MODELLING AND PREDICTING THE INDIRECT TAXES IN ROMANIA

Mihaela SIMIONESCU, PhD *

Abstract

The main aim of this study is to model and predict the quarterly indirect taxes in Romania. This variable provides important information for the standard levelling in a country. for data covering the period from 2004:Q1 to 2014:Q2, some econometric models were proposed (multiple regression model, trend model and a vector-auto-regression-VAR model. 45.52% of the variation in differentiated data series of logarithmic indirect taxes is explained by GDP and share of social assurance. According to Granger causality test for stationary data, at 5% level of significance the GDP index evolution is a cause for the indirect tax. In the first period almost 97.08% of the variation in indirect taxes is due to the changes in the values of this variable while only 2.923% of its variation is determined by the changes in GDP index. For the first 10 periods, the influence of GDP index does not exceed 3%. For the first quarter of 2014, the trend model provided the best prediction while for the second one the VAR process performed the best. For the next quarters of 2014 all the models predicted a decrease in indirect taxes in Romania.

Keywords: indirect taxes, forecasts, trend, VAR model

JEL Classification: C51, C53, H20

1. Introduction

Everyone has a private interest in the tax policy which brings gainers and losers. The main advantage of models for taxes is the support to rational policy analysis. The policy-makers can make their judgments by analysing the consequences of alternative policies.

The taxes, the main source of revenue for the public budget have a direct impact on GDP and final consumption. If the level of taxes is high, the population standard of living is low and the final consumption is directly correlated to it. According to Albu (2013) the GDP should increase in the next period, the economic crisis having a negative impact on economic growths and policy measures should be taken in order to grow the standard living.

Indirect taxation is a part of a mix of various revenue-raising and tax tools including taxes on property, income, and social security

* *Scientific Researcher III, Institute for Economic Forecasting, Romanian Academy.*

levies on employment income that households and other agents from economy face.

The main aim of this article is to model the quarter indirect taxes in Romania, some predictions being provided for 2014. Therefore, some econometric models were proposed (multiple regression model, trend model and a vector-auto-regression-VAR model). After the presentation of data and evolution of indirect taxes in Romania, the econometric models are proposed and several forecasts are provided.

2. Literature review

There is not a formal definition for the indirect taxes, according to Capéau, Decoster and Phillips (2014). In the common sense, the indirect taxes are those taxes that are levied on the sale of services and goods, being gathered and remitted by vendor. Two main characteristics have been identified for indirect taxes: the consumer can't be identified and the taxes schedule is linear. The assessment of tax policy reform considers two dimensions that were identified by Feltenstein, Lopes, Porras-Mendoza and Wallace (2014): equity of the tax code and its efficiency.

The selection of a certain model for taxes depends on the type of the analysed policies. The policy question may be related to various problems like the income implication of a specific tax or the redistributive effects and cost of a large number of taxes. The small models for explaining the taxes could help in providing useful principles for tax reform. The large tax models suppose the existence of teamwork and, consequently, the cost of such models raises. Most of the large models for taxation are non-behavioural, no assumptions being made on the effects of tax changes on population consumption plans or supply on labour market. In the case of these models, no econometric estimation is required. The consequences of changes in policies are evaluated using graphs and tabulations for different groups of people.

The impact of taxes and transfers measurement has been analysed in literature by many studies, Lambert (1993) providing many details. The author considered elements like: horizontal inequity effects, progressivity, social welfare and inequality. The measurement procedures include index comparisons and dominance checks. For making comparisons in income distributions Lambert (1993) used social welfare and inequality tests.

Indirect taxes became an increasingly important revenue raising instrument for developed states governments. Most of the studies regarding indirect taxes incidence consider the taxes that are paid by different groups. The paid taxes are seen as the loss in the real income. Sahn and Younger (2003) estimated the incidence of indirect taxes in developing countries. Creedy (1999) used his expertise to make a deep analysis of indirect taxes, insisting on these taxes modelling. Creedy (2002) described the econometric models used to represent the evolution of indirect taxes, many details being provided for the MITTS (Melbourne Institute Tax and Transfer Simulator) model, a microsimulations model. It takes into account the feedback effects. For example, large modifications in the tax structure for increase the participation on labour market may influence the labour demand. On the other hand, the modifications of transfer and tax system are assumed to have no consequence on wage rates. A microsimulation model was also developed by Bardazzi, Parisi and Pazienza (2004) for business sector. It model is used to analyse the effects of the fiscal changes in Italy and ex-post implicit tax rates are estimated. Moreover, two scenarios are proposed: one that studies the impact of tax modification during 1998-2001 and another one that considers the effects of the recent tax reform. O'donoghue, Baldini and Mantovani (2004) described a model used to simulate the indirect taxes in 12 countries from European Union using EUROMOD tax-benefit model. There is also made a classification of indirect taxes in the selected countries. A decomposition of the redistributive effect of indirect taxes is made by employing the tax from various commodity groups. The authors also analysed the progressive character and the redistributive effect of indirect taxes making comparison with income taxes, principal social benefit groups and social insurance contributions in all the countries from EU.

