Modeling of the Impacts of Revenue from Emission Allowances Trading on Selected Macroeconomic Indicators in the Czech Republic

Daniela Spiesová
Czech University of Life Sciences Prague

Abstract

The aim of this paper is to create and in terms of the Czech Republic also to apply a simultaneous model for determination of macroeconomic impacts of the trading of emission allowances. Another aim is to determine its adequateness of application both from econometric and economic point of view, or alternatively to define its limits and restrictions. At first, prerequisites and characteristics of the model are defined. The application of the model in terms of the Czech Republic is performed next followed by economic and econometric verification. The conclusion of the paper contains evaluation of the impacts of the changes in revenue from allowances on select basic macroeconomic indicators, as for instance inflation, unemployment, government purchases or net export. In case revenue from trading of emission allowances in the Czech Republic rise by 1 billion CZK, unemployment falls by 0.15% and the government expenses will increase by approximately 1.032 billion CZK and net export will increase as well, but only by 194 million CZK. Regarding inflation, the result of simultaneous model or the paired regression is the fact that revenue from allowances and inflation are independent on each other.

Keywords: emission allowances, regression analysis, EU ETS revenue, simultaneous model

Introduction

Green gas production in the Czech Republic is relatively high due to high share of industry and high energetic demands. There are about 400 machines involved in the system in the Czech Republic, including over 250 machines in the energy sector. The emission allowances trading system (EU ETS) covers about 60% of all green gas emissions in the Czech Republic (EU average is 40%). Industry makes one third of the Czech Republic's GDP. On the contrary, agriculture together with fishery holds about 2% of GDP. However, EU ETS has been dealing with a crisis given due to excess of supply of allowances over its demand and thus also by its very low price (price of allowance was only 5.9 Euro in the November of 2014). The original predictions of the system impact on the Czech Republic were optimistic due to increase in revenues achieved by selling allowances to the national budget. These prognoses, however, were not confirmed.

The aim of the paper is to evaluate the impacts of the EU ETS on selected macroeconomic indicators by creating a simultaneous model. From this point of view, this paper is unique though there are expert studies containing revenues estimations for the third trading period, but there are only a few studies dealing with consequent impacts. The advantage of this model is the fact that by performing the two-stage regression of the corresponding structural parameters and assessing their statistical significance, it is possible to determine, based on the sensitivity analysis of percentage change of the impact on inflation, unemployment and international relations and on percentage change (growth, decrease) of emission allowances revenue. A partial aim is to verify or falsify the hypothesis whether this model is adequate for examining the macroeconomic impacts of the EU ETS. In case this hypothesis would be confirmed, the model for determination of macroeconomic impacts of EU ETS could be used for any member state of the EU.

Literature review

Macroeconomic analyses of EU ETS system were naturally being prepared before starting of the system itself. However, EU ETS analyses applied for the first and the second trading period may not be applied for the period after 2012 due to fundamental changes (system revision for 2013). Furthermore, given the unpredictability of the allowance price and unclarity of implementation of rules for the third trading period, performing rather of ex-post analyses may be expected.

Therefore, the first analysis may be assumed to be the Model Based Analysis of the 2008 EU Policy Package on Climate Change and Renewable based on the model GEMINI-E3 and Primes (Capros, 2008). Factually, it is the analysis of impacts accompanying the climatologically-energetic package. The results of analyses imply that these impacts will be higher especially in post-communist countries of Central and Eastern Europe, thus including the Czech Republic. It is caused by two main factors:

- In the nineties, post-communist states went through economic transformation from centrally controlled to market economy. This transformation was connected to production decrease and thus also to decrease of green gas emissions. When economy recovery was taking place, green gas emissions were never increased to the level it occupied before 1990 and therefore, the majority of post-communist countries have been long since fulfilling the aims of the Kyoto protocol. However, the aims in Climatologically-energetic package are derived from 2005 and therefore, these states will factually decrease emissions compared to 1990 by far more than old member states of the EU.

