
total tax payments	**index**	0,227	0,216	0,210	0,214	0,183	0,170	0,173	0,161	0,153	0,157	0,195	0,184	0,177
	2.5% percentile	0,208	0,198	0,194	0,198	0,168	0,152	0,155	0,149	0,141	0,143	0,180	0,169	0,162
	97.5% percentile	0,244	0,234	0,227	0,229	0,199	0,188	0,191	0,172	0,165	0,170	0,210	0,199	0,194
labour taxation	**index**	0,244	0,237	0,236	0,247	0,215	0,215	0,217	0,213	0,204	0,214	0,246	0,231	0,214
	2.5% percentile	0,224	0,217	0,216	0,228	0,196	0,193	0,196	0,197	0,186	0,196	0,227	0,212	0,195
	97.5% percentile	0,265	0,257	0,255	0,265	0,233	0,236	0,238	0,230	0,221	0,230	0,265	0,249	0,234
ECO taxes	**index**	0,216	0,195	0,165	0,147	0,116	0,082	0,074	0,055	0,052	0,052	0,094	0,093	0,080
	2.5% percentile	0,192	0,168	0,139	0,123	0,094	0,062	0,052	0,039	0,035	0,035	0,076	0,075	0,062
	97.5% percentile	0,239	0,223	0,190	0,170	0,139	0,101	0,095	0,073	0,069	0,070	0,113	0,109	0,097
rest VAT	**index**	0,204	0,190	0,178	0,177	0,150	0,129	0,139	0,116	0,111	0,106	0,150	0,130	0,147
	2.5% percentile	0,186	0,170	0,160	0,158	0,132	0,105	0,118	0,100	0,094	0,088	0,133	0,115	0,129
	97.5% percentile	0,222	0,210	0,199	0,194	0,169	0,155	0,159	0,133	0,128	0,126	0,167	0,145	0,167
VAT on food	**index**	0,100	0,069	0,044	0,043	0,016	0,018	0,022	0,008	0,003	0,004	0,057	0,049	0,003
	2.5% percentile	0,084	0,051	0,027	0,026	0,001	0,003	0,006	-0,003	-0,011	-0,010	0,043	0,036	-0,011
	97.5% percentile	0,117	0,087	0,061	0,059	0,031	0,032	0,038	0,020	0,015	0,016	0,071	0,062	0,017
VAT on energy	**index**	0,017	-0,021	-0,041	-0,029	-0,060	-0,056	-0,050	-0,067	-0,065	-0,060	-0,019	-0,027	-0,041
	2.5% percentile	-0,001	-0,039	-0,058	-0,046	-0,075	-0,075	-0,068	-0,082	-0,081	-0,077	-0,036	-0,044	-0,057
	97.5% percentile	0,034	-0,003	-0,024	-0,013	-0,044	-0,038	-0,030	-0,053	-0,050	-0,043	-0,001	-0,011	-0,025
VAT on motor fuels	**index**	0,239	0,220	0,190	0,172	0,144	0,146	0,142	0,124	0,116	0,124	0,162	0,154	0,143
	2.5% percentile	0,214	0,192	0,163	0,146	0,120	0,121	0,118	0,104	0,095	0,103	0,140	0,134	0,122
	97.5% percentile	0,263	0,251	0,217	0,198	0,169	0,170	0,168	0,145	0,137	0,146	0,185	0,175	0,163
VAT on transport	**index**	0,167	0,158	0,118	0,125	0,090	0,100	0,107	0,084	0,077	0,082	0,091	0,091	0,061
	2.5% percentile	0,143	0,132	0,092	0,098	0,064	0,071	0,079	0,059	0,052	0,056	0,065	0,066	0,034
	97.5% percentile	0,190	0,184	0,143	0,150	0,116	0,127	0,135	0,108	0,102	0,109	0,118	0,116	0,088

Figure 4-X The Suits index
(based on the household income)