A policy simulation was made by Decoster, Loughrey, O'Donoghue and Verwerft (2010) who used the EUROMOD program for microsimulations and expenditures as input. The standard VAT rate is increased and the contributions to social security are lowered in order to keep the neutrality of government revenue. Several important conclusions were drawn: the indirect taxes are regressive compared to disposable revenue but it is progressive or proportional compared to overall expenditures, the indirect taxes are less progressive than other elements of tax system.

The impact of indirect taxes modifications was analyzed for some European countries by Figari and Paulus (2012) using tax-benefit simulation model at microeconomic level. The data are provided by income survey without expenditure data.

The modelling of impact of taxes needs data from microeconomic level, but the limit is given by the small data sets. In a recent study, Savage and Callan (2015) used microeconomic data to evaluate the sensitivity of distributional effects of indirect taxes in Ireland. Moreover, as micro-simulation analysis was conducted for simultaneous indirect tax, direct tax and welfare reform.

For endogenous consumption demands, the presentation of indirect taxes changes may require the elaboration of an auxiliary incidence model for taxes. In these auxiliary models, the impact on consumer prices could be traced under certain assumptions regarding the tax shifting degree. For example, in Australia there are a lot of indirect taxes in different phases of production process. A tax incidence model is likely to rely on input-output data, a model for Australia being built by Scutella (1999).

In the previous 40 years, many studies examined the effects of changes in indirect taxation by employing comparative static general equilibrium models. Dixon and Rimmer (1999) studied the modifications in indirect taxes in Australia by using a dynamic general equilibrium model. Moreover, the consequences of policy changes are analysed as deviations from explicit predictions that are essential for the results of government policies. For Australia the effects of employment on short-run depend on salary response, the exporters of merchandise have many advantages but the tourism is affected while the welfare effects on long term are more probably negative. The last observation implies an increase in compliance costs and a trade decrease. A detail presentation of computational general equilibrium (CGE) models for modelling indirect taxes is presented by Feltenstein, Lopes, Porras-Mendoza and Wallace (2014). CGE models are a traditional tool for analyzing the efficiency of tax reforms in some countries. They are used to assess the economy-wide impact of distortionary taxes. For indirect taxation, CGE models make a link between household utility functions, indicating the taxes welfare costs, as Ahmed and O'Donoghue (2007) showed. However, in the CGE framework used for microsimulation the household feedback is not taken into account in the macroeconomic framework. Moreover, the microsimulation based on this type of models does not ensure coherence between the macroeconomic structure and the microeconomic one.

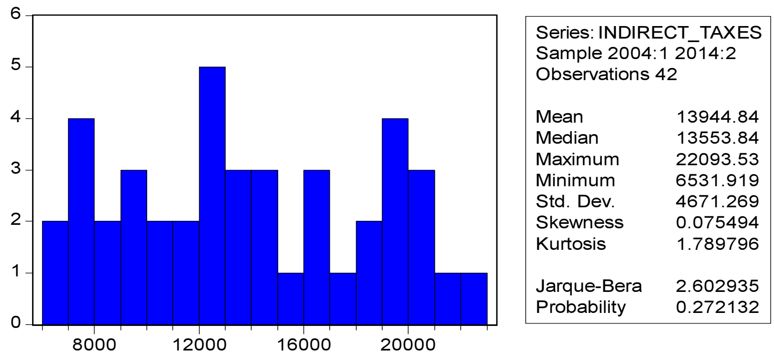
The CGE models can be linked with the microsimulation models (MSM) by multiplying the nominal pre-tax incomes, the consumer prices,m welfare and transfer in the microsimulation model by percentage modifications in the corresponding values of the CGE variables. A CGE-MSM model was built for Norway by Avitsland and Assness (2004) in order to study the tax policy.