- The second factor is the fuel base, in which there is a higher level of coal and generally higher carbon intensity of economies of post-communist countries (mainly Poland, Bulgaria, Estonia and the Czech Republic).

If there were no redistribution mechanisms in the Climatologically-energetic package, the study estimates the costs for fulfilling the aims of the Czech Republic to be annually on the level of 1.12% GDP. By utilizing all flexible and redistribution mechanisms, the Czech Republic could profit – expenses would be on the level of – 0.51% of GDP. In terms of the EU, expenses in 2020 would be on the level of 0.4–0.6% of GDP.

Alternatively to the analysis of the Commission, Christoph Böhringer, Andreas Löschel, Ulf Moslener and Thomas F. Rutherford (2009) arranged the analysis of impact, which deals more with the aims of climatology policy (at the same time, these authors used three models of the general stability in their study – DART, PACE, GEMINI-E3). This analysis shows two major findings: Reaching the reduction aim of 20% would lead to a loss of wealth by 0.5–2% in the case of utilizing all flexible mechanisms. The results of the above introduced study were consequently confirmed by Claudia Hermeling, Andrea Löschel and Tim Mennel (2012). These authors, however, applied a new approach in the analysis of climatology policy impacts and their analysis is based on the PACE model with the use of Gauss quadrature.

Climatological-energetic package for the budgets of the EU member states are analyzed by Pippo Ranci in terms of the THINK project (Ranci, 2011). The study identifies main factors impacting states' budgets. These are for instance introducing auctions that naturally have impact on income increase and on the contrary income decrease will cause possible decrease of GDP and lower tax collection from fossil fuels consumption. Impacts on individual states fundamentally differ, the highest negative impacts are expected in Bulgaria and Estonia (0.38–0.71% of GDP). On the contrary, in case of Hungary, Lithuania, Latvia and Romania the authors expect positive impact (+0.5% of GDP). In case of the Czech Republic, the authors expect increase of national budget's incomes in the level of 0.3% of GDP. In the whole EU they subsequently expect increase by 0.09%.

In recent years, there has been a growing trend with the existence of empirical studies which are concerned with the research of the prediction of emission allowances prices and revenue impacts of the EU ETS (European Trading System). The below mentioned studies use a broad methodological framework. For instance, Ščasný and Piša (2009) used an econometric model E3M2, while Kiuila and Markandya (2005) used a CGE model and Labandeira and Rodríguez (2013) used the integrated macro and micro model. ILO (2009) uses a slightly different method of modeling with the use of VAR model of time series.

Klepper and Peterson (2005) worked with the CGE model (specifically DART) to assess the macroeconomic impacts of the EU ETS in 2012. The scenario included the National Allocation Plan (NAP) for each member state of the EU-15 for the first trading period of 2005–2007. The model showed that the implementation of the EU ETS system leads to a loss of welfare by 0.9% in the EU-15 compared to the baseline BAU (loss of welfare due to ETS without the possibility of using CDM and JI would increase to 1.7%). In their article, Niels Anger and Ulrich Oberndorfer (2008) evaluate the impact of the EU ETS on employment. They concluded that the allocation of emission allowances had in the first phase no significant impact on employment in regulated German companies. For the results of their study they used an econometric model based on CGE. There are other simulations of ETS effect on the whole economics. For instance COWI (2004) uses a model GTAP-ECAT (European Carbon Allowance Trading) to evaluate the impacts of EU ETS on the competitiveness of European countries. The basic scenario was BAU (business as usual) where the policy of emission reducing is not established. Beside this scenario, another two are also analyzed: the scenario with the short-term trend of polluter adaptation to the change of technology (modernization) or the opposite – the scenario with the long-term trend of company's adaptation to the change of technology. Introducing of CDM and JI credits to the EU25 is determined exogenously (representing 100 million tons of carbon). The output of the model is the information that GDP will decrease in the EU by 0.36% with the long-term adaptation and by 0.48% for the short-term adapting.