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
total tax payments	**index**	0,110	0,123	0,143	0,138	0,098	0,101	0,111	0,113	0,105	0,108	0,128	0,130	0,126
	2.5% percentile	0,088	0,100	0,124	0,117	0,080	0,080	0,091	0,097	0,090	0,091	0,110	0,113	0,108
	97.5% percentile	0,133	0,145	0,163	0,158	0,117	0,120	0,131	0,127	0,121	0,124	0,146	0,147	0,144
labour taxation	**index**	0,149	0,163	0,180	0,176	0,133	0,145	0,162	0,166	0,161	0,165	0,185	0,184	0,172
	2.5% percentile	0,123	0,138	0,159	0,154	0,113	0,123	0,139	0,148	0,141	0,146	0,164	0,164	0,151
	97.5% percentile	0,173	0,187	0,201	0,198	0,156	0,167	0,185	0,184	0,180	0,186	0,206	0,205	0,192
ECO taxes	**index**	0,043	0,059	0,062	0,046	-0,002	-0,020	-0,019	-0,021	-0,026	-0,028	-0,004	0,009	-0,002
	2.5% percentile	0,015	0,027	0,033	0,016	-0,027	-0,044	-0,043	-0,041	-0,045	-0,048	-0,026	-0,012	-0,022
	97.5% percentile	0,071	0,091	0,090	0,074	0,024	0,003	0,004	-0,002	-0,006	-0,008	0,016	0,029	0,018
rest VAT	**index**	0,071	0,081	0,104	0,098	0,067	0,070	0,075	0,075	0,066	0,066	0,083	0,075	0,090
	2.5% percentile	0,049	0,058	0,081	0,076	0,046	0,044	0,052	0,055	0,045	0,045	0,064	0,056	0,067
	97.5% percentile	0,094	0,104	0,126	0,120	0,088	0,097	0,098	0,095	0,088	0,089	0,103	0,092	0,113
VAT on food	**index**	-0,048	-0,049	-0,050	-0,056	-0,093	-0,078	-0,068	-0,069	-0,071	-0,076	-0,041	-0,043	-0,087
	2.5% percentile	-0,069	-0,070	-0,068	-0,077	-0,110	-0,097	-0,087	-0,085	-0,086	-0,092	-0,059	-0,059	-0,103
	97.5% percentile	-0,027	-0,029	-0,031	-0,036	-0,076	-0,061	-0,049	-0,055	-0,056	-0,060	-0,024	-0,028	-0,070
VAT on energy	**index**	-0,076	-0,080	-0,075	-0,080	-0,108	-0,111	-0,104	-0,105	-0,106	-0,104	-0,079	-0,075	-0,088
	2.5% percentile	-0,097	-0,100	-0,094	-0,101	-0,125	-0,132	-0,126	-0,122	-0,123	-0,122	-0,099	-0,092	-0,105
	97.5% percentile	-0,055	-0,060	-0,057	-0,060	-0,090	-0,091	-0,083	-0,088	-0,088	-0,087	-0,059	-0,057	-0,069
VAT on motor fuels	**index**	0,056	0,075	0,079	0,064	0,015	0,023	0,029	0,027	0,017	0,021	0,041	0,051	0,043
	2.5% percentile	0,027	0,042	0,048	0,032	-0,013	-0,006	0,000	0,003	-0,007	-0,004	0,014	0,027	0,019
	97.5% percentile	0,086	0,110	0,110	0,095	0,044	0,051	0,057	0,051	0,041	0,046	0,066	0,075	0,067
VAT on transport	**index**	0,045	0,049	0,038	-0,023	-0,062	-0,045	-0,031	-0,039	-0,055	-0,056	0,024	-0,033	-0,049
	2.5% percentile	0,017	0,019	0,012	-0,053	-0,091	-0,077	-0,061	-0,067	-0,082	-0,084	-0,005	-0,061	-0,081
	97.5% percentile	0,073	0,077	0,066	0,006	-0,032	-0,013	0,000	-0,013	-0,028	-0,027	0,053	-0,005	-0,017

Figure 5-I. The estimation results of the energy demand

GROUP 1 - ELECTRICITY

	Uncompensated elasticities		Compensated elasticities		Income elasticities
	Electricity price	Price of other good	Electricity price	Price of other good	
Electricity	-0,516	-0,040	-0,491	0,290	0,358
Other good	-0,485	-0,960	-0,404	-0,014	1,045

GROUP 2 – ELEcookGAS

	Uncompensated elasticities			Compensated elasticities			Income elasticities
	Electricity price	Price of gas	Price of other good	Electricity price	Price of gas	Price of other good	
Electricity	-1,036	-0,180	0,216	-1,012	-0,123	0,404	0,346
Gas	0,681	-2,261	1,942	0,681	-2,244	1,982	0,929
Other good	0,017	0,039	-1,056	0,334	0,853	-0,899	2,153