3. Data

For explaining the relationship between indirect taxes and other macroeconomic variables like GDP in constant prices and share of social assurance, quarterly time series were used for the period from Q:2014-Q2:2014. The data are provided by the National Institute of Statistics and National Bank of Romania.

Figure 1

Histogram and descriptive statistics for indirect taxes in Romania during Q1:2004-Q2:2014

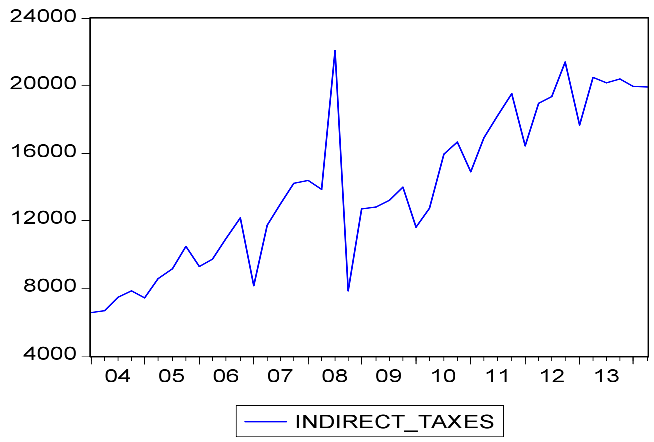


Source: author's graph

The distribution of indirect taxes in Romania is almost skewed, the Jarque-Bera test not rejecting the normality assumption. There is a quite high range and a coefficient of variation of 33,49%, the data series being relative homogenous during Q1:2004-Q2:2014.

Figure 2

The evolution of indirect taxes in Romania during Q1:2004-Q2:2014



Source: author's graph

For the total taxes we observed a tendency of increase followed by a sudden decrease. The indirect taxes have grown by

3.06 times in the second quarter of 2014 compared to the first quarter of 2004, a lower increase compared to direct taxes. The data having a quarterly frequency, the seasonal adjustment have been made, then the stationary character of the data series have been checked using Augmented Dickey-Fuller test. The level of significance used in this research is 5%. Some transformations are made to the data series in order to achieve the stationary character. Therefore, the logarithm and the first differentiation were applied to indirect taxes and to the GDP index. The data set for share of social assurance is stationary in level.

4. Models and predictions

Firstly, a model valid with trend has been estimated for the indirect taxes in Romania:

LOG(IND) = 8.9465 + 0.0261*TREND

The estimation results and the residuals' test results are presented in Appendix 1. Passing from a quarter to another, the logarithm of indirect taxes grows in average with 0.0261. The errors are independent as Breusch-Godfrey for a lag equaled to 1 indicated and the errors are also homoscedastic according to White test (the probability associated to LM statistic is greater than 0,05, the null hypothesis of homoscedasticity not being rejected at 5% level of significance). However, the Jarque-Bera test suggests that we do have reasons to reject the assumption of a normal distribution for the errors.

Moreover, for the stationary data series of indirect taxes a multiple regression model was proposed. 45.52% of the variation in differentiated data series of logarithmic indirect taxes is explained by GDP and share of social assurance. There is a weak correlation between the explanatory variables, according to correlation matrix, so the multi-colinearity problem is solved. The errors are independent as Breusch-Godfrey for a lag equalled to 1 indicated and the errors are also homoscedastic according to White test (the probability associated to LM statistic is greater than 0,05, the null hypothesis of homoscedasticity not being rejected at 5% level of significance). However, the Jarque-Bera test suggests that we do have reasons to reject the assumption of a normal distribution for the errors (results in Appendix 2).

Table 1

Granger causality test for log of indirect taxes and GDP index

Null Hypothesis:	Obs	F-Statistic	Probability
LOG_INDIRECT TAXES does not Granger Cause D_LOG_IGDP	37	0.43482	0.65115
D_LOG_IGDP does not Granger Cause LOG_IND		5.31889	0.01013

According to Granger causality test for stationary data, at 5% level of significance the GDP index evolution is a cause for the indirect tax. A vector-autoregressive model of order 3 (VAR(3)) model was estimated and the variance decomposition for the logarithm of indirect taxes suggests the following: in the first period almost 97.08% of the variation in indirect taxes is due to the changes in the values of this variable while only 2.923% of its variation is determined by the changes in GDP index. For the first 10 periods, the influence of GDP index does not exceed 3%.