Material and Methods

The model formation and determination of parameters are preceded by collecting foundation data, i.e. statistic data (time series). In this case, the time series from 2013 to 2020 is purposefully chosen as these years cover the third stage of the EU ETS when the trading with emission allowances in terms of auctions started. The data prediction was obtained from internal documents of the Ministry of finance, except for the R indicators (revenues from emission allowances), which were predicted on the basis of the Box Jenkins method, specifically ARIMA (1,1,1). This prediction was performed in the BAU scenario, i.e. without any external interventions. Only since 2015 to 2020, the prediction covers backloading (gradual removal of 900 million allowances from auctions and its return at the end of the period).

Fig. 1: Foundation data

Rok	$\mathbf{Y_t}$	$\mathbf{C_t}$	$\mathbf{G_t}$	$\mathbf{NX_t}$	**R**	$\mathbf{r_t}$	$\mathbf{\Delta\pi_t}$	**Ig**	$\mathbf{U_t}$
	Bilion CZK	Bilion CZK	Bilion CZK	Bilion CZK	Bilion CZK	%, r/r	%, r/r	Bilion CZK	%
2013	3858	1922.0	807.0	210	0.53	0.04	2.30	920.00	7.60
2014	3939	1965.0	803.0	214	1.57	0.03	1.90	957.00	7.70
2015	4079	2042.0	807.0	232	3.91	0.03	2.10	998.00	7.30
2016	4228	2116.0	815.0	260	11.17	0.02	2.00	1037.00	6.70
2017	4274	2145.0	815.0	278	12.48	0.02	2.10	1036.40	6.20
2018	4310	2195.0	817.8	240	14.12	0.01	2.00	1057.51	5.90
2019	4404	2245.0	820.6	260	14.36	0.01	2.20	1078.63	5.50
2020	4503	2296.0	823.4	284	15.64	0.01	2.10	1099.74	5.20

The author is aware of three major restrictions of the model. A first, it is problematic to have such a short time series (although purposefully chosen). This weak point may be, however, eliminated if included in the model of the fourth trading period (currently, however, due to absence of any legislature and information, it is impossible to predict data in this time horizon). The second restriction is right in the foundation data as it is only a prediction and therefore, the model may be partially misrepresented. But this limitation may also be minimized in the course of time by improving the accuracy of estimations as we will obtain more detailed information about EU ETS reformation or about development of the economy. It is also necessary to mention the issue of multicolinearity. Processes in the economy connect and mutually impact strongly other processes and it is very difficult to determine a specific cause of the given change. The model may be created if we accept these limitations.

This custom creation of the simultaneous model is based on the definition and selection of endogenous and predetermined variables including modeling their mutual logical and macroeconomic linkages. The parameters of the econometric model, together with the parameters of the distribution of its random components determine the economic structure and are called structural parameters. The simultaneous nature of the model lies in the fact that the non delayed endogenous variables play a simultaneous part in the model, i.e. simultaneously in the function of the response, as well as explanatory variables, and at the same time are determined by the solution of all equations in the model simultaneously.

The first equation of the model (2) defines the dependency of the gross domestic product (Y_t) on the change in the price level in a given time ($\Delta\pi_t$), the change of the government expenses (G_t), the change in gross business investment (Ig_t) and the unemployment rate (U_t). The consumption of "C" was removed from this equation because of multicollineration, i.e. strong dependency between predetermined variables. The dependency of GDP on the government expenses and investments is evident even from the expenditure method of GDP calculation. Investments are one of the most important factors affecting GDP. In statistics, they are the summation of supplies changes, amount of valuable purchases and so called creation of the gross fixed capital that is a representation of how local and foreign companies expand their capacities and by that also their growth potential of the whole economy. The unemployment rate is included in the equation due to the "Theory of potential product" in which in 2000 M. Hájek and V. Bezděk (2000) used this variable for the analysis of potential product estimation (they applied the two-factor Cobb-Douglas production function). The dependence of the rate of unemployment and the change in the price level is verified by the Phillips curve which was the source for Gordon's (1989) conception of the simple equation: $\pi_t = \alpha^*\pi_{t-1} + \beta^*(U_t - U^*)$, π_t labels the inflation rate, U_t the rate of unemployment in time t and U^* the natural rate of unemployment. Ten years later, J. S. Sekhon (1999) designed the modification of the model for inflation in the form of $\pi_t - \pi_t^* = \beta(U_t - U^*) + X_t + v_t$, where X_t contains other regressors determined for the control of supply shocks (e. g. exchange rate, import prices, price of oil etc.) and v is the error constituent.