GROUP 3 - HEATcookELE

	Uncompensated elasticities			Compensated elasticities			Income elasticities
	Electricity price	Heat price	Price of other good	Electricity price	Heat price	Price of other good	
Electricity	-0,246	-1,552	0,798	-0,236	-1,548	0,883	0,278
Heat	-0,829	-1,221	1,049	-0,820	-1,204	1,207	0,238
Other good	0,034	0,084	-1,117	0,278	0,294	-0,853	2,217

GROUP 4 - HEATblocks

	Uncompensated elasticities				Compensated elasticities				Income elasticities
	Electricity price	Price of gas	Heat price	Price of other good	Electricity price	Price of gas	Heat price	Price of other good	
Electricity	-0,32	0,52	-2,08	1,88	-0,31	0,51	-2,08	1,94	0,39
Gas	2,09	-0,95	3,43	-4,35	2,10	-0,92	3,43	-4,34	-0,19
Heat	-1,17	0,85	-0,84	1,26	-1,14	0,82	-0,83	1,42	0,17
Other good	0,06	-0,05	0,10	-1,11	0,40	-0,22	0,26	-0,96	2,22

GROUP 5 - GASheat

	Uncompensated elasticities			Compensated elasticities			Income elasticities
	Electricity price	Price of gas	Price of other good	Electricity price	Price of gas	Price of other good	
Electricity	-0,233	-0,919	0,152	-0,225	-0,913	0,254	0,187
Gas	-0,562	-0,939	0,951	-0,558	-0,938	1,098	0,098
Other good	0,007	0,296	-1,302	0,173	0,383	-0,681	2,228

GROUP 6 - COALHEAT

	Uncompensated elasticities			Compensated elasticities			Income elasticities
	Electricity price	Coal price	Price of other good	Electricity price	Coal price	Price of other good	
Electricity	-0,469	0,116	-0,647	-0,453	0,128	-0,529	0,305
Coal	0,216	-0,114	-1,102	0,222	-0,107	-1,038	0,216
Other good	-0,039	-0,036	-0,925	0,239	0,160	-0,905	2,163

Figure 5-II. The estimation results of the transport demand

Figure 5-IIa. **Income elasticities – point estimates**

Household group	Motor fuels	Bus	Rail	Public urban transport
Farmer (villages)	0.70	0.58	0.68	
Farmer (cities)	0.63	0.66	0.65	0.64
Pensioners (villages)	0.60	0.65	0.64	
Pensioners (small cities)	0.60	0.65	0.64	0.58
Pensioners (bigger cities)	0.57	0.58	0.50	0.58
EA1 (villages)	0.66	0.67	0.68	
EA1+ (villages)	0.82	0.74	0.68	
EA2 (villages)	0.64	0.55	0.84	
EA2+ (villages)	0.78	0.77	0.75	
EA1 (cities)	0.66	0.72	0.64	0.66
EA1+ (cities)	0.82	0.75	0.69	
EA2 (cities)	0.69	0.68	0.74	0.62
EA2+ (cities)	0.74	0.69	0.68	0.8
Weighted average	**0.707**	**0.681**	**0.665**	**0.685**

Figure 5-IIb. **Uncompensated (Marshallian) price elasticities (own prices elasticities are shaded)**

Household group	Uncompensated price elasticity of MOTOR FUEL demand with respect to price of				Uncompensated price elasticity of PUBLIC URBAN TRANSPORT demand with respect to price of			
	Motor fuels	Bus	Rail	Public urban transport	Motor fuels	Bus	Rail	Public urban transport
Farmer (villages)	-0.51	0	0.22					
Farmer (cities)	-0.058	-0.03	0.06	0.20	0.17	0.01	0.08	-0.43
Pensioners (villages)	-0.44	0.32	0.27					
Pensioners (small cities)	-0.67	-0.04	0.11	0.01	0.12	0.34	0.25	-0.64
Pensioners (bigger cities)	-0.44	0.04	0.11	0.04	-0.11	0.15	0.33	-0.51
EA1 (villages)	-0.59	0.18	0.38					
EA1+ (villages)	-0.55	0.28	-0.07	0.20				
EA2 (villages)	-0.55	0.29	0.01					
EA2+ (villages)	-0.52	0	-0.01					
EA1 (cities)	-0.6	0.28	0	0.10	0.23	0.45	0.18	-0.47
EA1+ (cities)	-0.62	0.10	0.24	0.11	-0.07	0.17	0.1	-0.60
EA2 (cities)	-0.51	0.20	-0.25	0.25	0.13	0.14	0.28	-0.61
EA2+ (cities)	-0.49	0.38	0.02	0.12	0.13	0.14	0.28	-0.46
Weighted average	**-0.517**	0.205	0.070	0.121	0.063	0.189	0.228	**-0.526**