Table 2

The variance decomposition of logarithm of indirect taxes

Period	Standard error	D_log_GDP	Log_indirect_taxes
1	0.172253	2.923398	97.07660
2	0.172520	2.958726	97.04127
3	0.192196	2.386634	97.61337
4	0.199638	2.369032	97.63097
5	0.206429	2.875895	97.12411
6	0.214641	2.662388	97.33761
7	0.218533	2.589169	97.41083
8	0.222525	2.575706	97.42429
9	0.227006	2.952698	97.04730
10	0.230378	2.867358	97.13264

Source: author's computations

The forecasts for the third and the fourth quarter of 2014 are made under the assumptions of keeping for index of GDP and share of social assurance the values in the second quarter of 2014.

Table 3

Forecasts of indirect taxes in Romania during 2014:Q1-2014:Q4

Quarter	Predictions based on:			Actual values
	Trend model	Multiple regression model	VAR(3) model	
2014:Q1	**20535.32**	20398.19	22119.21	20672.3
2014:Q2	20790.47	21089.91	**20418.6**	20033.8
2014:Q3	20148.32	20438.51	22961.45	-
2014:Q4	20034.1	20062.5	21568.3	-

For the first quarter of 2014, the trend model provided the best prediction while for the second one the VAR process performed the best. For the next quarters of 2014 all the models predicted a decrease in indirect taxes in Romania.

5. Conclusions

The indirect taxes are in correlation with GDP from a country and it reflects indirectly the living standard. If the revenues from taxes cover a large amount from current expenses, we have a fiscal policy that negatively influences the long-run economic growth and the potential GDP by overtaxing the current benefits.

The evolution of indirect taxes should carefully be observed, some econometric models being employed to analyse its evolution. Moreover, some short-run forecasts were made and we expect a decrease in indirect taxes in the last half of 2014 in Romania.

6. Acknowledgement

This work was financially supported through the project "Routes of academic excellence in doctoral and post-doctoral research - READ" co-financed through the European Social Fund, by Sectorial Operational Programme Human Resources Development 2007-2013, contract no POSDRU/159/1.5/S/137926.

References

1. Ahmed, V., & O'Donoghue, C. (2007). "CGE-microsimulation modelling: a survey" MPRA Paper, No. 9307.
2. Albu, L. L. (2013). "Foreign trade and FDI as main factors of growth in the EU", Journal for Economic Forecasting, (2), 7-17.
3. Åvitsland, T., & Aasness, J. (2004). "Combining CGE and microsimulation models: Effects on equality of VAT reforms", Discussion Papers No. 392, October 2004, Statistics Norway, Research Department.
4. Bardazzi, R., Parisi, V., & Pazienza, M. G. (2004). "Modelling direct and indirect taxes on firms: a policy simulation" Austrian Journal of Statistics, 33(1), 2.
5. Capéau, B., Decoster, A., & Phillips, D. (2014). "Consumption and Indirect Tax Models", Handbook of Microsimulation Modelling (Contributions to Economic Analysis, Volume 293) Emerald Group Publishing Limited, 293, 223-273.
6. Creedy, J. (1999). "Modelling indirect taxes and tax reform", Edward Elgar Publishing.
7. Creedy, J. (Ed.). (2002). "Microsimulation modelling of taxation and the labour market: the Melbourne Institute tax and transfer simulator", Edward Elgar Publishing.
8. Decoster, A., Loughrey, J., O'Donoghue, C., & Verwerft, D. (2010). "How regressive are indirect taxes? A microsimulation analysis for five European countries", Journal of Policy analysis and Management, 29(2), 326-350.

9. Dixon, P. B., Rimmer, M. T. (1999). “Changes in Indirect Taxes in Australia: A Dynamic General Equilibrium Analysis“, Australian Economic Review, 32: 327–348.
10. Feltenstein, A., Lopes, L., Porras-Mendoza, J., & Wallace, S. (2014). 3. “Modeling tax reform in developing countries“, Taxation and Development: The Weakest Link?: Essays in Honor of Roy Bahl, 69.
11. Figari, F., & Paulus, A. (2012). “The impact of indirect taxes and imputed rent on inequality: a comparison with cash transfers and direct taxes in five EU countries“, GINI DP, (28).
12. Lambert, P. J. (1993). “Evaluating impact effects of tax reforms“, Journal of Economic Surveys, 7(3), 205-242.
13. O'donoghue, C., Baldini, M., Mantovani, D. (2004). "Modelling the redistributive impact of indirect taxes in Europe: an application of EUROMOD (No. EM7/01)”, EUROMOD Working Paper.
14. Savage, M., & Callan, T. (2015). “Modelling the impact of direct and indirect taxes using complementary datasets“ (No. 8897). Institute for the Study of Labor (IZA).
15. Sahn, D. E., & Younger, S. D. (2003). “Estimating the incidence of indirect taxes in developing countries“, The impact of economic policies on poverty and income distribution: evaluation techniques and tools, 27-40.
16. Scutella, R. (1999). “The final incidence of Australian indirect taxes“, Australian Economic Review, 32(4), 349-368.