The second equation of the created simultaneous model (3) defines the dependence of investments on revenues from auctions with allowances (the price of allowances * their number) and also on the discount rate and consumption. In the model, investments (Ig_t) represent the simultaneously endogenous variable, which in the fifth model equation specifies the definitional relation for the net export, revenue from allowances trading is the predetermined variable. Predetermined variables are all exogenous (independent) variables in the model and endogenous (dependent) variables lagged in time are the households' consumption (C_t). The investment demand is given especially by the interest rate. The function of investments itself is: $I = I_a – b_i$, where b is the sensitivity of autonomous expenses (investments) on the interest rate. The relation of consumption and investments is already recorded in the expense model of J. M. Keynes, where in the most simple two-sector model the expenses consist of the household consumption and companies investments. In the equation, the relation between companies investments and revenue from allowances is stated intentionally as the change in revenue of allowances is given for instance by the change of allowance price which affects the demand of companies for investments for so called green technologies.

The third equation of the created simultaneous model (4) specifies the dependence of the government expenditures (G_t) on the size of the gross domestic product (Y_t), on the change of the interest rate (r_t) and consumption from the previous period (C_{t-1}). The relation of government expenses and the interest level may be in the form of expenses for debt repayments, which can change due to the interest rate which, among other things, affects the amount of government expenses.

The fourth equation of the simultaneous model (5) defines the dependence of consumption on the gross domestic product, the net export in given time (NX_t) and on the year-on-year change of the interest (discount) rate (r_t). Net export is the difference between export and import. Changing these values affects consumption. The relationship between consumption and the interest rate is verified by many macroeconomic theories, because if the interest rate increases, consumption decreases in favor of savings (or household investments).

The fifth equation (6) defines the gross domestic product – specifically it is a balance equation of the GDP usage expressed for the net export.

The structural form of the simultaneous equations model expresses the interdependence of all endogenous and all predetermined variables.

Matrix equation of the simultaneous equation model is in this form:

$$B^*Y_t + \Gamma^*X_t = U_t, \tag{1}$$

where B = matrix of simultaneously endogenous variables parameters
Γ = the matrix of simultaneously endogenous and predetermined variables parameters
U_t = vector of random components

$$Y_t = k + \beta^* G_t + \gamma^* \Delta\pi_t + \beta^* Ig_t + \gamma^* U_t + u_{1t} \quad (2)$$

$$Ig_t = a + \gamma^* R_t + \beta^* C_t + \gamma^* r_t + u_{2t} \quad (3)$$

$$G_t = e + \beta^* Y_t + \gamma^* r_t + \gamma^* C_{t-1} + u_{3t} \quad (4)$$

$$C_t = s + \beta^* NX_t + \beta^* Y_t + \gamma^* r_t + u_{4t} \quad (5)$$

$$NX_t = Y_t - Ig_t - G_t - C_t \quad (6)$$

The two-stage method of the smallest squares is one of the most widespread and most common methods for point estimations of the structural parameters of simultaneous equations models. The application of the method is performed for each equation separately. At first, in the first stage we replace the matrix of observed values of the endogenous variables by the matrix of theoretical values (balanced). Next, we apply the common method of the smallest squares to estimate the structural parameters of a given equation.