Household group	Uncompensated price elasticity of BUS demand with respect to price of				Uncompensated price elasticity of RAIL demand with respect to price of			
	Motor fuels	Bus	Rail	Public urban transport	Motor fuels	Bus	Rail	Public urban transport
Farmer (villages)	0.13	-0.45	0.30		0.14	0.32	-0.47	
Farmer (cities)	-0.03	-0.48	0.08	0.09	0.09	0.33	-0.51	-0.10
Pensioners (villages)	0	-0.39	0.09		0.05	-0.03	-0.57	
Pensioners (small cities)	0.18	-0.58	0.07	-0.21	0.09	0	-0.55	-0.09
Pensioners (bigger cities)	0.03	-0.56	0.21	-0.28	-0.10	-0.05	-0.56	0.04
EA1 (villages)	0.09	-0.43	0.01		0.05	-0.07	-0.47	
EA1+ (villages)	0.01	-0.48	-0.07		-0.2	0.03	-0.47	
EA2 (villages)	-0.25	-0.48	0.26		0.08	0.16	-0.44	
EA2+ (villages)	-0.05	-0.67	0.33		0.09	0.12	-0.54	
EA1 (cities)	-0.02	-0.19	0.19	0.06	0.17	0.2	-0.52	0.09
EA1+ (cities)	0.12	-0.55	0.38	0.02	0.06	0.29	-0.54	-0.02
EA2 (cities)	-0.02	-0.53	0.06	0.08	0.38	0.18	-0.42	0.12
EA2+ (cities)	0.08	-0.50	-0.02	0.2	-0.25	0.25	-0.48	0.06
Weighted average	0.049	**-0.494**	0.155	0.030	0.008	0.184	**-0.506**	0.036

Figure 5-III. The Suits Index for selected environmental-taxation scenarios
(index based on household income / living-minimum standard)

Suits Index income / liv min	**Scenario**							
	Benchmark	***SC1***	***SC2***	***SC3***	***SC4***	***SC5***	***SC6***	***SC7***
Labor income tax	0,382	0,382	0,397	0,382	0,411	0,382	0,382	0,532
Insurance	0,117	0,117	0,118	0,117	0,119	0,117	0,117	0,125
LABOR taxation	0,209	0,209	0,212	0,209	0,215	0,209	0,209	0,235
ET fuel	0,043	0,043	0,043	0,043	0,044	0,043	0,043	0,048
ET ener		-0,087	-0,087	-0,087	-0,086	-0,087	-0,092	-0,087
VAT fuel	0,043	0,043	0,043	0,043	0,044	0,043	0,043	0,048
VAT (public transport)	-0,049	-0,049	-0,049	-0,049	-0,047	-0,049	-0,049	-0,042
VAT (energie)	-0,087	-0,087	-0,087	-0,087	-0,086	-0,086	-0,087	-0,083
ECO TAXES	-0,001	-0,005	-0,005	-0,007	-0,006	-0,008	-0,015	-0,009
VAT food	-0,087	-0,087	-0,086	-0,087	-0,086	-0,087	-0,087	-0,082
VAT rest	0,087	0,087	0,088	0,087	0,088	0,088	0,087	0,091
VAT all	0,060	0,060	0,061	0,059	0,060	0,059	0,059	0,063
TAX - total	0,141	0,140	0,141	0,139	0,142	0,139	0,133	0,143

Figure 5-IV. The Suits Index for selected environmental-taxation scenarios
(index based on household income / number of persons)