Regression model with trend for logarithm of indirect taxes

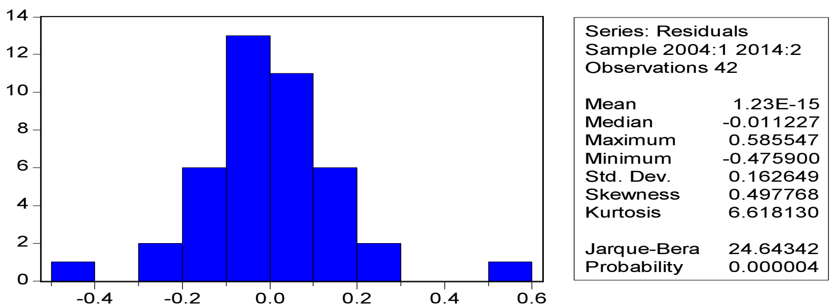
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.946503	0.049924	179.2033	0.0000
T	0.026166	0.002096	12.48208	0.0000

R-squared	0.795712	Mean dependent var	9.482908
Adjusted R-squared	0.790605	S.D. dependent var	0.359856
S.E. of regression	0.164669	Akaike info criterion	-0.723309
Sum squared resid	1.084637	Schwarz criterion	-0.640563
Log likelihood	17.18950	F-statistic	155.8024
Durbin-Watson stat	1.998397	Prob(F-statistic)	0.000000

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.012683	Probability	0.910912
Obs*R-squared	0.013654	Probability	0.906979

White Heteroskedasticity Test:			
F-statistic	1.740784	Probability	0.188734
Obs*R-squared	3.442101	Probability	0.178878

The errors distribution



ANNEX 2

Multiple regression model for indirect taxes

Dependent Variable: D_LOG_INDIRECT_TAXES
Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.021402	0.027601	0.775399	0.4429
D_LOG_IGDP	0.430831	0.128856	3.343496	0.0019
D_SA_SHARE	18.49902	3.781778	4.891620	0.0000

R-squared	0.455247	Mean dependent var	0.027201
Adjusted R-squared	0.426576	S.D. dependent var	0.232782
S.E. of regression	0.176273	Akaike info criterion	-0.563206
Sum squared resid	1.180747	Schwarz criterion	-0.437823
Log likelihood	14.54573	F-statistic	15.87821
Durbin-Watson stat	2.604012	Prob(F-statistic)	0.000010

Breusch-Godfrey Serial Correlation LM Test:

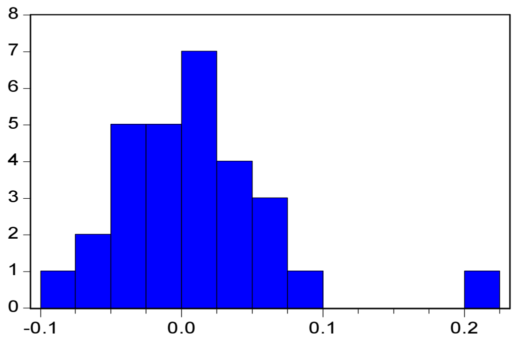
F-statistic	0.586630	Probability	0.451515
Obs*R-squared	0.000000	Probability	1.000000

ARCH Test:

F-statistic	0.098822	Probability	0.755757
Obs*R-squared	0.106021	Probability	0.744721

White Heteroskedasticity Test:

F-statistic	0.512714	Probability	0.726982
Obs*R-squared	2.283029	Probability	0.683861



Series: Residuals
Sample 2007:2 2014:2
Observations 29

Mean	0.011226
Median	0.001704
Maximum	0.206601
Minimum	-0.075738
Std. Dev.	0.056239
Skewness	1.349114
Kurtosis	6.200084
Jarque-Bera	21.17117
Probability	0.000025