The mentioned issues can be generally expressed according to the following equation (Čechura, 2008)

$$y_{1t} = B_{12}{}^* y_{2t} + B_{1g\Delta}{}^* y_{g\Delta t} + \Gamma_{11}{}^* x_{1t} + \Gamma_{12}{}^* x_{2t} + \ldots + \Gamma_{1k}{}^* x_{k\Delta t} + u_{1t} \quad (7)$$

Y_2	=	matrix of observed values of the endogenous variables included in the equation of the simultaneous model
$X*$	=	matrix of predetermined variables included in the equation of a given simultaneous model $(X_{1t} + \ldots X_{k\Delta t})$
$X**$	=	matrix of the values of predetermined variables not included in the estimated equation, but occurring in other equations of a given simultaneous model
K	=	complex matrix consisting of four submatrices

Matrix of the values of predetermined variables in the equations of the model consists of two submatricess: X = [X*; X**]

$$\text{Level} : \hat{Y}_2 = X^*(X^{T*}X)^{-1*}X^{T*}Y_2 \quad (8)$$

$$\text{Level:} \begin{bmatrix} B_2 \\ \Gamma_{1*} \end{bmatrix} = \begin{bmatrix} \hat{Y}_2^T\,\hat{Y}_2 & Y_2^T\,X_* \\ X_*^T\,Y_2 & X_*^T\,X_* \end{bmatrix} * \begin{bmatrix} \hat{Y}_2^T \\ X_*^T \end{bmatrix} * y_1 \quad (9)$$

y_1 = vector of real values of the response of endogenous variables

$$K = \begin{bmatrix} \hat{Y}_2^T\,\hat{Y}_2 & Y_2^T\,X_* \\ X_*^T\,Y_2 & X_*^T\,X_* \end{bmatrix} \quad (10)$$

Results

The partial output of the model is in the form of the following parameters in individual equations: (11)

$$Y_t = -1053 + 4.06G_t - 23.22\Delta\pi_t + 2.32Ig_t - 57.58U_t + u_{1t}$$

$$Ig_t = 629.72 + 2.36R_t + 0.192C_t – 1707.4r_t + u_{2t}$$

$$G_t = 624.7 + 0.026Y_t + 269.1r_t + 0.036C_{t-1} + u_{3t}$$

$$Ct = -819.30 – 0.93NX_t + 0.75Y_t + 1090.6r_t + u_{4t}$$

In case the government purchases increase by 1 billion CZK, the gross domestic product will increase by 4.06 billion CZK. With the increase in investment expenses by 1 billion CZK, the GDP will increase as well, approximately by 2.3 billion CZK. However, if the unemployment rate increases by 1%, GDP will fall by 58 billion CZK. The multiplier connected to revenue from allowances is 2.36 in the second equation, i.e. is these revenues increase by 1 billion CZK, the investment expenses of the companies will increase by 2.36 billion CZK, which eventually increase GDP by nearly 5.5 billion crowns. If the nominal product increases by one unit (1 billion CZK), it will lead to the growth of the government expenses by 26 million CZK. Conversely, when the annual growth rate of interest (discount) rate increases by 1% it gets to the decrease in consumption (in favor of savings) by almost 1 billion CZK. If net export falls by 1 billion CZK, it will lead to the growth of consumption by 0.93 million CZK. One of the advantages of the model is its potential usage for other prognoses because if any of the parameters constituting GDP changes (consumption, investments, government expenses, net export), then with the help of obtained parameters we can determine the impact on the gross domestic product.

Verification of the simultaneous model

The economic verification assesses especially the direction and intensity of the impact of explanatory variables on the explained variable. At the same time it is verified, whether there is a direct or indirect dependence.

The structure of the model is based on the universally valid calculation of GDP by the expense method (GDP = C + Ig + G + NX).