Suits Index income / persons	**Scenario**							
	Benchmark	***SC1***	***SC2***	***SC3***	***SC4***	***SC5***	***SC6***	***SC7***
Labor income tax	0,277	0,277	0,293	0,277	0,307	0,277	0,277	0,435
Insurance	-0,006	-0,006	-0,005	-0,006	-0,004	-0,006	-0,006	0,003
LABOR taxation	0,092	0,092	0,096	0,092	0,099	0,092	0,092	0,120
ET fuel	-0,088	-0,088	-0,087	-0,088	-0,086	-0,088	-0,088	-0,081
ET ener		-0,161	-0,160	-0,161	-0,159	-0,161	-0,172	-0,166
VAT fuel	-0,088	-0,088	-0,087	-0,088	-0,086	-0,088	-0,088	-0,081
VAT (public transport)	-0,142	-0,142	-0,141	-0,141	-0,139	-0,142	-0,141	-0,133
VAT (energie)	-0,164	-0,164	-0,163	-0,162	-0,161	-0,162	-0,163	-0,158
ECO TAXES	-0,113	-0,116	-0,115	-0,116	-0,115	-0,117	-0,122	-0,116
VAT food	-0,183	-0,183	-0,182	-0,183	-0,181	-0,183	-0,183	-0,176
VAT rest	-0,019	-0,019	-0,019	-0,019	-0,018	-0,019	-0,019	-0,014
VAT all	-0,044	-0,044	-0,043	-0,045	-0,043	-0,045	-0,045	-0,040
TAX - total	0,029	0,028	0,029	0,027	0,030	0,027	0,022	0,033

Figure 5-V. The Marginal Gini Index for selected environmental-taxation scenarios
(index based on household income / living-minimum standard)

Gini Index income / liv min	Scenario							
	Benchmark	***SC1***	***SC2***	***SC3***	***SC4***	***SC5***	***SC6***	***SC7***
Labor income tax	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04
Insurance	0,30	0,30	0,32	0,30	0,33	0,30	0,30	0,42
LABOR taxation	0,13	0,13	0,13	0,13	0,13	0,13	0,13	0,15
ET fuel	-0,04	-0,04	-0,04	-0,04	-0,04	-0,04	-0,04	-0,04
ET ener		-0,19	-0,19	-0,19	-0,19	-0,19	-0,18	-0,18
VAT fuel	-0,18	-0,18	-0,18	-0,18	-0,18	-0,18	-0,18	-0,18
VAT (public transport)	-0,17	-0,17	-0,17	-0,15	-0,15	-0,15	-0,15	-0,15
VAT (energie)	-0,04	-0,04	-0,04	-0,04	-0,04	-0,04	-0,04	-0,04
ECO TAXES	-0,08	-0,09	-0,09	-0,09	-0,09	-0,09	-0,10	-0,10
VAT food	-0,18	-0,18	-0,18	-0,18	-0,18	-0,18	-0,18	-0,17
VAT rest	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
VAT all	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03	-0,03
TAX - total	0,44	0,45	0,45	0,45	0,45	0,45	0,38	-1,75
Gini	0,26							

Figure 5-VI. The Marginal Gini Index for selected environmental-taxation scenarios
(index based on household income / number of persons)

Gini Index income / persons	Scenario							
	Benchmark	***SC1***	***SC2***	***SC3***	***SC4***	***SC5***	***SC6***	***SC7***
Labor income tax	-0,05	-0,05	-0,05	-0,05	-0,05	-0,05	-0,05	-0,05
Insurance	0,24	0,24	0,26	0,24	0,27	0,24	0,24	0,37
LABOR taxation	0,06	0,06	0,06	0,06	0,06	0,06	0,06	0,07
ET fuel	-0,13	-0,13	-0,13	-0,13	-0,13	-0,13	-0,13	-0,13
ET ener		-0,21	-0,21	-0,21	-0,21	-0,21	-0,21	-0,21
VAT fuel	-0,20	-0,20	-0,20	-0,20	-0,20	-0,20	-0,20	-0,20
VAT (public transport)	-0,22	-0,22	-0,22	-0,20	-0,20	-0,20	-0,20	-0,20
VAT (energie)	-0,13	-0,13	-0,13	-0,13	-0,13	-0,13	-0,13	-0,13
ECO TAXES	-0,15	-0,15	-0,15	-0,15	-0,15	-0,15	-0,16	-0,16
VAT food	-0,22	-0,22	-0,22	-0,22	-0,22	-0,22	-0,22	-0,22
VAT rest	-0,06	-0,06	-0,06	-0,06	-0,06	-0,06	-0,06	-0,06
VAT all	-0,08	-0,08	-0,08	-0,09	-0,09	-0,09	-0,09	-0,09
TAX - total	0,47	0,48	0,46	0,45	0,47	0,46	0,34	-1,35
Gini	0,25							