This calculation consists of the definition of the equation from which individual indicators are gradually explained. In the first equation there is the direct relationship between the gross domestic product and government expenses or investments. This follows from the valid expenditure method of GDP calculation. At the same time, the equation shows that GDP has an indirect relationship with unemployment. In the second equation, investments (of the companies) have a direct relationship with revenues from emission allowances. Revenue from allowances grow with the rise of their price which in the long term forces the companies to increase their investments in green technologies and thereby reduce the cost connected with the purchases of allowances. At the same time, there is a direct correlation between consumption and investments. This is also valid since when the growth of households consumption increases, the company obtains an income, which is then invested (for instance to new production or to the bank products etc.). According to the third equation, the government purchases will rise if the product grows as well. And in the fourth equation, the consumption positively depends on GDP growth. Both statements are correct. If net export is declining, household's consumption increases. This statement is correct provided the decrease in net export happens due to the increase of import.

Econometric verification is primarily concerned with the issues of autocorrelation and multicollinearity. For this paper, we have chosen the detection of multicolinearity. This requires forming the correlation matrix. The correlation coefficient gains values in absolute value between 0 and 1. The more the value approaches 1, the greater dependency exists between the variables. The main diagonal of the correlation matrix consists of ones. Other components of the matrix represent pair coefficient of the correlation between corresponding pairs of explanatory variables, which should not exceed the value of the absolute expression of 0.9 (Koop, 2008). If they do not exceed this value, there is a very strong dependence between the variables and the corresponding variables should not occur on the right side of one model equation simultaneously.

Fig. 2: Correlation matrix

	Y_t	Ig_t	G_t	C_t	NX	$\Delta\pi_t$	U_t	R_t	r_t	C_{t-1}
Y_t	1.000	0.994	0.954	0.997	0.891	-0.049	-0.973	0.972	-0.968	0.974
Ig_t	0.994	1.000	0.922	0.990	0.865	-0.125	-0.948	0.963	-0.972	0.948
G_t	0.954	0.927	1.000	0.959	0.838	0.149	-0.979	0.958	-0.920	0.974
C_t	0.997	0.990	0.959	1.000	0.855	-0.982	-0.982	0.967	-0.977	0.983
NX	0.891	0.865	0.838	0.855	1.000	-0.003	-0.834	0.872	-0.782	0.845
$\Delta\pi_t$	-0.049	-0.125	0.149	-0.031	-0.003	1.000	-0.094	-0.070	0.196	0.075
U_t	-0.973	-0.948	-0.979	-0.982	-0.834	-0.094	1.000	-0.960	0.952	-0.999
R_t	0.972	0.963	0.958	0.967	0.872	-0.070	-0.960	1.000	-0.955	0.959
r_t	-0.968	-0.740	-0.920	-0.977	-0.782	0.196	0.952	-0.955	1.000	-0.954
C_{t-1}	0.974	0.948	0.974	0.983	0.845	0.075	-0.999	0.959	-0.954	1.000

Discussion

Revenues from allowances of emission limits of CO_2 and the alternative expense of the capital (interests) are on the edge of significance (possible small distortion due to rounding) and have multiplicative effect on the development of companies' gross investments. From numerical solutions of the first two equations of the simultaneous model follows that revenues from the sale of emission allowances statistically on the edge of significance contribute to the growth of the gross domestic product.

The third equation of our simultaneous model indicates the statistically significant dependence (on the percentage level of significance $\alpha = 0.2$) on the mean value of government expenses. When setting the statistical significance of structural parameters, other macroeconomic variables are not statistically significant. Government expenses and revenues from auctioning of emission allowances are, in terms of the simultaneous model, bound by functionally structural parameters e, f, p and b. With the exception of parameter e are all the others statistically insignificant, therefore, after calculating the pair regression, the following founding arises: There is a strong dependence between G and Rt: 92%. The parameter b4 is 1.03236. Therefore it can be stated that if revenue from allowances coming to the state budget increase by 1 billion CZK, it will have positive impact on government expenses in the form of the growth by approximately 1.032 billion CZK.

The dependence between unemployment and revenue from EUA is very high as the coefficient of determination is 92%. In case the government revenue increases by 1 billion CZK, unemployment falls by 0.15%. From statistical and econometric verification, after testing for the significance of structural parameters "p", "c" and "b" follows that both parameters are statistically insignificant (parameter b is on the edge of significance), therefore as in the case of the previous example, the sensitivity analysis is performed with the help of simple linear regression between the change in the price level (dependent variable) and revenue from EUA (independent variable). The regression coefficient is equal to $a_3 = 2.10$ (which is amount of the annual change in the price level in %, in case revenue from emission allowances were zero) and $b_3 = -0.0014$. Examined indicators (the price level and revenue from EUA) are interdependent; the coefficient of determination is only 6.97%, which makes it impossible to determine the partial change for the sensitivity analysis.

When determining the indirect impacts of R_t on NX, it is necessary to take into consideration the parameters m, x and b. All of these are statistically insignificant according to the t-test, therefore, the regression was performed once again where the parameter b_5 was of 0.19451 and the determination coefficient was 76% which is a relatively strong dependence. It can therefore be stated that when revenue from allowances increase by 1 billion CZK, net export will increase by 194 million CZK.

In this work we modeled the impacts of revenue from emission allowances on selected macroeconomic indicators with the help of the simultaneous model. However, this model has a number of limitations and due to this fact, the results could be distorted. When testing the significance of the corresponding structural parameters, the other variables are not very significant for the model. This is mainly due to the fact that in our calculations we worked with the smaller number of observations ($n = 8$). In the first equation, 6 structural parameters were estimated and the number of freedom levels was reduced to 2 by which the estimation of residual distribution of the basic file significantly increased. The high residual variance of the basic file caused the decrease of the value in the denominator of the t-test. This distortion or inaccuracy could be removed by a greater number of observations, i.e. longer time series of a minimum of 20 years of development of the corresponding macroeconomic variables contained in the first equation. However, as already stated, the length of the time series was chosen deliberately because the trading period began during the third phase which dates from 2013 to 2020. In addition, the results point out to the potential presence of so-called spurious correlation or spurious regression which occurs when the change in the values of one variable is related to the change of values in other variable. The observed correlation between the variables can mean that there is another, to our observing still hidden variable, which acts as a cause of both occurrences.

Another problem of this model, as already implied above, is the occurrence of strong multicollinearity in several cases. The peak value is between Ig and C_t, Y_t and C_t, Ig and Y_t, U_t and C_{t-1}. At these pairs it was therefore thoroughly observed whether they are not on the same side of the equation. Due to the fact that multicolinearity reduces the accuracy of estimations and may cause errors, the consumption was remover especially from the first equation because it is the most problematic part in terms of multicollineatity. Correlation coefficients are generally very high, which may be caused due to the tendency of the time series to evolve in the same direction, due to the lagged variable or due to the higher number of explanatory variables than is the scope of the selection. Besides omitting the colinear variables, we can also eliminate multicollinearity due to the larger scope of selection or restriction of parameters.

I would therefore conclude that this model is not optimal for detecting the macroeconomic impacts of trading emission allowances and I would therefore reject the stated hypothesis at the beginning of the work. Nevertheless, the aim of the paper was fulfilled. The model may be used to prove economic relations; it shows high dependencies between basic economic magnitudes. It may also be used in practice when applying fiscal policy as, through the model, it is possible to predict the trend of consequence of the change in the individual magnitudes as for instance increasing government expenses or interest rate.

It would be adequate to use SW Gretl or R for the further research. Determination of revenues impacts on the state budget (or on the economy of a EU member state) and test the stacionarity of the time series with the help of Augmented Dickey-Fuller test. The time series would consequently be differentiated and possible presence of autocorrelation would be investigated with the help of Autocorrelation and Partial-autocorrelation function.

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Contact address:
Ing. Daniela Spiesová, Department of Economic Theories, Faculty of Economics and Management, Czech University of Life Sciences Prague, Kamýcká 129, 165 21 Praha 6, Czech Republic, *e-mail: saolinka@email.cz*

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